

Insomnia Among Japanese Adolescents: A Nationwide Representative Survey

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Study Objectives: Although a number of previous studies have examined the prevalence of insomnia among adolescents, there have been very few nationwide studies. The objectives of this nationwide study were to clarify the prevalence of insomnia, its symptoms, and associated factors among Japanese adolescents.

Design and Setting: This study was designed as a cross-sectional sampling survey. The targets were junior and senior high schools throughout Japan. Sample schools were selected by cluster sampling. Self-reported anonymous questionnaires were sent to schools for all students to fill out.

Participants: A total of 103,650 adolescents responded, and 102,451 questionnaires were subjected to analysis.

Intervention: N/A

Measurements and Results: The prevalence of difficulty initiating sleep, difficulty maintaining sleep, and early morning awakening was 14.8%, 11.3%, and 5.5%, respectively. Insomnia was defined as the presence

of one or more of these three symptoms. The prevalence of insomnia was 23.5%. Multivariate analyses revealed that, among junior high school students, male sex, poor mental health, skipping breakfast, drinking alcohol, smoking, not participating in extracurricular activities, and late bedtime had significantly higher odds ratios for insomnia. Among senior high school students, the same characteristics were associated with a significantly higher odds ratio for insomnia, as was the additional factor of having no intent to study at university.

Conclusion: Insomnia in Japanese adolescents is common and associated with multiple factors. The results of this study suggest the need for comprehensive program to prevent insomnia in Japanese adolescents.

Keywords: Insomnia; adolescents; Japan

Citation: Kaneita Y, Ohida T, Osaki Y et al. Insomnia among Japanese adolescents: a nationwide representative survey. *SLEEP* 2006;29(12):1543-1550.

INTRODUCTION

INSOMNIA IS A RISK FACTOR FOR ASSOCIATED WITH VARIOUS PHYSICAL AND MENTAL DISORDERS, AS WELL AS INDUSTRIAL AND TRAFFIC ACCIDENTS; INSOMNIA is therefore considered to be a serious public health issue. Nationwide epidemiological studies of sleep have been conducted in various countries using samples representative of the general population.^{1,2} Methods used for evaluating insomnia differed among these studies; the prevalence of insomnia among adults was reported to be between 5% and 48%.

In industrialized countries, insomnia is recognized to be a common problem. In Japan, a study conducted in 1997 on a general adult population comprising 3,030 subjects revealed that the prevalence of insomnia was 21.4%.³

Adolescence is a time of social as well as biological transition; therefore, sleep disturbance among adolescents must be discussed separately from that among adults. Since it is known that insom-

nia affects the future somatic, interpersonal, and psychological functioning of adolescents,⁴ it is expected to be a serious school health problem. Some epidemiological studies of insomnia among adolescents overseas have been reported. Ohayon et al., in a study of 1,125 adolescents sampled from 4 European countries (France, Great Britain, Germany, and Italy), reported that 25.7% of the adolescents had one or more of the following insomnia symptoms: difficulty initiating sleep (DIS), difficulty maintaining sleep (DMS), early morning awakening (EMA), or nonrestorative sleep.⁵ A study conducted in the United States on 5,423 adolescents reported that 34.0% of the subjects had experienced DIS, DMA, or EMA often or daily in the prior two weeks.⁶ In Asia, Liu et al. in a study of 1,365 Chinese adolescents reported that the prevalence of insomnia was 16.9% and that the factors associated with insomnia were greater age, lack of habitual physical exercise, poor physical health, self-selected diet, longer distance from home to school, and life stresses.⁷ These studies are meaningful because they have clarified the prevalence of insomnia among adolescents in each country. However, the studies were limited by relatively small sample sizes and poor representative sampling.

In Japan, a representative epidemiological study of sleep disturbance among adolescents was conducted for the first time in 2000.⁸ The study reported that factors such as female sex, not eating breakfast, smoking, drinking alcohol, and psychological stress were associated with sleep disturbances such as short sleep duration and subjective sleep insufficiency. However, the questionnaire used in that study assessed only one symptom of insomnia. In a self-reported study on sleep, it is usual to evaluate insomnia using the following three symptoms: DIS, DMA, and EMA.^{5-7,9-13} In the survey conducted in 2000, questions on DMS

Disclosure Statement

This was not an industry supported study. Drs. Kaneita, Ohida, Osaki, Tanihata, Minowa, Suzuki, Wada, Kanda, and Hayashi have indicated no financial conflicts of interest.

