

Figure 1. Center for Epidemiologic Studies Depression Scale (CES-D) score vs age group and gender: (□) male; (■) female. Data are given as average ± SEM. Increased age was associated with higher CES-D scores. Compared with men, women scored significantly higher on the CES-D (* $P < 0.001$).

RESULTS

The questionnaire was returned by 32 729 participants. Because the number of residents in each sampling community who were contacted for participation in the ASHW was not made public by the Ministry of Health, Labour and Welfare, we were unable to calculate the response rate. The response rate for a similar survey, however, conducted 3 and 4 years previously, was 87.1% and 89.6%, respectively. We assume that the response rate for the present study, which used a similar methodology, resembled those. A total of 707 subjects who returned a blank questionnaire were excluded from the analysis. Further, subjects who did not respond to items on gender or age ($n = 208$) or those who did not respond to five or more items on the CES-D ($n = 7471$) were excluded from the analysis. Because the present study was focused on late life, we further excluded subjects who were younger than 50 years of age ($n = 13 374$). The final sample size was 10 969.

Figure 1 shows the mean CES-D scores by age group and sex. Two-way ANOVA found a significant main effect of age group ($F(3,10 961) = 82.3, P < 0.001$). Post-hoc analyses indicated a significantly higher CES-D score among those in their 70s ($P < 0.001$) and 80s ($P < 0.001$) than those in their 50s and 60s, in other words, there were significantly more depressive symptoms with increased age. We

also found a significant main effect of gender ($F(1,10 961) = 18.5, P < 0.001$). Women reported a significantly higher CES-D score than men ($P < 0.001$). Age group × gender interaction was not significant ($F(3,10 961) = 1.3, P = 0.275$).

Table 2 lists the distribution of subjects in the control, the D_{16} , and the D_{26} groups as well as the male : female ratio in each age group. Of the entire study sample, 2397 (21.9%) and 1019 (9.3%) fell under the D_{16} and the D_{26} groups, respectively. Across age groups, there were significant differences in the distribution of subjects in the three symptom groups ($\chi^2 = 316.9, d.f. = 6, P < 0.001$). The majority of the subjects in the D_{16} group were in their 80s, while those in the D_{26} group were older than 70. There were also significant differences in the male : female ratio across the three symptoms groups ($\chi^2 = 40.9, d.f. = 2, P < 0.001$). The male : female ratio in the D_{16} and the D_{26} groups was lower at 0.71 and 0.70, respectively, compared with 0.92 in the control group.

Table 3 lists the percentage of subjects who endorsed the item as well as the relative risks (OR) for the presence of D_{16} and D_{26} symptoms for each of the life stressors, derived from and grouped based on the classification for the DSM-IV-TR Axis IV.²⁰ The most frequently endorsed life stressors were ‘health/illness/care of self’ (34.2%), ‘health/illness/care of family’ (21.5%), ‘stress on the job’ (15.9%), and ‘income/household budget’ (15.7%).

Among problems regarding the primary support group, all items except ‘separation/divorce’ and ‘health/illness/care of family’ had significant relationships with the increased incidence of D_{16} and D_{26} symptoms. The relationship was especially strong for ‘health/illness/care of self’ (OR = 1.7 and 2.2 for D_{16} and D_{26} symptoms, respectively). ‘Separation/divorce’ had a strong relationship with the increased incidence of D_{16} symptoms (OR = 2.8), but its

Table 2. Age vs severity of depression

Age group	%Control group (M/F ratio)	% D_{16} group (M/F ratio)	% D_{26} group (M/F ratio)
50-59	71.5 (1.05)	21.6 (0.85)	6.9 (0.75)
60-69	73.3 (0.97)	20.2 (0.74)	6.5 (1.02)
70-79	65.5 (0.81)	22.2 (0.63)	12.3 (0.64)
≥80	51.7 (0.50)	27.4 (0.44)	20.9 (0.47)
Whole	68.9 (0.92)	21.9 (0.71)	9.3 (0.70)

Significant differences were found for both D_{16} and D_{26} with respect to gender and age (χ^2 test, $P < 0.001$).

Table 3. Relative risk for the presence of D₁₆ and D₂₆ symptoms vs life stressor

Life stressor	% responders	D ₁₆ group			D ₂₆ group		
		Adjusted OR	95%CI	P	Adjusted OR	95%CI	P
Problems with primary support group							
Separation/divorce	0.7	2.8	1.4–5.3	0.002	2.2	0.9–5.6	NS
Health/illness/care of self	34.2	1.7	1.5–1.9	<0.001	2.2	1.9–2.7	<0.001
Death of a close person	5.6	1.6	1.3–2.0	<0.001	1.5	1.1–2.0	0.006
Burden of housework	3.8	1.4	1.1–1.8	0.006	1.7	1.2–2.4	0.004
Family relationship	12.5	1.5	1.3–1.8	<0.001	1.8	1.5–2.3	<0.001
Relationship with relatives	8.2	1.5	1.3–1.8	<0.001	1.4	1.1–1.9	0.009
Health/illness/care of family	21.5	0.9	0.8–1.05	NS	0.8	0.6–0.9	0.005
Problems related to social environment							
Having no one to talk to	4.5	3.3	2.5–4.4	<0.001	5.0	3.6–6.9	<0.001
Loss of purpose in life	6.4	1.8	1.5–2.2	<0.001	2.8	2.2–3.7	<0.001
Having nothing to do	3.1	1.5	1.1–2.0	0.016	2.4	1.7–3.4	<0.001
Retirement	12.1	1.1	0.95–1.3	NS	0.8	0.6–1.1	NS
Occupational problems							
Commuting (crowded, long distance, etc.)	0.9	1.5	0.9–2.3	NS	1.3	0.6–2.8	NS
Workplace relationship	8.5	1.4	1.2–1.7	<0.001	1.5	1.1–2.0	0.014
Unemployment	1.9	1.3	0.9–1.8	NS	1.2	0.7–1.9	NS
Adjusting to a new job	1.0	0.9	0.6–1.5	NS	1.1	0.6–2.1	NS
Stress on the job	15.9	1.1	0.9–1.2	NS	0.8	0.6–0.9	0.030
Housing problems							
Relationship with neighbors	7.6	1.4	1.1–1.7	<0.001	1.6	1.2–2.0	<0.001
Living environment (pollution, noise, etc.)	4.1	1.0	0.8–1.3	NS	1.0	0.7–1.5	NS
Concerns about housing	6.1	0.9	0.7–1.1	NS	0.9	0.7–1.2	NS
Economic Problems							
Debt	4.9	1.3	1.1–1.7	0.014	2.1	1.5–2.9	<0.001
Income/household budget	15.7	1.0	0.8–1.1	NS	1.0	0.8–1.2	NS

Covariates: life stressor, gender, age group, community size, geographic region, strength (burden) of life stressors. CI, confidence interval; OR, odds ratio.

relationship with the incidence of D₂₆ symptoms was not significant. In contrast, there was a significant relationship between 'health/illness/care of family' and decreased incidence of D₂₆ symptoms (OR = 0.8).

