Association Between Mental Health Status and Sleep Status Among Adolescents in Japan: A Nationwide Cross-Sectional Survey

Yoshitaka Kaneita, M.D.; Takashi Ohida, M.D.; Yoneatsu Osaki, M.D.; Takeo Tanihata, M.D.; Masumi Minowa, M.D.; Kenji Suzuki, M.D.; Kiyoshi Wada, M.D.; Hideyuki Kanda, M.D.; and Kenji Hayashi, M.D.

Objective: Previous epidemiological studies on relationships between mental health status and sleep status of adolescents have not been sufficiently representative. In the present study, using samples representative of Japanese adolescents nationwide, associations between mental health status and various sleep statuses were examined.

Method: The survey was conducted in December 2004 and January 2005 among students enrolled in randomly selected junior and senior high schools throughout Japan, using self-administered questionnaires that addressed lifestyle, sleep status, mental health status, and personal data. Of 103,650 questionnaires collected, 99,668 were analyzed. Sleep status was assessed according to sleep duration, subjective sleep assessment, bedtime, and insomnia symptoms. The Japanese version of the 12-item General Health Questionnaire was employed for assessment of mental health status.

Results: Mental health status of subjects whose sleep duration was less than 7 hours, and those who slept 9 hours or more, was poorer than that of subjects who slept for 7 hours or more but less than 9 hours. A U-shaped association was observed between mental health status and sleep duration. Furthermore, a linear association was observed between subjective sleep assessment and mental health status; the worse the subjective sleep assessment, the poorer the mental health status. Mental health status was also inversely proportional to the frequency of insomnia symptoms.

Conclusion: The fact that sleep duration and subjective sleep assessment showed different patterns of association with mental health status indicates that these 2 sleep parameters have independent significance. Considering these associations, it is important to promote mental health care and sleep hygiene education for adolescents.

(J Clin Psychiatry 2007;68:1426–1435)

Received Oct. 10, 2006; accepted Feb. 9, 2007. *From the Department of Public Health, School of Medicine, Nihon University, Tokyo, Japan (Drs. Kaneita and Ohida); the Division of Environmental and Preventive Medicine, Department of Social Medicine, Faculty of Medicine, Tottori University, Yonago, Japan (Dr. Osaki); the Department of Epidemiology, National Institute of Public Health, Wako, Japan (Dr. Tanihata); the Faculty of Humanities, Seitoku University, Matsudo, Japan (Dr. Minowa); the Section on Behavioral Science, Division of Clinical Research, National Hospital Organization, Kurihama Alcoholism Center, Yokosuka, Japan (Dr. Suzuki); the Department of Drug Dependence Research, National Institute of Mental Health, National Center of Neurology and Psychiatry, Kodaira, Japan (Dr. Wada); the Department of Hygiene and Preventive Medicine, Fukushima Medical University, Fukushima, Japan (Dr. Kanda); and the Vice President, National Institute of Public Health, Wako, Japan (Dr. Hayashi).*

This study was supported by a Health Science Research Grant from the Ministry of Health, Labor and Welfare of the Japanese Government (#H16-KENKO-024) to Dr. Hayashi.

The authors thank Professor Makoto Uchiyama, M.D., (Department of Neuropsychiatry, School of Medicine, Nihon University) for his very helpful suggestions. Dr. Uchiyama has no conflicts of interest to disclose.

The authors report no financial affiliations or other relationships relevant to the subject of this article.

Corresponding author and reprints: Yoshitaka Kaneita, M.D., Department of Public Health, School of Medicine, Nihon University, 30-1, Ohyaguchikami-machi, Itabashi-ku, Tokyo 173-8610, Japan (e-mail: kaneita@med.nihon-u.ac.jp).

As physical, mental, and social development occur during adolescence, the sleep habits of adolescents tend to change easily. Sleep disturbance is not a rare complaint among adolescents living in developed countries. Previous studies of sleep disturbance among adolescents have estimated that the prevalence of sleep disturbance ranges from approximately 5% to 40%.[1–8] In Japan, a representative epidemiological study on sleep disturbance among adolescents was conducted for the first time in 2000. According to this study, the prevalence of difficulty initiating sleep was 16% and that of subjective sleep insufficiency was 39%.[9]

One of the important factors associated with sleep disturbance among adolescents is mental health status. Many cross-sectional epidemiological studies have shown a close relationship between sleep disturbance and mental health status. The first report to demonstrate that symptoms such as anxiety and depression were associated with subjective poor sleep among adolescents was published in the United States in 1976.[1] Thereafter, similar findings were reported in New Zealand,[3] Italy,[5] China,[7] and France.[8]

  © COPYRIGHT 2007 PHYSICIANS POSTGRADUATE PRESS, INC

However, previous studies that examined associations between mental health status and sleep disturbance had several limitations. First, few of them analyzed sleep status from diverse perspectives, by adding items such as sleep duration and subjective sleep assessment. Second, for assessment of mental health status, few studies used methods whose validity and reliability had been established. Third, many previous studies used specific groups of people as samples, which made them less representative. Fourth, the numbers of subjects in previous studies were comparatively small. To overcome these limitations, the present study targeted about 100,000 representative adolescents throughout Japan, and their mental health status was assessed using a questionnaire that is widely employed worldwide. Associations between their mental health status and sleep status were then examined. The primary purpose of this study was to clarify the prevalence of poor mental health and that of sleep disturbance. The second was to analyze associations between poor mental health and sleep status in detail, and the third was to clarify factors other than sleep status that might be associated with poor mental health.