Submitted for publication April 20, 2006

Accepted for publication August 8, 2006

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and EMA were not posed. Therefore, in this study, questions on all three of these insomnia symptoms were included in the questionnaire. The aim of this study was to clarify the prevalence of insomnia and its associated factors among Japanese adolescents.

METHODS

Subjects and Sampling

We have previously conducted two cross-sectional nationwide surveys (1996 and 2000) on lifestyle habits such as drinking alcohol, smoking, eating, and sleeping among Japanese adolescents.^{8,14-18} This study was the third such survey.

For this study, of the 11,060 junior high schools and 4,627 senior high schools registered in Japan in May 2003, 131 junior high schools (selection rate: 1.2%) and 109 senior high schools (selection rate: 1.9%) were sampled. A single-stage cluster sampling method was employed with the probability of sampling proportional to the number of current students. All students enrolled in the sampled schools were subjects of this study. The sample size was determined by referring to the response rates and confidence intervals (CIs) based on variance of results obtained from the two previous studies.

In the Japanese education system, children enter primary school at the age of 6 years and leave after 6 years of study. They then enter junior high school for 3 years of study, followed by 3 years of study at senior high school. Primary and junior high school education is compulsory. In this report, the first to third years of junior high school are called the 7th to 9th grades, and the first to third years of senior high school are called the 10th to 12th grades.

Survey Procedure

We sent a letter to the principal of each selected school, asking for cooperation in our survey, along with the same number of questionnaires and envelopes as the number of students enrolled at the school. At schools that agreed to participate in our survey, each class teacher distributed the questionnaires to the students. To protect the privacy of respondents and to obtain candid responses, it was clearly stated on the questionnaire that completed questionnaires would not be seen by the teachers. After filling in the anonymous questionnaire, each student was asked to seal the questionnaire in the provided envelope with an adhesive flap. Collection and delivery of the questionnaires were entrusted to the teachers, who were instructed to follow the guidelines for conducting the survey. The teachers collected and sent the sealed envelopes back to the National Institute of Public Health without opening them. The survey period was from December 2004 to the end of January 2005. This survey was approved by the Ethics Committee of the National Institute of Public Health.

Measures

The major areas that were included in the questionnaire were: (1) lifestyle, including drinking and smoking behavior; (2) sleep status, including insomnia symptoms and bedtime; (3) mental health status; and (4) personal data. The following three questions about insomnia symptoms experienced during the previous month were embedded in the questionnaire:

1. "Do you have difficulty falling asleep at night?" (DIS)
2. "Do you wake up during the night after you have gone to

sleep?" (DMS)

3. "Do you wake up too early in the morning and have difficulty getting back to sleep?" (EMA)

Each question had five possible replies: "never," "seldom," "sometimes," "often," and "always." "Often" and "always" were taken as an affirmative answer to the question. The presence of DIS, DMS, or EMA was defined when an affirmative answer to question 1, 2, or 3 was obtained, respectively. Insomnia was defined as being present when an affirmative answer was obtained for any of the three questions.

The demographic variables were: sex, grade, type of school (junior high school/senior high school), and intention to study at university (yes/no). The questions related to lifestyle were whether the student ate breakfast (daily/occasionally/never), and whether he/she participated in extracurricular activities (participating actively/ participating but not actively/not participating).

A question "How many days did you smoke in the past one month?" was included in the questionnaire. If the response to this question was one day or more, then it was defined as "smoking." Similarly, a question "How many days did you consume alcoholic beverages in the past one month?" was asked, and if the response was one day or more, then it was defined as "drinking alcohol."

The Japanese version of the 12-item General Health Questionnaire (GHQ12-J) was used to evaluate mental health status.^{19,20} The GHQ12-J is a widely used, self-administered questionnaire that was designed as a screening tool for mental illness. It assesses 12 symptoms of psychiatric disorders during the previous month. Every item on the GHQ12-J describes a symptom and has four possible replies: the two answers that indicate the absence of the symptom are given a score of "0", and the two that indicate the presence of the symptom receive a "1." The overall score on the scale will thus fall into a range of 0-12, and it follows that the higher the total score, the poorer the state of mental health. The GHQ was originally applied to adult populations and subsequently used and validated for adolescents as well.²¹⁻²³ In the present study, any participant whose total GHQ12-J score was ≥ 4 points was considered to be a person with poor mental health, as assessed by most previous studies.²³⁻²⁵

Statistical Analyses

First, the prevalences of DIS, DMS, EMA, and insomnia, and the 95% CIs were calculated. Then, the prevalences of DIS, DMS, EMA, and insomnia with regard to sex and grade were calculated. Finally, multivariate logistic regression analyses were performed to examine the factors associated with insomnia symptoms. The analyses were conducted separately for the junior and senior high school students since the results might provide the basis for future educational planning at each level. All analyses were performed using SPSS 11.5 for Windows.