Among problems related to social environment, 'having no one to talk to' (OR = 3.3 and 5.0), 'loss of purpose in life' (OR = 1.8 and 2.8), and 'having nothing to do' (OR = 1.5 and 2.4) had significant relationships with the increased incidence of D₁₆ and D₂₆ symptoms, respectively. Among occupational problems, only 'workplace relationship' had significant relationships with the increased incidence of D₁₆ and D₂₆ symptoms (OR = 1.4 and 1.5, respectively). 'Stress on the job' had a significant relationship with the decreased incidence of D₂₆ symptoms (OR = 0.8). Among housing problems, only 'relationship with neighbors' had significant relationships with the increased incidence of D₁₆ and D₂₆ symptoms

(OR = 1.4 and 1.6, respectively). Among financial problems, 'debt' had significant relationships with the increased incidence of D₁₆ and D₂₆ symptoms (OR = 1.3 and 2.1, respectively).

DISCUSSION

The aim of the present study was to clarify the psychosocial stress in daily life associated with late-life depression. The study subjects were individuals aged ≥50 randomly selected throughout Japan. Their age distribution was comparable to that from the Census conducted around the same time. That is, the present study has epidemiological value due to its use of a large representative sample of the general population. This study included >10 000 subjects in late life who were living in 300 different communities across Japan, which enabled us to obtain data representing

the Japanese general population. In the present sample approximately one in five (21.9%) and one in 10 (9.3%) subjects fell into the groups D₁₆ (mild–moderate depressive symptoms with a score of 16–25 on the CES-D) and D₂₆ (severe depressive symptoms with a score of ≥ 26 on the CES-D), respectively. Further, increased age and being female were associated with more severe depressive symptoms (i.e. higher scores on the CES-D). In order to examine whether the presence of subjective stress in late life is associated with the incidence of D₁₆ and D₂₆ depressive symptoms, survey questions were designed to ask participants to report stressors only when they identified items in the list as stress, rather than simply asking about the presence of stressors.

The study found the strongest relationship between incidence of both D₁₆ and D₂₆ symptoms and life stressors stemming from ‘having no one to talk to’. All other life stressors related to social relationships such as ‘relationship with neighbors’, ‘workplace relationship’, and ‘relationship with relatives’ were also significantly related to the presence of depressive symptoms. The association between diminished social contacts and the development of depression in late life has been established in previous studies.^{21,22} With the aging of the population, the number of Japanese elderly people living alone is markedly increasing. This is unlikely to be unrelated to the high prevalence of late-life depressive state found in the present study. Diminished social contacts in late life include attenuation of human relationships and insufficient social support. Indeed, previous research suggests that adequate social support not only directly improves psychological health, but may act as a buffer against social stress as a risk factor for depression.²³ Therefore, improvement in nursing care insurance services in Japan, especially increasing service utilization among community-living elderly people may help combat late-life depression.

Next to ‘having no one to talk to’, experiences of loss and bereavement (‘loss of purpose in life’, ‘separation/divorce’, ‘death of a close person’, and ‘having nothing to do’) were strongly related to the incidence of late-life depressive symptoms. A number of studies in Europe and USA have consistently shown a strong relationship between the death of a spouse or a loved one and subsequent development of depression.^{24–27} Life events associated with a strong sense of loss that may be destructive to the individual and that may persist over a long period of time, such as separation from or bereavement of an important

person, loss of purpose in life, and loss of social roles, have been identified as risk factors for late-life depression.^{15,28} The present results support the possibility that experiences of loss and bereavement may increase the risk for late-life depression among the Japanese as well. Previous studies that examined risk factors for depression did not identify ‘separation/divorce’ as a significant risk factor.^{29,30} This may be attributable in large part to insufficient statistical power to detect its effect due to the low frequency of occurrence. Although the proportion of respondents who selected ‘separation/divorce’ was also very low in the present study, at 0.7% (the least), a relationship was found between ‘separation/divorce’ and the incidence of D₁₆ symptoms, due to the larger sample size. In contrast, among experiences of loss and bereavement, ‘separation/divorce’ was not significantly associated with the incidence of D₂₆ symptoms. This finding suggests that even though ‘separation/divorce’ in late life was associated with mild depressive symptoms, examining whether this item could be a risk factor for moderate–severe clinical depression remains as a question for further study.

The third strongest relationship with late-life depressive symptoms was found for ‘health/illness/care of self’. This item was the most common life stressor, endorsed by 34.2% of the entire sample, 49.2% of the D₁₆ group, and 66.4% of the D₂₆ group. Studies on the elderly have repeatedly shown that having physical illness and/or disabilities increases the risk for developing depression.^{22,26,31,32} Cerebrovascular disease, in particular, is a risk factor consistently associated with the development of late-life depression.³³ The influence of physical illnesses on the development of depression has primarily been attributed to biological processes, including alterations in the neuroendocrine system or cerebral blood flow and physical stress such as chronic pain. As a psychosocial risk factor, in contrast, physical illnesses play a role in one’s psychological reactions when faced with aging or death or in social aspects such as hospitalization, institutionalization, and reduced social activities.¹⁵ Similar to other life events development or exacerbation of a severe and fatal illness may incur strong psychological burden and frequent and significant confusion in lifestyle among afflicted elderly people. Some elderly people must face serious yet unavoidable issues such as their own senility, remaining days, or death upon receiving a diagnosis or being informed of serious or chronic physical illness such as cerebrovascular disease

cancer, myocardial infarction, or diabetes. These issues may result in impairment in life functioning or hospitalization, which in turn may diminish social contact.

Another life stressor significantly associated with late-life depressive symptoms was 'debt'. It is generally well-recognized that economic status affects physical and mental health. It is therefore not surprising that the present study found a relationship between 'debt' and late-life depressive symptoms. Limited income leads to poor access to medical care and mental health services, which consequently hinder the early detection and treatment of depression. Even when depression is detected at a relatively early stage, financial hardship will hamper prevention of major depressive episodes or access to mental health resources ensuring appropriate treatment for the current depressive episode.³⁴ Meanwhile, the present study did not find a significant relationship between 'income/household budget' and depressive symptoms. This may be attributable to Japan's universal health insurance system, in which people with low income have relatively easy access to medical care. Therefore, depression among the elderly people who have debts may be largely attributable to reduced quality of living conditions or psychological pain stemming from the obligation to repay the debt.

Finally, the relative risk of respondents who endorsed 'health/illness/care of family' and 'stress on the job' to have severe depressive symptoms (i.e. score ≥ 26 on the CES-D) was < 1 , suggesting that these two items were not identified as risk factors for clinical depression. These two items, however, were both endorsed at high frequencies overall, indicating that many of the subjects in the control (no depression) group also endorsed them. Therefore, the lack of relationship between increased incidence of depressive symptoms and either of 'health/illness/care of family' or 'stress on the job' observed in the present study does not guarantee that these items do not affect late-life depression.

Study limitations

There were several limitations to the present study. First, as a cross-sectional survey, it was not possible to ascertain the time of onset and duration of depressive symptoms and life stressors or the time interval between them. Therefore, a causal relationship cannot be inferred. Investigation into the

causal relationship was outside of the scope of the present study, but is suggested for future research. We were able, however, to achieve the primary goal of the study, which was to clarify the relationship between life stressors and late-life depressive symptoms in a large representative sample of the general population.

Second, the survey data were collected via a self-administered questionnaire, and structured interview was not used to determine definitive diagnosis. Data collection using interview for a large sample in the present study would present tremendous methodological and financial challenges. Hence there is the possibility that some of the individuals defined as having depression in the present study may have had comorbid psychiatric disorders such as anxiety disorders.