METHOD

Subjects and Sampling

We have previously conducted 2 cross-sectional nationwide surveys (1996 and 2000) on lifestyle habits such as alcohol drinking, smoking, eating, and sleeping among Japanese adolescents.[9–11] The present study was the third such survey.

For this study, of the 11,060 junior high schools and 4627 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 the students enrolled in the sampled schools were the subjects of this study. The sample size was determined by referring to the response rates and CIs based on variance of results, which were obtained from the 2 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 a further 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 each school that agreed to participate in our survey, each class teacher distributed the questionnaires among the students. To protect the privacy of respondents and to obtain as candid a response as possible from each, 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. Delivery and collection 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, (3) mental health status, and (4) personal data.

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). The 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 the student was defined as "smoking." Similarly, the 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 the student was defined as "drinking alcohol."

Sleep status was addressed by the following questions about (a) sleep duration, (b) subjective sleep assessment, (c) time of going to bed, (d) difficulty initiating sleep, (e) difficulty maintaining sleep, and (f) early morning awakening experienced during the previous month were embedded in the questionnaire: the choices are indicated in parentheses.

(a) How many hours on average do you sleep at night? (Less than 5 hours/5 hours or more but less than 6 hours/6 hours or more but less than 7 hours/7 hours or more but less than 8 hours/8 hours or more but less than 9 hours/9 hours or more).

(b) How do you assess the quality of your sleep? (Very good/good/bad/very bad).

(c) What time is your bedtime on average? (Before 10 p.m./10 p.m. or after but before 11 p.m./11 p.m. or after but before midnight/midnight or after but before 1 a.m./1 a.m. or after but before 2 a.m./2 a.m. or after).

(d) Do you have difficulty falling asleep at night? (Never/seldom/sometimes/often/always).

(e) Do you wake up during the night after you have gone to sleep? (Never/seldom/sometimes/often/always).

(f) Do you wake up too early in the morning and have difficulty getting back to sleep? (Never/seldom/sometimes/often/always).

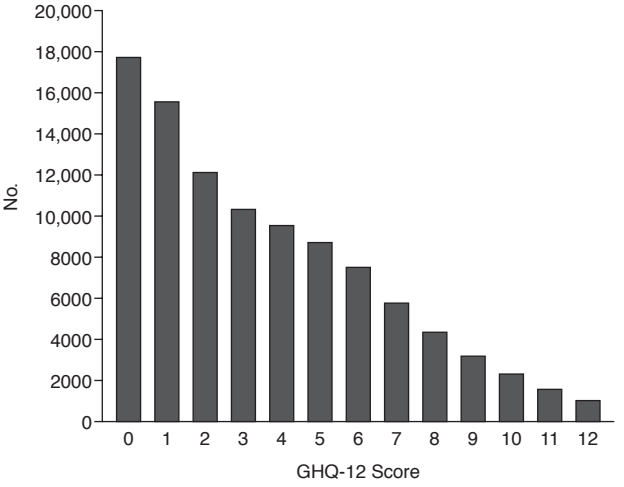
The demographic variables derived from personal data were sex, grade, type of school (junior high school/senior high school), and intention to study at university (yes/no).

The Japanese version of the 12-item General Health Questionnaire (GHQ-12) was used to evaluate mental health status.[12,13] The GHQ-12 is a widely used, self-administered questionnaire that was designed as a screening tool for mental illness. It assesses 12 symptoms of psychiatric disorders that have been experienced during the previous month. Every item on the GHQ-12 describes a symptom and has 4 possible replies: the 2 answers that indicate the absence of the symptom are given a score of 0, and the 2 that indicate the presence of the symptom receive a score of 1. The overall score on the scale will thus fall into a range of 0 to 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 was used and validated for adolescents as well.[14–16] In the present study, any participant whose total GHQ-12 score was 4 points or more was considered to be a person with poor mental health, an assessment consistent with most previous studies.[16–18]

Statistical Analyses

For statistical analysis, the internal consistency of the GHQ-12 was first studied, and then the GHQ-12 scores were summed. The prevalence of poor mental health, which was defined as having a GHQ-12 score of 4 or higher, and the mean value and standard deviation of the GHQ-12 scores, were then calculated according to sex and grade. Similarly, the associations between mental health status and sleep status were examined. The significance of categorical data, such as the prevalence of poor mental health, was analyzed using the χ^2 test, and the significance of the raw data of the GHQ-12 was calculated using the Kruskal-Wallis test. Finally, a logistic regression analysis was conducted to investigate factors associated with poor mental health. Sex, grade, subjective sleep assessment, sleep duration, bedtime, difficulty initiating sleep, difficulty maintaining sleep, early morning awakening, eating breakfast, drinking more than once a month, smoking more than once a month, participating in extracurricular activities, and intention of studying at university were used as covariates in this analysis. Odds ratios (ORs) and 95% CIs were calculated from both the univariate analysis and the multivariate logistic regression analysis.