RESULTS

Response Rates

Replies were obtained from 92 of the 131 junior high schools (school response rate: 70.2%) and 87 of the 109 senior high schools (school response rate: 79.8%; combined junior and senior high school response rate: 74.6%). A total of 103,650 envelopes were collected. The student response rate as a proportion of enrolled students in the sampled schools was 88.4% in the junior

high schools. 86.3% in the senior high schools, and 87.1% as a whole. Accordingly, the overall response rate was 60.7% in the junior high schools, 67.7% in the senior high schools, and 64.8% as a whole. Of the collected questionnaires, 1,199 were excluded because the sex or grade was not specified, or the answers were inconsistent. The data of the remaining 102,451 questionnaires were analyzed.

Prevalence of Insomnia and Insomnia Symptoms

The responses to the questions on the three insomnia-related symptoms with regard to sex and grade are shown in Tables 1 to

3. The prevalence (and 95% CI) of DIS, DMA, and EMA were 14.8% (14.6%-15.0%), 11.3% (11.1%-11.5%), and 5.5% (5.4%-5.6%), respectively. The prevalence of DIS was the highest. The prevalence (and 95% CI) of DIS among males was 14.4% (14.1%-14.7%) and among females was 15.3% (15.0%-15.6%). Thus, the prevalence of DIS was significantly higher among females ($P < .01$). The prevalence (and 95% CI) of DMS among males was 11.0% (10.7%-11.3%) and among females was 11.7% (11.4%-12.0%). Thus, the prevalence of DMS was also significantly higher among females ($P < .01$). The prevalence (and 95% CI) of EMA among males was 5.7% (5.5%-5.9%) and among females was 5.2% (5.0%-5.4%); in this case, the prevalence was

Table 1—Prevalence of Difficulty Initiating Sleep Among Japanese Adolescents*

	Never	Seldom	Sometimes	Often	Always	Uncertain	N
Male							
Junior high school							
7th grade	38.2	19.5	27.6	6.8	4.5	3.4	6917
8th grade	36.0	18.7	29.2	7.7	5.2	3.1	6845
9th grade	32.1	16.3	32.7	10.1	6.3	2.4	6917
Senior high school							
10th grade	34.9	19.2	30.1	8.9	5.1	1.8	12235
11th grade	32.7	19.2	31.7	9.4	5.1	1.8	12241
12th grade	32.5	18.5	30.8	10.1	6.3	1.8	10843
Total	34.2	18.7	30.5	9.0	5.4	2.2	55998
Female							
Junior high school							
7th grade	30.9	21.8	32.5	7.8	5.4	1.6	6229
8th grade	29.4	19.4	34.2	9.2	6.2	1.6	6234
9th grade	28.2	16.1	35.9	10.5	8.1	1.2	6243
Senior high school							
10th grade	32.8	18.8	32.9	8.8	5.5	1.1	9580
11th grade	30.4	18.9	34.1	9.8	5.4	1.3	9289
12th grade	29.9	18.4	34.7	10.3	5.5	1.2	8878
Total	30.4	18.9	34.0	9.4	5.9	1.3	46453

*Data expressed as percentage of the analyzed subjects.

Table 2—Prevalence of Difficulty Maintaining Sleep Among Japanese Adolescents*

	Never	Seldom	Sometimes	Often	Always	Uncertain	N
Male							
Junior high school							
7th grade	38.5	20.0	28.5	6.1	3.5	3.4	6917
8th grade	40.3	18.0	28.1	6.6	4.0	3.0	6845
9th grade	42.5	17.7	26.9	7.0	3.6	2.2	6917
Senior high school							
10th grade	41.2	17.9	27.9	7.4	3.8	1.7	12235
11th grade	39.8	18.7	27.8	8.0	3.9	1.8	12241
12th grade	42.4	18.0	26.9	7.3	3.7	1.8	10843
Total	40.8	18.3	27.7	7.2	3.8	2.2	55998
Female							
Junior high school							
7th grade	38.0	20.1	30.1	6.4	3.8	1.6	6229
8th grade	37.7	19.9	30.5	6.7	3.8	1.5	6234
9th grade	41.1	17.8	28.5	7.2	4.2	1.1	6243
Senior high school							
10th grade	40.5	17.7	29.0	7.6	4.2	1.0	9580
11th grade	37.8	17.5	30.6	8.1	4.6	1.3	9289
12th grade	37.5	17.2	31.6	8.0	4.6	1.2	8878
Total	38.8	18.2	30.1	7.4	4.3	1.3	46453

*Data expressed as percentage of the analyzed subjects.