Third, because the CES-D is a screening instrument for depression among the generations,¹⁶ some of the study subjects who scored 16 (the cut-off) or higher on the CES-D may not have met the clinical diagnostic criteria (e.g. DSM-IV-TR) for depression. The reliability and validity of the CES-D, however, have been widely established in epidemiological studies using a representative population sample. We therefore believe that the investigation into the relationship between life stressors and late-life depression is beneficial to gaining insight into how to combat the risk factors for depression.

Fourth, it is difficult to identify whether items included in the 'problems related to social environment' domain (such as 'loss of purpose in life' and 'having nothing to do') are stress factors or induced as a part of depressive symptoms. It is necessary to consider the possibility that the study results may include both.

Conclusion

The aim of the present study was to clarify the relationship between late-life depression and life stressors in a large representative sample of the Japanese general population. A relationship was found between late-life depression and diminished social relationships, experiences with loss of purpose in life or human relationships, and health problems. The findings provide valuable insights for policies to help sustain mental health in late life in rapidly 'super-aging' Japan, where the population is growing older at a rate incomparable to any other country.

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**ORIGINAL ARTICLE**

Stress coping behaviors and sleep hygiene practices in a sample of Japanese adults with insomnia

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Abstract

This study examined the characteristics of behaviours for coping with stress and sleep hygiene practices utilized by adult people with insomnia. Self-administered questionnaire data from a representative sample of 24 551 adults (completed in 2000) were analyzed. Participants reported insomnia symptoms present during the last 1-month period, answering 11 items on physical and psychological conditions, 7 items on problem-solving and emotion-focused coping behaviors in response to stress (SCBs), 5 items on measures taken to ensure adequate sleep (SHPs), and the Center for Epidemiologic Studies Depression Scale (CES-D). Those presenting with insomnia symptoms accompanied by daytime complaints were defined as having insomnia. Multivariable logistic regressions were performed with sex, age, and the presence of stress as covariants to determine which SCBs and SHPs are factors associated with insomnia. Prevalence of insomnia was 43.4% ($n = 10\,653$) and comorbidity of depression ($CES-D > 26$) occurred in 12.7% of participants ($n = 1357$, 5.5% of total sample). Logistic regression analysis controlling for other adjustment factors revealed that insomnia was positively associated with 4 emotion-focused SCBs ("Bearing", "Smoking", "Eating" and "TV/Radio"), negatively associated with "Problem-solving," and positively associated with 3 SHPs ("Alcohol", "Books/Music" and "Bath"). Insomnia comorbid with depression had a strong positive association with Bearing ($OR = 3.44$), but a strong negative association with Problem-solving ($OR = 0.50$). Japanese adults with insomnia might engage in various maladaptive SCBs and SHPs. The negative correlate of Problem-solving supports the importance of promoting self-help sleep practices in public health.

Key words: depression, insomnia, Japanese adult population, sleep hygiene practices (SHPs), stress coping behaviors (SCBs).

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Acronyms used: ICSD-2 = International Classification of Sleep Disorders, 2nd Edition; DSM-IV-TR = Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, Text Revision; SCBs = stress coping behaviors; SHPs = sleep hygiene practices; CES-D = Center for Epidemiologic Studies Depression Scale; OR = odds ratio.

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INTRODUCTION

Insomnia is a common sleep disorder. The reported prevalence of insomnia in the general population varies widely, ranging between 4.4% and 48%, depending on sample characteristics and the definition of insomnia.¹⁻⁴ Chronic insomnia not only reduces the quality of sleep during the night, but also causes a variety of impairments in mental and physical functioning during the daytime.⁵⁻¹⁰ Chronic insomnia is associated with both human and socioeconomic costs, such as increased long-term absenteeism at work, reduced performance and productivity, and increased industrial accidents and health-care costs.¹¹⁻¹⁶ Moreover, alongside insomnia being the most common symptom of depression,¹⁷⁻²¹ persistent insomnia is a risk or exacerbating factor of depressive disorders.²²⁻²⁷

Factors leading to the onset and worsening of insomnia are multidimensional in nature,²⁸ and many life events and life stresses can result in acute insomnia.²⁸⁻³⁰ Based on the 3P model proposed by Spielman that is widely used to explain the onset mechanism of insomnia,³¹ three factors (predisposing, precipitating, and perpetuating) are closely linked to insomnia development. With underlying predisposing factors (including age, sex, genetic disposition, and lifestyle), insomnia emerges as precipitating factors (stressful life events such as divorce, pain, and psychological and physical problems) are superimposed, and the insomnia becomes chronic and difficult to treat because of perpetuating factors (maladaptive sleep hygiene practices, dysfunctional cognition about sleep loss and its impact on life).^{23,31-34}

Inadequate stress coping behavior also precipitates insomnia, and heightens uneasiness and tension around being unable to sleep, thereby perpetuating the sleeplessness.^{7,8,35} Further, insomniacs may often engage in poor sleep hygiene, such as having an inadequate sleep environment, lack of daytime activities, and excessive afternoon napping.^{7,8,30-35} It is reported that the majority of people with insomnia attempt to cope with sleep problems in various ways,³⁶ have fewer adaptive coping skills, rely more on emotion-focused coping strategies than on problem-solving strategies,³⁷ and report lower feelings of mastery.^{24,38-40} Although reduced quality of life associated with insomnia has been reported in a general population sample,^{9,10,32} few studies have examined specific daily behaviors and practices of people with insomnia.

The aims of this study are: (i) to investigate the prevalence of insomnia during the past one month associated with daytime impairments among Japanese adults; and (ii) to examine how insomnia and comorbid depression

are associated with stress coping behaviors (SCBs) and sleep hygiene practices (SHPs), using data of a representative sample from a large-scale epidemiological study on sleep habits and their correlates.

MATERIALS AND METHODS

Data source

The present study was conducted using partial data from the Active Survey of Health and Welfare performed in June 2000 by the Ministry of Health, Labour and Welfare. The purpose of the survey was to collect basic data on health and welfare, including sleep habits, from the general public of Japan. To provide a representative sample of the general population, the survey was conducted through public health centers in 300 target areas randomly selected from the 881 851 national census areas nationwide. Participants were household members aged ≥ 12 years, all Japanese. Survey officials for home visits were employed part-time and trained as research associates by public health centers across Japan during this time. For data collection, these research associates visited each participating household to distribute self-administered questionnaires and collect them a few days later.

All survey respondents provided verbal informed consent to participate. Their privacy was protected in accordance with the Declaration of Helsinki guidelines.

Measures

The self-administered questionnaire for the present study was developed by two of the authors (MU and TO.) and an appropriate official from the Ministry of Health, Labour, and Welfare. The self-administered questionnaire consisted of 44 items covering: (i) socio-demographic characteristics including age and sex; (ii) general health status; (iii) physical and psychological complaints; (iv) information on mental stress; (v) sleep habits and problems; and (vi) Center for Epidemiologic Studies Depression Scale (CES-D) Japanese version.⁴¹

To examine factors associated with 1-month insomnia and determine whether stress was present, one item ("Have you experienced stress in your daily life during the last one month period?") was extracted from the 44 items on the self-administered questionnaire. Seven items related to mental stress were extracted from the question "What do you do to deal with insomnia, worries, difficulties, and/or stress?" Five items related to sleep habits and problems were extracted from the

question “Have you tried to do any of the following during the last one month period to get enough sleep?” The CES-D is a self-report scale designed specifically to measure depressive symptomatology in the general population during the previous week-long period⁴² and has appropriate levels of reliability and validity for use with a general population. Each item is rated on a scale of 1 to 3 points, and the result is evaluated based on the total score for all 20 items (range 0 to 60 points). Higher scores indicate increased severity of depression. This scale is designed to screen, not to diagnose, major depression. The reliability and validity of the CES-D Japanese version has been reported in Japan.⁴¹

Case definition of insomnia

Based on an algorithm that combined the general criteria of insomnia in ICSD-2⁴³ and the diagnostic criteria of primary insomnia in DSM-IV,⁴⁴ we first selected cases reporting the presence of both insomnia symptoms and physical/psychological complaints during the past one month, identified based on the responses to the survey questionnaire about sleep problems and daytime functioning during the past one month. Then we excluded cases reporting a common comorbid sleep disorder (sleep-disordered breathing and restless leg syndrome). Therefore, people with insomnia were defined here as individuals who reported all of the following.