Figure 1. Distribution of GHQ-12 Scores in a Sample of Japanese Adolescents[a]



[a]The number of subjects for each score decreases stepwise as the score increases, with a peak number of subjects scoring zero.
Abbreviation: GHQ-12 = 12-item General Health Questionnaire.

Table 1. Prevalence of Poor Mental Health and Mean (SD) 12-Item General Health Questionnaire (GHQ-12) Score by Sex and School Grade (N = 99,668)

Population	N	Prevalence of GHQ-12 Score ≥ 4 (%)	95% CI	GHQ-12 Score	
				Mean	SD
Overall	99,668	44.0	43.7 to 44.3	3.54	3.04
Boys					
Grade 7	6661	28.6	27.5 to 29.7	2.52	2.67
Grade 8	6599	31.9	30.8 to 33.1	2.78	2.82
Grade 9	6685	37.7	36.5 to 38.9	3.13	2.93
Grade 10	11,918	41.5	40.7 to 42.4	3.44	3.07
Grade 11	11,931	42.1	41.2 to 43.0	3.42	3.02
Grade 12	10,561	44.7	43.8 to 45.6	3.60	3.12
Total	54,355	39.1	38.7 to 39.5	3.23	3.00
Girls					
Grade 7	6009	40.9	39.6 to 42.1	3.30	2.92
Grade 8	6055	44.0	42.7 to 45.2	3.55	3.05
Grade 9	6081	48.5	47.3 to 49.8	3.85	3.03
Grade 10	9364	51.7	50.7 to 52.7	4.04	3.06
Grade 11	9103	54.5	53.5 to 55.6	4.19	3.07
Grade 12	8701	54.8	53.8 to 55.9	4.21	3.06
Total	45,313	50.0	49.5 to 50.4	3.91	3.06

The GHQ-12 contains 1 item on sleep. Therefore, when an association between mental health status and sleep status is analyzed using GHQ-12 scores, a stronger association than the actual one may result. To adjust for this possibility, the scores for the 11 items, excluding the sleep item, were calculated, and any person with a total score of 4 or higher was defined as being in poor mental health. Then the statistical analyses mentioned above were performed again. All analyses were performed using SPSS version 11.5 for Windows (SPSS, Inc., Chicago, Ill.).

Table 2. Prevalence of Poor Mental Health and Mean (SD) 12-Item General Health Questionnaire (GHQ-12) Score by Sleep Status (N = 99,668)[a]

Sleep Status	N	Prevalence of GHQ-12 Score ≥ 4 (%)	95% CI	p Value[b]	GHQ-12 Score		
					Mean	SD	p Value[c]
Subjective sleep assessment				< .001			< .001
Very good	14,867	27.4	26.7 to 28.1		2.37	2.63	
Good	44,277	36.6	36.1 to 37.0		2.98	2.72	
Bad	32,923	57.1	56.6 to 57.7		4.46	3.11	
Very bad	5596	72.0	70.9 to 73.2		5.88	3.43	
Sleep duration, h				< .001			< .001
< 5	14,757	58.3	57.5 to 59.1		4.59	3.38	
≥ 5, < 6	17,563	50.9	50.2 to 51.7		4.00	3.03	
≥ 6, < 7	40,030	42.2	41.7 to 42.7		3.40	2.92	
≥ 7, < 8	15,151	33.7	33.0 to 34.5		2.82	2.76	
≥ 8, < 9	7416	33.2	32.1 to 34.2		2.80	2.78	
≥ 9	3002	40.8	39.0 to 42.5		3.43	3.27	
Bedtime				< .001			< .001
Before 10 p.m.	4332	32.2	30.8 to 33.5		2.68	3.02	
10 p.m.–11 p.m.	12,044	33.1	32.2 to 33.9		2.79	2.75	
11 p.m.–midnight	34,925	40.3	39.7 to 40.8		3.26	2.91	
Midnight–1 a.m.	23,870	47.2	46.6 to 47.8		3.75	3.01	
1 a.m.–2 a.m.	14,345	52.3	51.5 to 53.1		4.11	3.11	
After 2 a.m.	8490	59.5	58.5 to 60.6		4.78	3.37	
Difficulty initiating sleep				< .001			< .001
Never	32,484	31.5	31.0 to 32.0		2.65	2.66	
Seldom	18,797	36.3	35.6 to 37.0		2.96	2.70	
Sometimes	32,015	50.9	50.4 to 51.5		3.98	3.02	
Often	9169	62.6	61.6 to 63.6		4.90	3.20	
Always	5633	74.7	73.5 to 75.8		6.12	3.40	
Difficulty maintaining sleep				< .001			< .001
Never	39,909	36.5	36.0 to 37.0		2.98	2.81	
Seldom	18,277	39.6	38.9 to 40.3		3.22	2.88	
Sometimes	28,728	50.4	49.8 to 51.0		3.97	3.07	
Often	7278	58.6	57.5 to 59.8		4.65	3.21	
Always	3980	69.9	68.4 to 71.3		5.81	3.52	
Early morning awakening				< .001			< .001
Never	68,057	39.2	38.8 to 39.6		3.17	2.87	
Seldom	14,488	47.2	46.4 to 48.0		3.73	3.00	
Sometimes	11,591	57.3	56.4 to 58.2		4.54	3.22	
Often	3224	64.5	62.9 to 66.2		5.15	3.34	
Always	2243	72.0	70.1 to 73.8		6.10	3.62	

[a]In each section, the missing data have been excluded from the statistical analyses.
[b]χ^2 test.
[c]Kruskal-Wallis test.