Table 3—Prevalence of Early Morning Awakening Among Japanese Adolescents*

	Never	Seldom	Sometimes	Often	Always	Uncertain	N
Male							
Junior high school							
7th grade	67.0	14.0	12.4	3.1	2.9	0.6	6917
8th grade	68.0	13.4	11.6	3.5	3.0	0.6	6845
9th grade	70.0	12.1	11.1	3.1	3.0	0.7	6917
Senior high school							
10th grade	68.5	14.0	10.9	3.6	2.4	0.5	12235
11th grade	68.2	14.7	11.3	3.2	2.1	0.5	12241
12th grade	69.5	14.0	10.8	3.1	2.1	0.6	10843
Total	68.6	13.9	11.3	3.3	2.5	0.6	55998
Female							
Junior high school							
7th grade	66.7	15.7	12.1	2.8	2.3	0.4	6229
8th grade	67.9	14.7	11.9	3.0	2.1	0.4	6234
9th grade	68.2	14.4	11.4	3.3	2.2	0.4	6243
Senior high school							
10th grade	67.6	14.9	12.0	3.4	1.8	0.4	9580
11th grade	66.0	16.2	12.2	3.3	1.9	0.4	9289
12th grade	66.4	15.4	12.6	3.3	1.9	0.4	8878
Total	67.0	15.3	12.1	3.2	2.0	0.4	46453

*Data expressed as percentage of the analyzed subjects.

significantly higher among males ($P < .01$).

The prevalence of insomnia in relation to sex and grade is shown in Table 4. The prevalence (and 95% CI) of insomnia was 23.5% (23.2%-23.8%) in the total sample: 23.3% (22.9%-23.7%) among males, and 23.7% (23.3%-24.1%) among females. No statistically significant difference was observed between males and females ($P = .47$). Among both males and females, the prevalence of DIS and insomnia increased gradually from the 7th to 9th grade, decreased in the 10th grade, and then gradually increased again toward the 12th grade.

Table 4—Prevalence of Insomnia Among Japanese Adolescents*

	Without insomnia	With insomnia	Uncertain	N
Male				
Junior high school				
7th grade	76.1	20.3	3.6	6917
8th grade	74.7	22.1	3.3	6845
9th grade	72.8	24.6	2.5	6917
Senior high school				
10th grade	74.5	23.5	2.0	12235
11th grade	74.3	23.7	2.0	12241
12th grade	73.4	24.6	2.1	10843
Total	74.3	23.3	2.4	55998
Female				
Junior high school				
7th grade	77.2	21.0	1.7	6229
8th grade	75.5	22.7	1.7	6234
9th grade	72.5	26.1	1.4	6243
Senior high school				
10th grade	75.7	23.0	1.2	9580
11th grade	74.0	24.5	1.5	9289
12th grade	73.9	24.7	1.4	8878
Total	74.8	23.7	1.5	46453

*Data expressed as percentage of the analyzed subjects.

Logistic Regression Analyses

The results of logistic regression analyses using the data for junior and senior high school students are shown in Tables 5 and 6, respectively. Four logistic models that use DIS, DMS, EMA, and insomnia as response variables were created. As covariates, 9 items that are shown in Tables 5 and 6 were used in common.

The adjusted odds ratios (AORs) for EMA and insomnia among male junior high school students and AORs for DIS, EMA, and insomnia among male senior high school students were significantly higher than among their female counterparts. With regard to EMA among junior and senior high school students, AORs were found to be significantly higher as grades became lower.

Among junior high school students, AOR for DIS was higher, and AOR for EMA was lower among students who intended to study at university than among those who did not. However, among senior high school students, AORs for all response variables were significantly lower among students who intended to study at university than among those who did not.