- A) *Sleep problems.* We determined a respondent had insomnia symptoms when reporting any of the following items occurring or persisting during the past one month: “difficulty falling asleep,” “waking up frequently during the night,” “waking up early in the morning,” and “getting up in the morning feeling unrefreshed or not restored (nonrestorative sleep).”
- B) *Daytime impairments.* We determined that a respondent had daytime impairments when reporting any of 6 physical complaints (head-heaviness/headache, gastric discomfort, diarrhea/constipation, shoulder/neck stiffness, fatigability, and residual fatigue) or 5 psychological complaints (depression, irritability, anxiety, hypochondria, and daytime sleepiness), which are common symptoms of insomnia,⁴³ occurring or persisting during the past one month.⁴⁴
- C) *No comorbid sleep disorder.* We excluded cases with comorbid sleep-disordered breathing or restless legs syndrome, which are also common in the general population. We excluded respondents reporting either “waking up during the night due to loud

snoring and breathing difficulty” or “feeling a crawling sensation deep inside my legs” occurring or persisting during the past one month.

Case definition of insomnia comorbid with depression

We defined the presence of depression as a score of ≥ 26 (range 0–60) on the 20-item CES-D Japanese version. Studies in West European countries indicate that a score of ≥ 16 is indicative of probable clinical depression,⁴² but we set the cutoff score for depression at 26 according to the criterion used by national census studies conducted in Korea⁴⁵ and Japan.⁴⁶ Among the respondents of the Active Survey of Health and Welfare, 8.1% scored ≥ 26 on the CES-D, which was close to the 12-month prevalence of mood disorders based on the DSM criteria (6.8%) obtained in a community survey conducted between 2002 and 2003 in Japan.⁴⁷ We defined “people with insomnia comorbid with depression” as those who had 1-month insomnia and scored ≥ 26 points on the CES-D Japanese version.

Stress coping behaviors (SCBs)

Respondents were asked to answer the following questions: “Do you use the following coping behaviors when you feel dissatisfied or distressed, or experience problems or stress?” (yes = 1, no = 0). They indicated if each of the following 7 items describing everyday stress coping behaviors applied to them: (i) “Making an effort to solve the problems actively [Problem-solving];” (ii) “Making plans to take time off [Time off];” (iii) “Eating something [Eating];” (iv) “Watching TV/ Listening to the radio [TV/Radio];” (v) “Taking it easy [Ease];” (vi) “Smoking [Smoking];” and (vii) “Bearing the stress without taking any action [Bearing].”

Sleep hygiene practices (SHPs)

Respondents were asked to answer the following questions: “Did you engage in any of the following practices in the past one month in order to sleep well?” (yes = 1, no = 0, except for the first item). They indicated whether each of the following 5 items describing everyday sleep hygiene practices applied to them: (i) “Drinking alcohol [Alcohol];” (ii) “Taking light exercise [Exercise];” (iii) “Taking a bath [Bath];” (iv) “Reading books/Listening to music [Books/Music];” and (v) “Trying to have regular daily habits [Regularity].”

Table 1 Demographic characteristics of analyzed subjects in a sample of the Japanese adult general population ($n = 24\,551$)^a

Age class (years)	Study subjects			Census 2000 ($n = 100\,733\,618$)	
	Subtotal % (n)	Male % (n)	Female % (n)	Male %	Female %
20–29	18.2 (4468)	18.4 (2145)	18.0 (2323)	19.1	17.2
30–39	18.4 (4508)	18.4 (2152)	18.3 (2356)	17.5	16.1
40–49	18.8 (4606)	19.2 (2249)	18.3 (2357)	17.2	16.0
50–59	20.5 (5036)	21.0 (2453)	20.0 (2583)	19.5	18.6
60–69	14.0 (3436)	14.5 (1691)	13.6 (1745)	14.6	14.9
≤70	10.2 (2497)	8.5 (999)	11.6 (1498)	12.1	17.4
Total	100 (24551)	100 (11689)	100 (12862)	100	100

^aData for both the present study and the overall census were obtained in 2000.

Respondents rated the item [Alcohol] on a 4-point scale: “None,” “1–2 times per month,” “1–2 times per week,” and “more than 3 times per week.” On this item, we coded “1–2 times per week” and “more than 3 times per week” as “yes.”

Presence of stress

Respondents were asked to answer the following question: “Did you feel dissatisfied or distressed, or experience any difficulties or stress during the past one month?” They answered this question on a 4-point scale: “much,” “some,” “little,” and “none.” In our study, “much” was coded as “yes” and the other response choices were coded as “no” (yes = 1, no = 0).

Statistical analysis

The prevalence of insomnia and prevalence of insomnia comorbid with depression were compared by sex and age group, using chi-square tests. Associations between individual SCB and SHP factors and insomnia (or comorbid with depression) were examined. Logistic regression analyses were performed to identify associations between each factor and 1-month insomnia.

Sex, age group – younger (20–39), middle-aged (40–59), and old-aged (≥ 60) – and presence of stress were entered into the regression models to adjust for the confounding effects of sociodemographic and other factors. Odd ratios (ORs) were calculated from both the univariate analyses and the multivariate logistic regression analysis with 95% confidence intervals. Statistical significance was set at $P < 0.01$. All analyses were performed using SPSS 11.5 for Windows (SPSS Inc, Chicago, IL, USA).

RESULTS

Sample characteristics

A total of 32 729 people completed the survey questionnaire. We limited the sample to adults aged ≥ 20 years and further excluded those with any missing data for the variables included in our analysis. Before conducting analyses, data from 707 participants were excluded for submitting blank survey sheets. Minors aged < 20 years ($n = 3284$) were excluded because this study focused on adults. Additionally, data from respondents who did not answer questions regarding sex and age ($n = 208$) and data from those who did not answer > 6 items on the CES-D were excluded ($n = 3979$). Thus, the final sample for analysis comprised 24 551 adults: 11 689 (47.7%) men and 12 862 (52.3%) women, with a mean age of 47.1 years (range 20–100 years). Demographic data of the study sample are shown in Table 1.