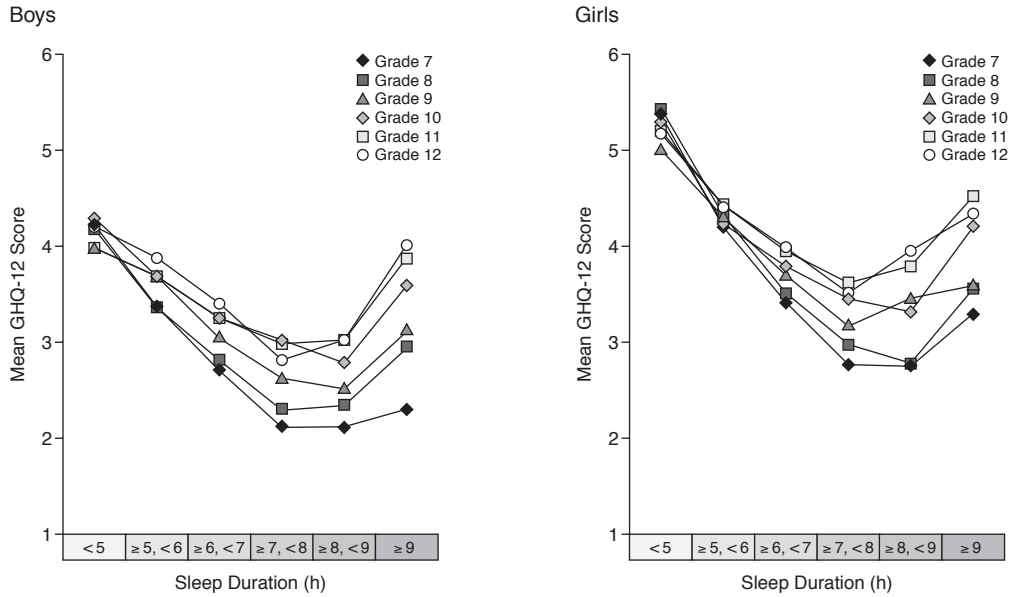
RESULTS

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 students enrolled at the sampled schools was 88.4% for the junior high schools, 86.3% for the senior high schools, and 87.1% as a whole. Accordingly, the overall response rate was 60.7% for the junior high schools, 67.7% for the senior high schools, and 64.8% as a whole. Of the collected questionnaires, 3982 were excluded because the sex or grade was not specified or the answers for the GHQ-12 were incomplete. The data for the remaining 99,668 questionnaires were analyzed.

The GHQ-12 showed good internal consistency. Cronbach α of the GHQ-12 for the whole sample was 0.833 (0.837 for males, 0.822 for females). The distribution of GHQ-12 scores is shown in Figure 1. The number of subjects with each score decreased stepwise as the score increased, with a peak number of subjects scoring zero.

The prevalence and its 95% CI for those whose GHQ-12 scores were 4 or higher (poor mental health) and the mean value and standard deviation of GHQ-12 scores, by sex and school grade, are shown in Table 1. The prevalence of poor mental health (95% CI) among the total cases analyzed was 44.0% (43.7% to 44.3%), that among boys was 39.1% (38.7% to 39.5%), and that among girls was 50.0% (49.5% to 50.4%); thus, the prevalence among girls was significantly higher than that among boys. Among both boys and girls, the prevalence of poor mental health increased as the school grade advanced.

Figure 2. Relationship Between Sleep Duration and Mean GHQ-12 Scores by Sex and School Grade[a]



[a]For all school grades, a U-shaped association was observed between sleep duration and GHQ-12 score.
Abbreviation: GHQ-12 = 12-item General Health Questionnaire.

The prevalence of poor mental health and its 95% CI and the mean value and SD of GHQ-12 scores for the answers to each question on sleep status are shown in Table 2. The prevalence of poor mental health decreased with longer sleep duration when subjects slept between 5 and 9 hours. However, it increased when sleep duration was 9 hours or longer. The prevalence of poor mental health also increased as results of subjective sleep assessment went from good to bad or as bedtime became later. The prevalence of poor mental health also increased with higher frequency of experiencing difficulty initiating sleep, difficulty maintaining sleep, and early morning awakening.

The association between sleep duration and the mean GHQ-12 score, by sex and school grade, is shown in Figure 2. U-shaped associations were observed among both boys and girls in every school grade. Compared with 7th and 8th grade students, the inclination of the mean GHQ-12 score for 11th and 12th grade students was steeper when the sleep duration was 8 hours or longer.

The association between subjective sleep assessment and the mean GHQ-12 score by sex and school grade is shown in Figure 3. Linear associations were observed among both boys and girls in every school grade.