Among both junior and senior high school students, AORs for all response variables were significantly higher among those who had been evaluated as having poor mental health, those who skipped breakfast, those who drank alcohol, and those who smoked than among subjects who did not have these features. AORs for insomnia were significantly lower among those who participated in extracurricular activity than among those who did not.

Among both junior and senior high school students, AORs for DIS and insomnia were significantly higher among those whose bedtime was after 00:00 than among those whose bedtime was before or at 00:00. On the contrary, AORs for DMS were significantly low among senior high school students whose bedtime was after 00:00.

Table 5—Logistic Regression Results for Prediction of Insomnia and Symptoms of Insomnia Among Japanese Junior High School Students

	N	DIS			DMS			EMA			Insomnia		
		AOR	95%CI	P value	AOR	95%CI	P value	AOR	95%CI	P value	AOR	95%CI	P value
Sex				.69			.58			<.01			<.01
Male	20030	1.00			1.00			1.00			1.00		
Female	18401	1.01	0.95-1.08		0.93	0.87-1.00		0.71	0.65-0.78		0.91	0.86-0.96	
Junior high school				.55			.10			<.01			.72
7th grade	12788	1.00			1.00			1.00			1.00		
8th grade	12746	1.02	0.94-1.11		0.98	0.89-1.06		0.93	0.82-1.04		0.99	0.93-1.06	
9th grade	12897	1.05	0.96-1.14		0.91	0.83-0.99		0.79	0.70-0.90		0.97	0.91-1.04	
Intention to study at university				.02			.74			<.01			.50
No	33679	1.00			1.00			1.00			1.00		
Yes	4525	1.12	1.02-1.23		0.98	0.88-1.10		0.73	0.62-0.86		1.03	0.95-1.11	
Poor mental health (GHQ score ≥ 4)				<.01			<.01			<.01			<.01
No	22963	1.00			1.00			1.00			1.00		
Yes	14379	2.96	2.78-3.16		2.35	2.19-2.52		3.05	2.76-3.36		2.74	2.60-2.89	
Eating breakfast				<.01			<.01			<.01			<.01
Daily	31104	1.00			1.00			1.00			1.00		
Occasional	3668	1.43	1.30-1.57		1.47	1.33-1.63		1.58	1.38-1.81		1.48	1.37-1.61	
Never	2009	1.86	1.66-2.08		1.88	1.66-2.14		2.21	1.89-2.57		1.89	1.70-2.09	
Drinking alcohol				<.01			<.01			<.01			<.01
No	30416	1.00			1.00			1.00			1.00		
Yes	7771	1.39	1.30-1.50		1.34	1.23-1.46		1.46	1.31-1.63		1.39	1.30-1.48	
Smoking				<.01			<.01			<.01			<.01
No	36333	1.00			1.00			1.00			1.00		
Yes	1662	1.44	1.26-1.64		1.65	1.44-1.90		1.79	1.51-2.11		1.62	1.44-1.82	
Participating in extracurricular activities				<.01			<.01			<.01			<.01
No	7730	1.00			1.00			1.00			1.00		
Yes	30251	0.88	0.81-0.95		0.86	0.78-0.93		0.80	0.71-0.90		0.87	0.81-0.93	
Bedtime				<.01			.10			.06			<.01
Before or at 00:00	25786	1.00			1.00			1.00			1.00		
After 00:00	12454	1.83	1.71-1.95		1.07	0.99-1.15		1.11	1.00-1.23		1.41	1.33-1.50	

Abbreviations: DIS, difficulty initiating sleep; DMS, difficulty maintaining sleep; EMA, early morning awakening; AOR, adjusted odds ratio; CI, confidence interval; GHQ, general health questionnaire. Subjects with missing data were excluded from the analysis.

DISCUSSION

The results of this study appear to be representative of the study population for three reasons: (1) the subject schools were selected randomly from among those nationwide; (2) the number of analyzed cases exceeded 100,000; and (3) the rate of response to the questionnaires was acceptably high. Epidemiological studies of insomnia among adolescents have already been conducted in Western countries. However, to our knowledge, none of these previous studies involved such a large sample size or were as representative as our present study.