Compared with the national census data collected around the same time, our study sample included a smaller proportion of adults aged ≥ 70 , but the rates for the other age groups were similar. The national census data were based on all residents of Japan on October 1, 2000, and Table 1 indicates that our study sample was a representative sample of the general population of Japan. Because the total number of residents recruited in each target area was not made public by the Ministry of Health, Labour and Welfare, we were unable to compute the response rate. The Active Surveys of Health and Welfare conducted 3, 4, and 6 years prior to 2000 had response rates of 87.1%, 89.6%, and 87.3%, respectively. Since the methodology of the survey has remained the same over the years, we postulated that the response rate for our study sample was similar to those from previous surveys.⁴⁶

Table 2 Presence of insomnia and insomnia comorbid with depression, by age group and sex

Age class (years)	Insomnia			Insomnia comorbid with depression		
	Subtotal % (n)	Male % (n)	Female % (n)	Subtotal % (n)	Male % (n)	Female % (n)
20–29	37.1 (1661)	33.4 (716)	40.7 (945)	5.6 (252)	4.9 (106)	6.3 (146)
30–39	41.7 (1881)	38.8 (834)	44.4 (1047)	4.4 (198)	3.3 (72)	5.3 (126)
40–49	41.5 (1911)	42.3 (953)	40.6 (958)	5.1 (236)	4.5 (102)	5.7 (134)
50–59	45.5 (2290)	45.1 (1107)	45.8 (1183)	5.0 (253)	4.6 (112)	5.5 (141)
60–69	48.1 (1653)	46.1 (780)	50.0 (873)	4.5 (155)	4.6 (78)	4.4 (77)
≤70	50.3 (1257)	48.8 (488)	51.3 (769)	10.5 (263)	9.0 (90)	9.8 (173)
Total	43.4 (10653)	41.7 (4878)	44.9 (5775) [†]	5.5 (1357)	4.8 (560)	6.2 (797) [†]

[†]Significant difference between men and women ($P < 0.001$, chi-square test).

Prevalence of insomnia

Prevalence of insomnia in the study sample by sex and age group is summarized in Table 2. In the entire sample, the prevalence was 43.4% ($n = 10\,653$). The rate was significantly higher in women than in men: 44.9% (5775/12 862) versus 41.7% (4878/11 689), $\chi^2 = 25.02$, $P < 0.001$. The prevalence comorbid with depression (i.e. people with insomnia who scored ≥ 26 on the CES-D Japanese version) was 5.5% ($n = 1357$) of the entire sample and 12.7% of the sample of people with 1-month insomnia. The prevalence was significantly higher in women than in men: 6.2% (797/12 862) versus 4.8% (560/11 689), $\chi^2 = 23.17$; $P < 0.001$.

Percentage of SCBs and SHPs

The frequencies of each SCB and SHP item among people with insomnia and insomnia comorbid with depression are shown in Table 3.

SCB factors associated with insomnia

Table 3 shows the SCB factors associated with insomnia and their ORs. In multivariable logistic regression, incidence was significantly positively associated with four SCB factors: Bearing (OR = 1.69), Smoking (OR = 1.26), Eating (OR = 1.22), and TV/Radio (OR = 1.18), all $P < 0.01$. Conversely, Problem-solving was the only SCB with a significantly negative correlation (OR = 0.87). Time off and Ease showed no significant association.

SHP factors associated with insomnia

Table 3 also shows the SHP factors associated with insomnia and their ORs. In multivariable logistic

regression, insomnia was significantly positively associated with three of the SHP factors: Alcohol (OR = 1.27), Books/Music (OR = 1.24), and Bath (OR = 1.09), all $P < 0.01$. Regularity and Exercise were not significantly correlated. None of the SHPs was negatively correlated.

SCB factors associated with insomnia comorbid with depression

Table 3 shows the SCB factors associated with insomnia comorbid with depression and their odds ratios. Multivariate logistic analysis showed the following four SCB factors had significant positive relations with insomnia comorbid with depression in descending order: Bearing (OR = 3.44), Smoking (OR = 1.73), TV/Radio (OR = 1.52), and Eating (OR = 1.51). Conversely, SCB factors with significant negative relations with insomnia comorbid with depression included Problem-solving (OR = 0.50) and Ease (OR = 0.74). Time off was not significantly related to insomnia comorbid with depression.

SHP factors associated with insomnia comorbid with depression

The SHPs associated with insomnia comorbid with depression and their odds ratios are also shown in Table 3. Multivariate logistic analysis showed insomnia comorbid with depression was significantly and positively related only to Books/Music (OR = 1.36). Conversely, the only factor with a significant negative relationship with insomnia comorbid with depression was Regularity. The individual factors of Alcohol, Bath, and Exercise showed no significant relationship with incidence comorbid with depression.

Table 3 Association between insomnia or insomnia comorbid with depression and each factor of stress coping behaviors and sleep hygiene practices

	Insomnia (<i>n</i> = 10653)					Insomnia comorbid with depression (<i>n</i> = 1357)				
	N	Crude		Adjusted ^a		N	Crude		Adjusted ^a	
		OR	95%CI	OR	95%CI		OR	95%CI	OR	95%CI
Stress coping behaviors (SCB)										
Bearing the stress without taking any action (Bearing)	1576	1.97	1.78–2.18	1.69	1.52–1.88	378	3.49	2.96–4.10	3.44	2.92–4.05
Smoking (Smoking)	1954	1.22	1.12–1.33	1.26	1.15–1.38	317	1.48	1.24–1.76	1.73	1.44–2.08
Eating something (Eating)	1663	1.27	1.16–1.39	1.22	1.11–1.34	273	1.58	1.33–1.88	1.51	1.26–1.81
Watching TV/Listening to radio (TV/ Radio)	3650	1.26	1.17–1.35	1.18	1.10–1.27	537	1.57	1.35–1.83	1.52	1.30–1.78
Making an effort to solve problems actively (Problem solving)	1609	0.88	0.80–0.96	0.87	0.80–0.95	121	0.50	0.39–0.64	0.50	0.39–0.65
Taking it easy (Ease)	3630	<i>n.s.</i>	–	<i>n.s.</i>	–	354	0.72	0.61–0.85	0.74	0.63–0.87
Making plans to take time off (Time off)	734	<i>n.s.</i>	–	<i>n.s.</i>	–	65	<i>n.s.</i>	–	<i>n.s.</i>	–
Sleep hygiene practices (SHP)										
Drinking alcohol (Alcohol)	2961	1.24	1.15–1.34	1.27	1.18–1.38	349	<i>n.s.</i>	–	<i>n.s.</i>	–
Reading books/Listening to music (Books/Music)	3747	1.20	1.12–1.29	1.24	1.15–1.33	460	1.36	1.16–1.59	1.39	1.19–1.63
Taking a bath (Bath)	4983	1.13	1.05–1.21	1.09	1.01–1.17	587	<i>n.s.</i>	–	<i>n.s.</i>	–
Trying to have regular daily habits (Regularity)	4114	<i>n.s.</i>	–	<i>n.s.</i>	–	420	0.69	0.59–0.80	0.64	0.55–0.75
Taking light exercise (Exercise)	2174	<i>n.s.</i>	–	<i>n.s.</i>	–	239	<i>n.s.</i>	–	<i>n.s.</i>	–

^aAdjusted for sex, age, and presence of stress by multiple logistic regression analyses. CI, confidence interval; Crude, non-adjustment; OR, odds ratio ($P < 0.01$).