The results of logistic regression analyses are shown in Table 3. Significant associations were indicated between all items input as covariates and poor mental health. The results of multivariate logistic regression analyses showed a U-shaped association between sleep duration and poor mental health. The lowest adjusted OR was indicated for a sleep duration of "7 hours or more but less than 8 hours," and higher adjusted ORs were indicated for sleep durations of less than 7 hours and 9 hours or more. In the multivariate logistic analyses for every school grade, the adjusted ORs with regard to poor mental health did not show a statistically significant difference between "7 hours or more but less than 8 hours" and "8 hours or more but less than 9 hours." A linear association was observed between the adjusted OR for poor mental health and subjective sleep assessment. The adjusted OR for poor mental health became higher as the results of subjective sleep assessment went from good to bad.

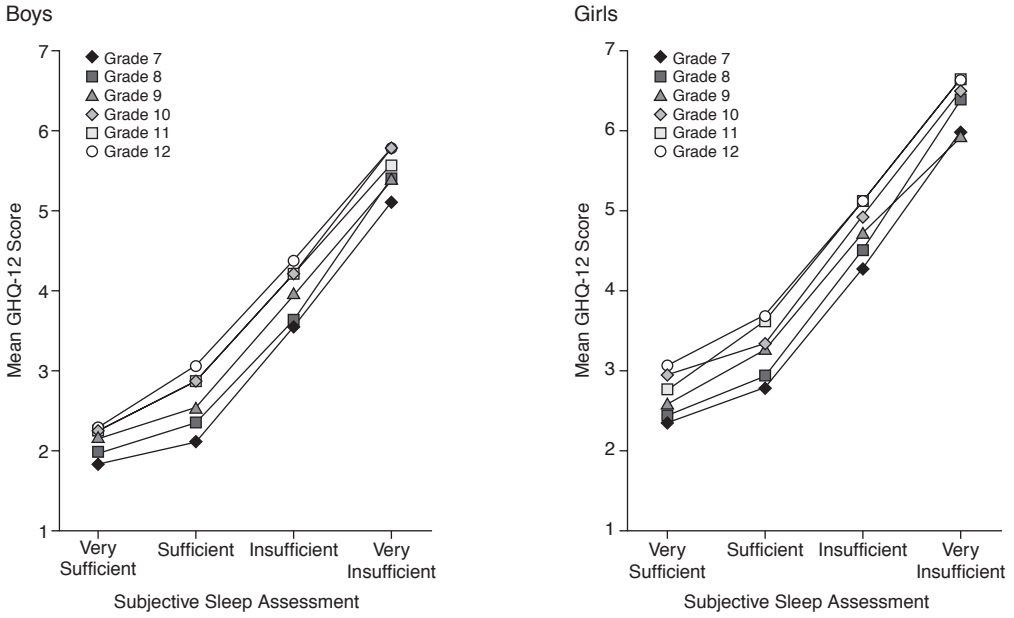
The total scores for the 11 items, after excluding the sleep item from the GHQ-12, were calculated, and any person whose total score was 4 or higher was defined as being in poor mental health. Then the statistical analyses were performed again. The results showed the same associations between mental health status and sleep status as those mentioned above.

DISCUSSION

The present study had a large representative sample because (1) it included subjects who were selected randomly on a nationwide basis; (2) the number of analyzed cases, about 100,000, was large; and (3) the questionnaire collection rate was acceptably high.

In this study, subjects whose GHQ-12 scores were 4 or higher were defined as being in poor mental health. High scores on the GHQ-12 are not diagnostic of specific psychiatric disorders but are possible indicators of poor

Figure 3. Relationship Between Subjective Sleep Assessment and Mean GHQ-12 Scores by Sex and School Grade[a]



[a]For all school grades, a linear and unidirectional association was observed between subjective sleep assessment and GHQ-12 score.
Abbreviation: GHQ-12 = 12-item General Health Questionnaire.

mental health. Three distinctive findings were obtained regarding the prevalence of poor mental health in this population. First, the prevalence of poor mental health was significantly higher among girls, at 50.0%, compared with 39.1% among boys. When compared by school grade, the prevalence among girls was significantly higher than that among boys in all grades. Higher GHQ-12 scores among girls than among boys have been observed among adolescents in Canada,[15] Italy,[19] Greece,[20] and Turkey.[20] When assessed by methods other than the GHQ-12, a higher prevalence of poor mental health among girls than among boys has been reported in countries such as the United States,[21] Australia,[22] and Finland.[23] Therefore, a higher prevalence of poor mental health among Japanese girls is not exceptional and reflects a commonly observed phenomenon in developed countries.

Second, the prevalence of poor mental health increased with advancing school grade, among both boys and girls. In a study of 9863 adolescents in the United States, Saluja et al.[21] reported that the prevalence of depression increased with age, and this was also the case in our present study population.

Third, the prevalence of poor mental health among adolescents was higher than that among adults. Several studies have already reported the mental health status of Japanese adults, as assessed using the GHQ-12.[13,17] In a study of 1343 Japanese adults aged 40 to 69 years, Fuchino et al. reported that the prevalence of those whose GHQ-12 scores were 4 or higher was 21.6% among men and 23.8% among women.[17] In the present study, the prevalence among adolescents was markedly higher than that reported for adults. This finding suggests that the mental health care of adolescents, who are in an important stage of mental development, is a vital social issue.