A uniform definition of insomnia was not followed in the previous epidemiological studies of adolescents. However, in many investigations, three insomnia symptoms – DIS, DMS, and EMA – were studied, and insomnia was evaluated and examined by using a combination of these symptoms.^{5-7,9-13} In this study, a subject was considered to have insomnia if he/she had experienced one or more of these three insomnia symptoms in the past month. This definition of insomnia was adopted when our questionnaire was compiled to allow comparison between our study and the previous studies that had targeted either the general adult population of Japan³ or Chinese adolescents.⁷ The prevalence of insomnia observed among the adolescents in our study (23.5%) appears to be similar to that observed among the general adult population of

Japan (21.4%). However, the prevalence of DIS, DMS, and EMS among the adolescents was 14.8%, 11.3%, and 5.5%, respectively, and differed from the values observed among the general adult population (8.3%, 15.0%, and 8.0%, respectively).³ Among all the insomnia symptoms, the prevalence of DIS was the highest among the adolescents, and was much higher than that observed among Japanese adults. Thus, DIS may be a form of sleep disturbance among Japanese adolescents that requires special attention. As it is known that the prevalence of DMS and EMA increases with age,^{3,26} the low prevalence of DMS and EMA in adolescents as compared to adults is not surprising. The prevalence of insomnia, DIS, DMS, and EMA among Chinese adolescents was reported to be 16.9%, 10.8%, 6.3%, and 2.1%, respectively⁷; thus the corresponding values for Japanese adolescents were higher.

We observed that the prevalence of both DIS and DMS was higher among females, whereas that of EMA was significantly higher among males. As a study conducted in 2000 targeting the general adult population of Japan revealed a similar result,²⁶ this may be a common characteristic feature among both Japanese adults and adolescents. Although there was no significant sex-based difference in the prevalence of insomnia, a significantly high AOR for insomnia among males was revealed by multivariate analysis. Some confounding factors may account for this observation; one of these may be mental health status. In this study,

Table 6—Logistic Regression Results for Prediction of Insomnia and Symptoms of Insomnia Among Japanese Senior High School Students

	N	DIS			DMS			EMA			Insomnia		
		AOR	95%CI	P value	AOR	95%CI	P value	AOR	95%CI	P value	AOR	95%CI	P value
Sex				.02			.15			<.01			.02
Male	34608	1.00			1.00			1.00			1.00		
Female	27371	0.95	0.90-0.99		1.04	0.99-1.10		0.90	0.84-0.97		0.95	0.91-0.99	
Senior high school				.32			.05			<.01			.21
10th grade	21458	1.00			1.00			1.00			1.00		
11th grade	21144	0.98	0.92-1.04		1.07	1.00-1.13		0.86	0.79-0.94		0.99	0.95-1.04	
12th grade	19377	0.95	0.90-1.01		0.99	0.93-1.06		0.83	0.75-0.91		0.96	0.91-1.01	
Intention to study at university				<.01			<.01			<.01			<.01
No	25224	1.00			1.00			1.00			1.00		
Yes	36561	0.77	0.73-0.81		0.76	0.72-0.80		0.72	0.67-0.78		0.75	0.72-0.78	
Poor mental health (GHQ score ≥4)				<.01			<.01			<.01			<.01
No	31802	1.00			1.00			1.00			1.00		
Yes	28963	2.68	2.55-2.82		2.13	2.02-2.25		2.47	2.28-2.67		2.41	2.31-2.51	
Eating breakfast				<.01			<.01			<.01			<.01
Daily	47268	1.00			1.00			1.00			1.00		
Occasional	6788	1.40	1.30-1.50		1.34	1.24-1.45		1.38	1.24-1.53		1.38	1.30-1.46	
Never	5001	1.79	1.66-1.93		1.66	1.53-1.80		1.80	1.61-2.01		1.75	1.64-1.87	
Drinking alcohol				<.01			<.01			<.01			<.01
No	39854	1.00			1.00			1.00			1.00		
Yes	21869	1.20	1.14-1.26		1.20	1.13-1.27		1.21	1.12-1.31		1.22	1.17-1.27	
Smoking				<.01			<.01			<.01			<.01
No	53577	1.00			1.00			1.00			1.00		
Yes	7721	1.46	1.36-1.56		1.41	1.30-1.52		1.57	1.41-1.74		1.48	1.39-1.57	
Participating in extracurricular activities				<.01			.17			.07			<.01
No	25120	1.00			1.00			1.00			1.00		
Yes	36586	0.83	0.79-0.87		0.96	0.91-1.02		0.93	0.86-1.01		0.90	0.86-0.93	
Bedtime				<.01			<.01			.06			<.01
Before or at 00:00	26681	1.00			1.00			1.00			1.00		
After 00:00	35168	1.81	1.72-1.91		0.81	0.76-0.85		0.93	0.86-1.00		1.17	1.12-1.22	

Abbreviations: DIS, difficulty initiating sleep; DMS, difficulty maintaining sleep; EMA, early morning awakening; AOR, adjusted odds ratio; CI, confidence interval; GHQ general health questionnaire. Subjects with missing data were excluded from the analysis.