DISCUSSION

We found a fairly high prevalence of insomnia (43.4%) as defined in this study in the general Japanese population. Although previous studies have pointed out that Japanese people tend to underreport their sleep problems because of cultural reticence compared with those in Western cultures,³ our results did not necessarily align with these studies. One previous study based on a sample of 3030 Japanese reported that 21.4% of the general population suffered “always” or “often” from insomnia.⁴⁶ Stewart *et al.* have shown the prevalence of insomnia symptoms/syndromes differs dramatically

when different definitions of insomnia are applied.⁴⁹ More than 50 large-scale surveys have examined the prevalence of insomnia, but variations in the rates are attributable to differences in methodology and confusion over the standardized definitions of insomnia used.^{1–5,49}

Possible reasons for the higher prevalence of insomnia obtained in our study include the following. First, following the ICSD-2 criteria, an item on nonrestorative sleep was added to our definition of insomnia. Secondly, our sample may have included cases with short-term insomnia occurring in less than the past one month (e.g. adjustment insomnia) in the absence of specifications on

the duration and frequency of insomnia symptoms. The case definition of insomnia based partially on the ICSD-2 and DSM-IV was more liberal than the original definitions of the disorder. Lastly, the greatest factor responsible for our higher prevalence rate was the inadequate assessment of daytime impairments associated with insomnia. It is possible that the complaints from participants were related to physical or psychological problems, which are separate issues from insomnia. However, as some studies have indicated,^{9,10} and to the extent of our knowledge, there is no validated self-reporting tool about which researchers are in consensus for accurately measuring daytime impairments due to insomnia.

The presence of insomnia comorbid with depression was 5.5% ($n = 1357$), with a rate of 12.7% among the sample of people with insomnia. Ford *et al.* reported 14.0% as a prevalence of insomnia co-occurring with depression in a study based on 7954 American households.²² Vollarath *et al.* state that insomnia constitutes an independent syndrome,²⁴ and Buysse *et al.* suggest that insomnia and depression are commonly comorbid, and insomnia comorbid with depression is an important intermediate phenotype.²⁵ Our study is the first to find that the frequency of insomnia comorbid with depression observed in Western countries is stable in Japanese adults as well (approximately one seventh of the population).

SCBs among people with insomnia

As far as we know, this is the first report that investigates stress-coping behaviors among people with insomnia in the general adult population. According to Lazarus and Folkman,⁵⁰ coping behavior refers to cognitive and behavioral efforts to manage external and internal demands. There are two types of coping behaviors: problem-focused and emotion-focused behaviors.⁵¹ With regards to the coping behaviors among people with insomnia, Morin *et al.*³⁷ indicate that, compared with good sleepers, people with insomnia are apt to perceive their lifestyle as more stressful and choose more emotion-focused coping behaviors. This does not contradict reports indicating that people with insomnia tend to internalize stress, affecting emotions.^{8,35-39} Similar trends were observed in the sample of people with insomnia in the present study. Our multivariable logistic regression analysis revealed that, among the seven SCBs, insomnia was positively related to the emotion-focused coping behaviors of bearing, smoking, eating, and TV/radio. Bearing had the strongest positive correlation with insomnia (OR = 1.69), and an even stronger correlation

with insomnia comorbid with depression (OR = 3.44). Therefore, our study indicates that problem-focused behaviors represented by Problem-solving could be helpful in overcoming insomnia.

While Ease was not significantly related to insomnia, it had a significant relation with insomnia comorbid with depression (OR = 0.74). This indicates that people with insomnia may not necessarily engage in the same stress-coping behavior as insomniacs comorbid with depression. The present findings indicate that novel therapeutic strategies need to be developed, taking into account both characteristics of insomnia and depression.

This study further revealed a strong positive association between Smoking and insomnia (OR = 1.26). Previous research in Europe and in the United States indicates a relationship between nicotine consumption through smoking and poor sleep quality.^{34,52-54} Furthermore, the strong association between Smoking and insomnia comorbid with depression (OR = 1.73) indicates that individuals with insomnia comorbid with depression tend to rely on more unhealthy coping strategies in their daily life. Our results might highlight the importance of strongly urging people complaining of insomnia to quit smoking.^{24,33,34}

Eating was significantly related to insomnia. A previous epidemiological study reported that irregular eating habits and subjective sleep insufficiency were closely associated.⁵⁵ TV/Radio is also significantly related to insomnia. Morin *et al.* indicated that many individuals initiate a variety of self-help strategies to alleviate insomnia, including listening to music and relaxation.² In fact, these individuals may experiment with a variety of these passive emotional focused self-help remedies for a considerable period of time before seeking professional help.

SHPs among people with insomnia

There have been several studies that have shown that individuals with insomnia often engage in some inappropriate sleep practices. In a population-based sample of 258 insomniacs, Jefferson *et al.*³⁴ reported that, compared with healthy people, insomniacs more habitually drank alcohol before going to bed. Our study also demonstrated that alcohol consumption before going to bed is positively related to insomnia. Research in the United States suggests that drinking alcohol is an important risk factor for sleep problems.⁵⁶ In their comparison of sleep habits among people in ten different countries, Soldatos *et al.* found that Japan ranked the highest in terms of the prevalence of alcohol use as a sleep aid (30.3%).⁵⁷ Thus,

it is critical to provide sleep hygiene education about minimizing alcohol consumption before bedtime to people with insomnia.

Our analysis further found that Books/Music was also positively related to insomnia. Some previous studies have reported that reading behavior is significantly more frequent among groups with insomnia than control groups.^{2,35,58} Morin *et al.* found in their epidemiological survey of a general population in Canada that insomnia syndrome sufferers use music (OR = 2.6) and reading (OR = 1.8) as self-help strategies to facilitate sleeping.² In our study, combining Books and Music into one item in the questionnaire may have comparatively reduced the odds ratio.

One epidemiological study among Japanese indicates that poor exercise habits are associated with insomnia.⁴⁸ Based on this finding, we hypothesized that physical activity would be an inhibiting factor for insomnia symptoms; however, there was no significant relationship between Exercise and insomnia. Previous research suggests that daytime physical activity improves sleep.^{58,59} The inconsistency in the findings might be attributable to the lack of information available regarding the type (level), duration, and frequency of physical activity in our study.

While Bath was slightly related to insomnia, it had no significant association with insomnia comorbid with depression. Subjective sleep sufficiency is better for individuals when they take a bath before going to bed rather than when they do not.⁶⁰ Taken together, these observations may indicate that taking a bath improves the subjective quality of comorbid depression.

By contrast with previous studies,^{61,62} our analysis found no significant association between Regularity and insomnia. This may be attributable to the fact that we did not define the behaviors belonging to this SHP in a concrete manner. Regular exposure to photic and non-photic time cues (Zeitgebers) for the circadian clock system supposedly stabilizes the acrophases of the sleep-wake rhythm as well as the physiological rhythm, allowing one to fall asleep and maintain sleep more easily. The strong negative association between Regularity and insomnia comorbid with depression (OR = 0.64) found in the present study supports a treatment emphasis on regularity for mood disorders including bipolar disorder.⁶³

Study limitations

We recognize several limitations of this research. Firstly, due to the cross-sectional survey design, the study is

unable to establish a direct causal relationship between insomnia and SCBs and SHPs. This study also lacked analysis on the socioeconomic background of participants. This is an essential defect of the study because sleep behaviors are markedly affected by this component. However, the main purpose of this study was not to conclude that SCBs and SHPs in daily life cause or are caused by insomnia, not to investigate socioeconomic background, but rather to examine the psycho-behavioral characteristics of people with insomnia based on a large representative sample of the general population, and this purpose was achieved. Secondly, people with insomnia in the present study were identified only by a subjective assessment via a self-administered questionnaire; they were not diagnosed by objective measures such as polysomnography and actigraphy. Since it was a large-scale survey of the general population, subjective responses were not obtained via a rigorous methodology (e.g. a structured interview). For this reason, the definition of insomnia in the study might include other sleep disorders that occur less frequently than insomnia but are observed across a wide range of ages, such as parasomnia and circadian rhythm sleep disorder. Indeed, many physical and other psychiatric problems (schizophrenia, affective disorder and chronic pain, etc.) still included in the study may cause insomnia. Identifying cases with insomnia meeting the general criteria of the ICSD-2 or DSM-IV in a finer-grained manner to claim a prevalence figure not only requires a self-report survey, but also a structured interview and polysomnography. Thus, the prevalence figure in this study is of very limited value, since the case definition of insomnia does not fulfill the frequency, severity and duration criteria. Such data collection for more rigorous epidemiological study would incur an enormous cost. Lastly, as our previous reports have also suggested,^{46,55} the stress coping behaviors and sleep hygiene practices defined in this study were not clearly distinguished and selected properties. As a result, it is unknown whether the characteristics of the Japanese population-based sample of people with insomnia will generalize to those of clinically referred people with insomnia.