In the present study, the mental health status of subjects whose sleep duration was 9 hours or longer, as well as those whose sleep duration was less than 7 hours, was recognized to be poorer than that of subjects whose sleep duration was 7 hours or more but less than 9 hours. A U-shaped association was observed between sleep duration and GHQ-12 score. On the other hand, a linear proportional association was observed between subjective sleep assessment and GHQ-12 score. GHQ-12 scores increased as results of subjective sleep assessment went from good to bad. As to the association between mental health status and sleep duration and that between mental health status and subjective sleep assessment, a common pattern was observed in all school grades. The results of stratified analysis by sex also demonstrated a common pattern for each. These findings suggest that a U-shaped association between sleep duration and mental health status and a linear association between subjective sleep assessment and mental health status are universal associations, regardless of sex or school grade. In a recent study of more than 24,000 Japanese adults from the

Table 3 Logistic Regression Results: Variables Predicting Poor Mental Health in a Sample of Japanese Adolescents (N = 99,668)[a,b,c]

Variable	N	Crude OR	95% CI	p Value	Adjusted OR	95% CI	p Value
Sex				< .01			< .01
Male	54,355	1.00			1.00		
Female	45,313	1.56	1.52 to 1.60		1.63	1.59 to 1.68	
Grade				< .01			< .01
7	12,670	1.00			1.00		
8	12,654	1.15	1.10 to 1.21		1.08	1.02 to 1.14	
9	12,766	1.43	1.36 to 1.50		1.23	1.16 to 1.30	
10	21,282	1.62	1.55 to 1.70		1.38	1.30 to 1.46	
11	21,034	1.72	1.64 to 1.80		1.47	1.39 to 1.55	
12	19,262	1.85	1.77 to 1.94		1.54	1.45 to 1.63	
Subjective sleep assessment				< .01			< .01
Very good	14,867	1.00			1.00		
Good	44,277	1.53	1.47 to 1.59		1.41	1.35 to 1.48	
Bad	32,923	3.53	3.39 to 3.69		2.75	2.62 to 2.89	
Very bad	5596	6.83	6.38 to 7.31		4.41	4.07 to 4.78	
Sleep duration, h				< .01			< .01
< 5	14,757	2.74	2.62 to 2.87		1.35	1.27 to 1.44	
≥ 5, < 6	17,563	2.04	1.95 to 2.13		1.21	1.15 to 1.28	
≥ 6, < 7	40,030	1.43	1.38 to 1.49		1.13	1.08 to 1.18	
≥ 7, < 8	15,151	1.00			1.00		
≥ 8, < 9	7416	0.97	0.92 to 1.03		1.03	0.96 to 1.10	
≥ 9	3002	1.35	1.25 to 1.46		1.26	1.15 to 1.39	
Bedtime				< .01			.01
Before 10 p.m.	4332	1.00			1.00		
10 p.m.–11 p.m.	12,044	1.04	0.97 to 1.12		0.97	0.89 to 1.06	
11 p.m.–midnight	34,925	1.42	1.33 to 1.52		0.98	0.91 to 1.07	
Midnight–1 a.m.	23,870	1.89	1.76 to 2.02		0.96	0.89 to 1.05	
1 a.m.–2 a.m.	14,345	2.32	2.16 to 2.49		0.95	0.87 to 1.03	
After 2 a.m.	8490	3.10	2.87 to 3.35		0.86	0.78 to 0.95	
Difficulty initiating sleep				< .01			< .01
Never/seldom/sometimes	83,296	1.00	2.96 to 3.19	< .01	1.00	1.79 to 1.95	< .01
Often/always	14,802	3.07			1.86		
Difficulty maintaining sleep							
Never/seldom/sometimes	86,914	1.00	2.24 to 2.43	< .01	1.00	1.46 to 1.60	< .01
Often/always	11,258	2.34			1.53		
Early morning awakening							
Never/seldom/sometimes	94,136	1.00	2.64 to 2.97	< .01	1.00	1.64 to 1.88	< .01
Often/always	5467	2.80			1.76		
Eating breakfast							
Daily	76,860	1.00			1.00		
Occasionally	10,219	1.38	1.33 to 1.44		1.08	1.03 to 1.13	
Never	6822	1.64	1.56 to 1.72		1.08	1.03 to 1.15	
Drinking more than once a month				< .01			< .01
No	69,775	1.00			1.00		
Yes	29,412	1.34	1.30 to 1.37		1.07	1.03 to 1.10	
Smoking more than once a month				< .01			< .01
No	89,301	1.00			1.00		
Yes	9276	1.54	1.47 to 1.61		1.16	1.10 to 1.22	
Participating in extracurricular activities				< .01			< .01
No	32,204	1.00			1.00		
Yes	65,440	0.74	0.72 to 0.76		0.94	0.91 to 0.97	
Intention of studying at university				< .01			< .01
No	57,536	1.00			1.00		
Yes	40,389	1.17	1.14 to 1.20		1.08	1.05 to 1.12	

[a]In each section, the missing data have been excluded from the statistical analyses.
[b]Poor mental health has been defined as a 12-item General Health Questionnaire score ≥ 4.
[c]All the items included in this table were input as covariates in the logistic model.
Abbreviation: OR = odds ratio.

general population, a U-shaped association was observed between sleep duration and depression, and a linear association was observed between subjective sleep assessment and depression.[24] The fact that similar findings were obtained for both adults and adolescents is significant for understanding the associations between human sleep behavior and mental health status.