GHQ scores were used as covariates to evaluate mental health status. GHQ scores tended to be higher among female than among male participants. In addition, participants whose GHQ scores were higher tended to have insomnia symptoms. Therefore, if an analysis is conducted without adjusting for GHQ scores, any association between males and the prevalence of insomnia may not be conspicuous. In a previous survey we conducted on sleep disturbances among Japanese adolescents,⁸ we did not place sufficient emphasis on mental health status; therefore, females were observed to be at higher risk of all forms of sleep disturbance that were examined. However, as revealed in the present study, if an analysis is conducted with adjustment for GHQ scores, males appear to have a significantly higher risk of insomnia than females.

In this study, when insomnia was used as a response variable, no significant association was recognized between insomnia and school grade. However, when each insomnia symptom was used as a response variable, interesting results were obtained. AOR for EMA among both junior and senior high school students decreased as the grade advanced. Few studies have reported the associations between each insomnia symptom and the school grade or age of adolescents. Among Chinese adolescents, the prevalence of DIS and EMA was reported to increase with age.⁷ This was not consistent with our findings. The social factors affecting students may differ according to school grade, however specifying the social

factors that affect students is beyond the scope of this study. In any event, it must be recognized that students of different grades have different levels of risk for symptoms of insomnia. Further studies of this issue are required in the future.

This study recognized a strong association between poor mental health status and insomnia, and all insomnia symptoms, among both junior and senior high school students. In Japan, Tagaya et al. reported in a community study targeting senior high school students that an association was recognized between short sleep duration and poor mental health.²⁷ Also, many studies overseas reported that an association was observed between adolescents' mental health status and sleep disturbance.^{4,9,12,28-33} The present study supports the findings of the previous ones, and is also meaningful for two reasons: (1) we used the GHQ, which is employed worldwide, for evaluation of mental health status, and (2) representative samples were selected. Our findings further suggest the importance of mental health care for adolescents in the context of sleep hygiene.

Many studies conducted in Japan and overseas have reported associations between various sleep disorders and smoking cigarettes or drinking alcohol among adolescents.^{7,8,11,12,30,32,34} Only two studies, however, have investigated the association of insomnia with these two factors.^{7,12} In our study, smoking and drinking alcohol were considered to be independent risk factors for insom-

nia and all symptoms of insomnia among both junior and senior high school students. It is known that although alcohol promotes sleepiness immediately after its consumption, its hypnotic effect persists for only a short time, and that it disturbs the later part of sleep at night.³⁵ Furthermore, Wetter et al. in an epidemiological study that targeted 3,516 adults reported an association between smoking and sleep disturbance.³⁶ They inferred that sleep disturbances were due to the stimulant effects of nicotine, followed by withdrawal of nicotine at night, although they stated that a specific causal relationship was not proven. Such pharmacodynamics of alcohol or nicotine may affect sleep patterns among Japanese adolescents.

Associations between various sleep disorders and skipping breakfast have been reported among Japanese adolescents.^{8,37} Arakawa et al. in a study of 3,754 junior high school students indicated that the percentage of students who skipped breakfast was significantly high among students who went to sleep at 00:00 or later.³⁷ They also warned against the increase in active night life culture in Japanese society. In a previous study, we observed associations between: (1) DIS, short sleep duration, subjective sleep insufficiency, and excessive daytime sleepiness; and (2) skipping breakfast.⁸ In the present study, an association was newly recognized between insomnia and skipping breakfast. These findings indicate the need for future health education regarding eating habits of adolescents in Japan.

Among senior high school students who intended to study at university, we observed a significantly decreased AOR for insomnia. It is suggested that senior high school students who study for university entrance examinations rarely suffer from insomnia. Participating in extracurricular activities significantly decreased the AORs for insomnia among both junior and senior high school students. The risk of insomnia onset was high among those who did not intend to enter university, did not participate in extracurricular activities, or both. In the future, measures should be taken to improve sleep patterns in these groups.