To date, individuals still underreport possible sleep problems and are unlikely to be receiving proper treatment.^{2,3,32,36,64} Many of the participants with insomnia as described in this study are likely those who are in the "preinsomnia" moment,²⁸ and do not consider themselves insomniacs. They may be characterized by vulnerabilities in how they perceive and experience stressful life events negatively.^{28,29,37} Most are not seeking help,^{2,6,64} and possibly they will continue to engage in

self-help maladaptive practices, such as substance abuse, until they are finally diagnosed with chronic insomnia or depression.^{2,24,35,39} This study mainly targeted adults, but future research needs to examine SCBs and SHPs among minors,⁶⁵ as well as study the onset of insomnia and its temporal development into chronic insomnia.^{25,28–30,66}

CONCLUSION

We found that the presence of insomnia among Japanese was as high as 43.4% and that insomnia comorbid with depression occurred at a fixed frequency of 12.7% (approximately one seventh) of this general sample. Among the SCBs that people with insomnia use in daily life, emotion-focused coping behaviors such as bearing and smoking may act as precipitating or perpetuating factors for insomnia. With regard to SHPs, we found several distinguishing self-help behaviors among the participants. These findings may offer critical insights for developing effective sleep educational preventative programs.

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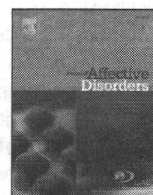
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Research report

Self-help behaviors for sleep and depression: A Japanese nationwide general population survey

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ABSTRACT

Objective: The aim of this study was to examine the relationship between self-help behaviors for sleep (SHBS) and depression among the general adult population in Japan.

Methods: The survey was conducted in June 2000 using self-administered questionnaires for subjects living in 300 communities randomly selected throughout Japan. A total of 24,686 responses were analyzed from individuals aged 20 years or older. The Center for Epidemiologic Studies Depression Scale was used to assess the prevalence of depression with two cut-off points: 16 and 25. Details of 6 types of SHBS were asked, based on given examples of actual behavior and frequency.

Results: After adjusting for sociodemographic variables, sleep problems and other SHBS, multiple logistic regression analyses revealed that “snacking on food and/or beverages” was independently associated with an increased odds ratio for depression, whereas “maintaining lifestyle regularity” was independently associated with a decreased odds ratio for depression. “Drinking alcoholic beverages,” “having a bath,” and “reading books or listening to music” were associated with an increased odds ratio for depression in crude analyses, but the significance of the association disappeared after adjusting for sociodemographic variables, sleep problems and other SHBS.

Limitation: Complex constructs are being correlated.

Conclusions: These results suggest that individual SHBS are differentially associated with depression, thus providing important clues for establishing sleep hygiene for treatment and prevention of depression.

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1. Introduction

Sleep disturbance is common among individuals suffering from depression, and it has been reported that 50–90% of patients with depression suffer from insomnia (Tsuno et al., 2005). Conversely, previous epidemiological studies have documented that 14–20% of individuals with insomnia were diagnosed as having depression (Ford and Kamerow, 1989;

Mellinger et al., 1985). Recent findings in the field of sleep and depression research have indicated that insomnia is not only a symptom of, but also a risk factor for depression (Brabbins et al., 1993; Chang et al., 1997; Foley et al., 1999; Livingston et al., 1993; Paffenbarger et al., 1994).

It has been well demonstrated that antidepressant treatments significantly improve insomnia in depressive patients, even when no interventions are employed to treat insomnia (Benca, 2000). Recently, it has been reported that co-administration of hypnotics in addition to antidepressants leads to significantly greater improvement of insomnia and depressive symptoms in patients suffering from both (Fava et al., 2006; Lundborg et al., 2000). A non-controlled study has

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suggested that cognitive-behavioral therapy (CBT) for insomnia is effective for ameliorating not only insomnia but also symptoms of depression (Taylor et al., 2007). A more recent randomized controlled study comparing antidepressant therapy with and without CBT for insomnia documented that additional CBT for insomnia improved depressive symptoms more effectively than drug therapy alone (Manber et al., 2008). The results obtained from these studies indicate that attempted interventions to improve insomnia in patients with depression may ameliorate coexisting depressive symptoms.

Most of those who experience insomnia, before visiting physicians, seem to cope by adopting self-help behaviors for sleep (SHBS) (Morin, 2004). Previous studies have reported that such SHBS include intake of alcohol or natural products, reading books, listening to music, mental relaxation techniques, and over-the-counter sleep medications (Ancoli-Israel and Roth, 1999; Morin et al., 2006). Some SHBS may allow individuals to cope successfully with insomnia, whereas others may not. Since insomnia is reported to be one of the earliest symptoms of depression (Jackson et al., 2003; Perlis et al., 1997), it is possible to consider that patients with depression might attempt SHBS in the early stage of the disorder. Moreover, SHBS in patients with insomnia might influence the risk of developing depression, given that attempted interventions to improve insomnia have been reported to influence depression with respect to hypnotic medication therapy and CBT for insomnia, in addition to treatment of depression (Fava et al., 2006; Lønborg et al., 2000; Manber et al., 2008; Taylor et al., 2007). However, there has been virtually no information about the relationships between depression and SHBS.

In the present study we investigated the associations between SHBS and depression using a cross-sectional approach, based on epidemiologic data for a large sample of the general population of Japan. Our findings provide the first documented evidence that some SHBS have a positive or negative association with depression, providing important data for establishing sleep hygiene for the treatment and prevention of depression.

2. Methods

2.1. Selection of subjects

The present study was part of a national survey (Active Survey of Health and Welfare) conducted by the Ministry of Health, Labor and Welfare of Japan in June 2000. The Active Survey of Health and Welfare was conducted in 1996, 1997, 1999 and 2000 to provide the information required for establishing governmental health and welfare policies. To ensure that the survey sample was representative of the general population, study participants were selected from residents aged 12 years or over living in 300 target areas. These areas were selected randomly, through stratified sampling, from 881,851 areas included in the national census (2000). Part-time investigators paid by the public health center in each area delivered self-administered questionnaires to the subjects and collected the completed questionnaires a few days later. Oral informed consent to participate was obtained from the subjects, whose privacy

was protected in accordance with Declaration of Helsinki guidelines.

2.2. Procedures

The self-administered questionnaire consisted of 44 items, including: (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, (5) sleep habits and sleep problems, and (6) the Japanese version of the Center for Epidemiologic Studies Depression Scale (CES-D) (Shima et al., 1985).