It is well known that mortality shows a U-shaped association with sleep duration.[25–29] In addition, it is significant that a U-shaped association is also evident between sleep duration and mental health status. It is easily understandable that shorter sleep duration would lead to poor mental health, or on the contrary, that being in poor mental health could lead to shorter sleep duration. In a long-term

prospective study, Chang et al.[30] reported that subjects getting 7 hours of sleep or less per night were at higher risk of becoming depressed than those getting more than 7 hours of sleep. What, then, is the association between longer sleep duration and poor mental health? In a laboratory study, Hartmann et al.[31] found that subjects who always slept more than 9 hours per night tended to be mildly depressed. Patel et al.,[32] after analyzing data for 60,000 women in the United States, also reported that depression was associated with long sleep duration, although its causal relationship was not clear. Detre et al.[33] reported that, among those who suffered from depression, hypersomnia was not an unusual symptom. From these studies, it may be assumed that longer sleep duration is one of the pathological features of poor mental health. However, the possibility that some confounding factors, such as disease and physical impairment, might both prolong sleep duration and increase GHQ-12 scores cannot be ruled out. Unfortunately, the present study was unable to clarify the mechanism of how long sleep duration and poor mental health are related, and further studies of this issue will therefore be needed.

It is interesting that the association between sleep duration/subjective sleep assessment and mental health status showed different patterns, suggesting that these 2 sleep parameters are of independent significance. Therefore, for adolescents who complain of sleep disturbance, data on sleep duration and subjective sleep assessment must be collected and assessed separately.

The present study data indicated that the prevalence of poor mental health increased as bedtime became later. In a study of Italian high school students, Giannotti et al.[34] reported that so-called evening-type students, who showed a preference for going to sleep at a later hour and who often found it difficult to get up in the morning, also suffered from emotional problems. However, unlike the results of the univariate analysis, the multivariate analysis of this issue in the present study demonstrated a significantly lower adjusted OR with regard to poor mental health for subjects who went to bed "after 2 a.m." This finding is attributed to strong associations between late bedtime and short sleep duration and between late bedtime and difficulty initiating sleep. Since these 2 items were adjusted, the OR for late bedtime with regard to poor mental health was lowered. From this result, it was suggested that late bedtime not accompanied by short sleep duration or difficulty initiating sleep would not be associated with poor mental health.

The mental health status of subjects who suffered from difficulty initiating sleep, difficulty maintaining sleep, or early morning awakening was poorer than that of subjects who did not. These 3 conditions are typical symptoms of insomnia, and it has been indicated in several cross-sectional epidemiological studies targeting adolescents that insomnia is closely related to mental health status.[1,3,5,7,8] This relationship has also been indicated in some longitudinal studies. In a study that observed adolescents in the United States over a 4-year period, Patten et al.[35] reported that depressive symptoms could be a risk factor for onset of insomnia. In addition, Roberts et al.[36] reported that insomnia among adolescents aged 11 to 17 years adversely affected their mental health status after 1 year. From these reports, it can be considered that mental health status and insomnia have a bidirectional relationship in which either can be a cause or a result. The results of the present study reconfirmed these previous findings.

Our findings indicated that lifestyle habits such as alcohol drinking, smoking, skipping breakfast, and not participating in extracurricular activities were associated with poor mental health. The association between alcohol drinking/smoking and poor mental health has been reported in several cross-sectional studies overseas.[21,37,38] Moreover, in a prospective study, Hallfors et al.[39] found that alcohol drinking and smoking were independent risk factors for depression. As to extracurricular activities, these can be roughly divided into cultural and physical activities. It is known that participating in physical activities, in particular, has a positive influence on the mental health status of adolescents, because it helps to improve psychological well-being and self-esteem, as well as formation of social networks.[40,41] The association recognized in this study between lifestyle habits and poor mental health among Japanese adolescents largely coincides with the results of previous studies overseas targeting adolescents. These results suggest that guidance on lifestyle habits is important for improving the mental health status of adolescents.

In this study, having an intention to study at university showed a significant association with poor mental health. Conventionally, Japanese society has a tendency to place excessive emphasis on academic record, and the competition to gain a university place is fierce. Such tremendous academic pressure may affect the mental health status of individuals intending to study at university. In fact, a study conducted in Japan found that the 28-item GHQ scores of first-year university students who had passed entrance exams were lower than those of seniors in high school who had been preparing for entrance exams.[42] These findings suggest that mental health support must be provided for adolescents, particularly for those who intend to study at university.