In the present study, AORs for DIS and insomnia were significantly higher among those whose bedtime was after 00:00. As this study was a cross-sectional survey, a causal relationship cannot be discussed. However, it can be assumed that DIS leads to late bedtime. Among previous studies on sleep among adolescents, some included insomnia symptoms and bedtime as survey items,^{5,7} but none of them scrutinized possible associations between each insomnia symptom and bedtime. In the present study, associations between each insomnia symptom and bedtime were clarified, by entering bedtime as a covariate in the logistic model. This method of analysis also helped us to distinguish delayed sleep phase syndrome from insomnia when we translated the results of the study. We expect that this method of analysis will be used in future epidemiological studies on sleep.

There were some limitations in our study. First, since this was a cross-sectional survey, a causal relationship could not be determined. When examining a causal relationship, a longitudinal study such as a cohort study is required, and such a study will be required in the future. Second, physiologic measurements such as electroencephalography could not be employed to obtain objective data for evaluation of sleep habits; such measurements, although desirable, are not normally included in epidemiological studies because such studies involve many subjects. Furthermore, several reports have stated that self-reported data on sleep status were consistent with the physiologic data to a certain degree.^{38,39}

Third, in the present study, questions concerning underlying sleep disorders were not posed in the questionnaire. Because insomnia symptoms may be caused by underlying sleep disorders, questions concerning underlying sleep disorders must be posed in the questionnaires of future studies. Fourth, the questions included in our questionnaire did not include all the factors that might affect sleep. For example, noise levels at night, the person/s with whom a subject sleeps, and commuting time to school are factors that could affect a subject's sleep. However, we could not include them in the questionnaire because of space limitations. These items must be examined in future. Fifth, there may have been a nonresponse bias. The rate of response to the questionnaire in this study was 64.8%; therefore, approximately 35% of the subjects did not participate in the survey. In Japan, people below 20 years of age are prohibited by law from smoking and drinking alcohol. Therefore, schools and individual students tend to be noncooperative in responding to a survey that includes questions on smoking and drinking alcohol. This may be the main reason for the nonresponsiveness. However, there is a possibility that the effect of the non-response bias on the results of our analysis is present.

In conclusion, this study revealed that the prevalence of insomnia among Japanese adolescents was similar to that among the general adult population of Japan. However, the prevalence of DIS, in comparison with the other symptoms of insomnia, was conspicuously high. The positive factors associated with insomnia among the junior high school students were male sex, poor mental health, skipping breakfast, drinking alcohol, smoking, and not participating in extracurricular activities. Positive factors in the senior high school students, besides the above-mentioned factors, was having no intention to enter university. The results of this study suggest that education on sleep hygiene must be promoted among Japanese adolescents.

ACKNOWLEDGMENTS

We wish to express our thanks to Ms. Hiromi Sekine (Department of Public Health, School of Medicine, Nihon University) for her help in this study, and to Professor Makoto Uchiyama M.D. (Department of Neuropsychiatry, School of Medicine, Nihon University) for his very helpful suggestions.

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ABBREVIATIONS

- CI, confidence interval
 DIS, difficulty initiating sleep
 DMS, difficulty maintaining sleep
 EMA, early morning awakening
 AOR, adjusted odds ratio

How much do high school students decide the cigarette price to prevent smoking in Japan?

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Abstract

OBJECTIVES: Most of the prices of 20 cigarettes in one box are around 3.⁰⁰ US dollars in Japan. The current study was clarified the cigarette prices which high school students thought to prevent smoking and teen smokers gave up smoking.

METHOD: This study was based on a cross-sectional self-reported anonymous national-wide data from 168 high schools in the 2007 National Smoking Survey among Japanese high school students. Of the 90,361 students who sent back the questionnaires, 90,039 students were eligible to analyze in this study, except 322 students didn't have the complete data needed for the analysis.

RESULTS: The prices that adolescents thought to prevent smoking were over 10.⁰⁰ US

dollars among 60% of students in each boys and girls. The most of students thought the cigarette prices to quit smoking in teen smokers were around 15.⁰⁰ US dollars despite of current smokers or not.

CONCLUSIONS: We found that high school students thought the cigarette price over 10.⁰⁰ US dollars to prevent smoking, around 15.⁰⁰ US dollars to quit smoking. Compared with US, the price of cigarette box is cheaper in Japan. The low cigarette price may lead Japanese adolescents to access smoking more easily. The raise of the cigarette price is necessary to prevent and quit smoking among high school students.

Key Words: Cigarette price, High school students, Japan