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 one week leading up to the survey (Radloff, 1977). This questionnaire is adequately reliable and valid for use in a general population. The CES-D yields an item score (range: 0–3) and a sum of the 20-item scores (range: 0–60). Higher scores indicate increasing severity of depressive symptoms. Although this scale is designed to screen, but not diagnose, major depressive disorder, a score of 16 or higher is highly suggestive of symptoms of depression. In addition, a severe cut-off point has been assumed in several studies (Cho et al., 1998; Madianos et al., 1988; Nagase et al., 2009). We set a score of 25 or higher to define CES-D-25 depression as described previously (Kaneita et al., 2006), because the cut-off point of 16 demonstrated that nearly 30% of the Japanese adult population had depression, indicating an over-estimation of prevalence in comparison with Western countries (20% or less) (Barnes et al., 1988; Eaton and Kessler, 1981; Hsu and Marshall, 1987).

The following six questions about SHBS during the previous month were embedded in the questionnaire:

1. Do you drink alcoholic beverages? (None/Once or twice per month/Once or twice per week/Three times or more per week)
2. Do you snack on food and/or beverages? (Yes/No)
3. Do you take light exercise? (Yes/No)
4. Do you take a bath? (Yes/No)
5. Do you read a book or listen to music? (Yes/No)
6. Do you try to maintain lifestyle regularity? (Yes/No)

One of the four options (“None,” “Once or twice per month,” “Once or twice per week,” or “Three times or more per week”) was to be selected regarding use of alcohol. In the statistical analysis, these four optional categories were regrouped, if required, into two categories: the former two categories and the latter two (i.e., “Once or more per week” and “Less than once per week”).

With regard to sleep duration, we asked the question, “What was your average sleep duration per night?” Participants who answered “less than 6 h” were categorized as having “short sleep duration”.

For subjective sleep insufficiency, participants were asked to respond to the question, “Have you had sufficiently restful sleep?” by selecting one of the following four options: “Sufficient,” “Fairly sufficient,” “Rather insufficient,” and “Completely insufficient”. Those who selected the latter two options were categorized as having “subjective insufficient sleep”.

For hypnotic medications, participants were asked to respond to the question, “Did you take medicine, such as a hypnotic, during the previous month?” by selecting one of the following four options: “None/Once or twice per month/Once or twice per week/Three times or more per week.” Because, in 2000, no over-the-counter hypnotic drug was available in Japan, those who selected the latter three options were categorized as using “taking hypnotic medication”.

2.3. Statistical analysis

For statistical analysis, the CES-D scores were first calculated. To examine the association between sleep and CES-D scores, we calculated the CES-D scores based on responses to the remaining 19 questions after excluding one 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” \times “20/19” \times “19/number of answered questions.” The prevalence of depression was calculated using two different cut-off points; 16 or higher (CES-D-16 depression) and 25 or higher (CES-D-25 depression). The effects of age and gender on the prevalence of depression were examined by χ^2 test. The mean value and standard deviation (S.D.) of the CES-D scores were calculated according to age and gender. The presence of SHBS was examined by age and gender. The associations of individual SHBS with CES-D-16 depression and that with CES-D-25 depression were examined. Multiple logistic regression analyses were utilized to examine the associations between depression and SHBS. In these analyses, CES-D-16 depression and CES-D-25 depression were separately taken as a response variable, and the following parameters were used as covariates: age group, size of community, short sleep duration, subjective sleep insufficiency, insomnia (difficulty initiating sleep, difficulty maintaining sleep, early morning awakening), and taking hypnotic medication. Odds ratios were calculated from both the crude analysis and the multiple logistic regression analysis with 95% confidence intervals. All analyses were performed using SPSS 16.0 for Windows.

3. Results

Questionnaires were returned by 32,729 subjects. As the Ministry of Health, Labor, and Welfare did not publish the number of residents contacted in the target areas, it was not possible to calculate the response rate for the present survey. The collection rates of similar investigations carried out 3 and 4 years earlier were 87.1% and 89.6%, respectively, and since the present survey was performed using similar methods, the response rate was estimated to be similar (Kaneita et al., 2006). Data from the following respondents were excluded from the analyses: (i) those who submitted blank answer forms ($n = 707$); (ii) those under 20 years of age, because the study was aimed at adults ($n = 3086$); (iii) those who did not respond to the questions on gender or age ($n = 222$); and (iv) those who neglected to answer six or more questions on the CES-D questionnaire ($n = 4028$). Finally, data from 24,686 adults were analyzed.

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 (Table 1).

The prevalence of CES-D-16 depression and that of CES-D-25 depression, together with the mean value and S.D. of the CES-D scores sorted by gender and age groups, are shown in Table 2. Both CES-D-16 depression and CES-D-25 depression were more prevalent in women than in men ($\chi^2 = 52.61$, $df = 1$, $p < 0.01$ for CES-D-16 depression and $\chi^2 = 28.59$, $df = 1$, $p < 0.01$ for CES-D-25 depression). By age groups, both CES-D-16 depression and CES-D-25 depression were most frequent in those aged 70 years or older ($\chi^2 = 118.7$, $df = 5$, $p < 0.01$ for CES-D-16 depression and $\chi^2 = 171.2$, $df = 5$, $p < 0.01$ for CES-D-25 depression).

The prevalence of SHBS by gender and age group is shown in Table 3. The overall prevalence of SHBS differed significantly between men and women ($p < 0.01$). Male dominance was apparent for “drinking alcoholic beverages” (48.3% vs. 18.3%) and “snacking on food and/or beverages” (36.1% vs. 27.9%), whereas female dominance was apparent for “exercising” (29.4% vs. 26.2%), “having a bath” (64.4% vs. 59.0%), “reading books or listening to music” (49.4% vs. 43.4%) and “maintaining lifestyle regularity” (58.6% vs. 49.0%).

All types of SHBS differed significantly among age groups ($p < 0.01$). “Reading books or listening to music” was prevalent in the younger group (20–39 years), “drinking alcoholic beverages” and “snacking on food and/or beverages” were prevalent in the middle-aged group (40–59 years), and other types of SHBS were prevalent in the old-age group (60 years and over) for both men and women.

Table 4 shows the association between individual SHBS and depression. “Drinking alcoholic beverages,” “snacking on food and/or beverages,” “having a bath” and “reading books or listening to music” were associated with an increased odds ratio for CES-D-16 depression after adjustment for socio-demographic variables, sleep problems and other SHBS. “Maintaining lifestyle regularity” was associated with a decreased odds ratio for CES-D-16 depression after adjustment for sociodemographic variables, sleep problems and other SHBS. “Exercising” was associated with an increased odds ratio for CES-D-16 depression in the crude analysis, but not in the multivariate model after adjustment for socio-demographic variables, sleep problems and other SHBS.

Table 1
Percentages of study participants and the general population classified according to gender and age groups.

Age (year)	Present study (2000)		Census (2000)	
	Male	Female	Male	Female
20–29	18%	18%	19%	17%
30–39	18%	18%	18%	16%
40–49	19%	18%	17%	16%
50–59	21%	20%	20%	19%
60–69	15%	14%	15%	15%
70+	9%	12%	12%	17%
Total	100%	100%	100%	100%
n	11,752	12,934	48,669	52,067
			(thousands)	(thousands)

Due to rounding, the percentages may not equal 100%.