There were some limitations to this 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, physiological measurements such as electroencephalography could not be employed to obtain objective data for evaluation of sleep status. However, such

measurements, although desirable, are not normally included in epidemiological studies because of the very large number of subjects involved. Furthermore, several reports have stated that self-reported data on sleep status are consistent with physiological data to a certain degree.[43,44] Third, the items included in our questionnaire did not include all the factors that were considered to affect sleep. For example, noise levels at night, the person/s with whom a subject sleeps, and commuting time to school are all possible factors that could affect a subject's sleep. However, we could not include them in the questionnaire because of space limitations. These items will need to be examined in the future. Fourth, 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 any survey that includes questions on smoking and drinking alcohol. This reluctance may be the main reason for the high level of nonresponsiveness. However, there is a possibility that students with poorer mental health did not participate in this survey. Fifth, a question on excessive daytime sleepiness (EDS) was not included in the questionnaire used. It is known that chronic insufficient sleep may induce EDS or mood and behavior problems among adolescents.[45,46] The association between short sleep duration and poor mental health recognized in the present study may be explained by EDS. In future studies, associations between sleep habits and mental health status among adolescents should be examined by taking EDS into consideration.

In the present study, an association between mental health status and sleep status was examined, using representative samples of Japanese adolescents. As a result, it was indicated that a U-shaped association existed between mental health status and sleep duration and that, from a mental health viewpoint, an appropriate sleep duration was 7 hours or more but less than 9 hours. Meanwhile, a linear proportional association was observed between mental health status and subjective sleep assessment. As to insomnia symptoms, such as difficulty initiating sleep, difficulty maintaining sleep, and early morning awakening, as the frequency of such symptoms increased, mental health became poorer. People engaged in the clinical care of adolescents in psychiatric medicine must be fully aware of the associations between mental health status and sleep status revealed in this study.

REFERENCES

1. Marks PA, Monroe LJ. Correlates of adolescent poor sleepers. J Abnorm Psychol 1976;85:243–246
2. Price VA, Coates TJ, Thoresen CE, et al. Prevalence and correlates of poor sleep among adolescents. Am J Dis Child 1978;132:583–586
3. Morrison DN, McGee R, Stanton WR. Sleep problems in adolescence. J Am Acad Child Adolesc Psychiatry 1992;31:94–99
4. Gau SF, Soong WT. Sleep problems of junior high school students in Taipei. Sleep 1995;18:667–673
5. Manni R, Ratti MT, Marchioni E, et al. Poor sleep in adolescents: a study of 869 17-year-old Italian secondary school students. J Sleep Res 1997;6:44–49
6. Liu X, Uchiyama M, Okawa M, et al. Prevalence and correlates of self-reported sleep problems among Chinese adolescents. Sleep 2000; 23:27–34
7. Liu X, Zhou H. Sleep duration, insomnia and behavioral problems among Chinese adolescents. Psychiatry Res 2002;111:75–85
8. Bailly D, Bailly-Lambin I, Querleu D, et al. Sleep in adolescents and its disorders: a survey in schools (in French). Encephale 2004;30:352–359
9. Ohida T, Osaki Y, Doi Y, et al. An epidemiologic study of self-reported sleep problems among Japanese adolescents. Sleep 2004;27:978–985
10. Suzuki K, Minowa M, Osaki Y. Japanese national survey of adolescent drinking behavior in 1996. Alcohol Clin Exp Res 2000;24:377–381
11. Osaki Y, Tanihata T, Ohida T, et al. Adolescent smoking behavior and cigarette brand preference in Japan. Tob Control 2006;15:172–180
12. Goldberg DP, Rickels K, Downing R, et al. A comparison of two psychiatric screening tests. Br J Psychiatry 1976;129:61–67
13. Doi Y, Minowa M. Factor structure of the 12-item General Health Questionnaire in the Japanese general adult population. Psychiatry Clin Neurosci 2003;57:379–383
14. Radovanovic Z, Eric L. Validity of the General Health Questionnaire in a Yogoslav student population. Psychol Med 1983;13:205–207
15. D'Arcy C, Siddique CM. Psychological distress among Canadian adolescents. Psychol Med 1984;14:615–628
16. Arakida M, Takahashi S, Aoyagi M, et al. Examination of mental health status and related factors in junior high school students: a three-year longitudinal investigation (Japanese). Shouni Hoken Kenkyuu 2003; 62:667–679
17. Fuchino Y, Mizoue T, Tokui N, et al. Health-related lifestyle and mental health among inhabitants of a city in Japan (Japanese). Nippon Koshu Eisei Zasshi 2003;50:303–313
18. Shimbo M, Nakamura K, Jing Shi H, et al. Green tea consumption in everyday life and mental health. Public Health Nutr 2005;8:1300–1306
19. Marinoni A, Degrate A, Villani S, et al. Psychological distress and its correlates in secondary school students in Pavia, Italy. Eur J Epidemiol 1997;13:779–786
20. Fichter MM, Elton M, Diallina M, et al. Mental illness in Greek and Turkish adolescents. Eur Arch Psychiatry Neurol Sci 1988;237:125–134
21. Saluja G, Iachan R, Scheidt PC, et al. Prevalence of and risk factors for depressive symptoms among young adolescents. Arch Pediatr Adolesc Med 2004;158:760–765
22. Allison S, Roeger L, Martin G, et al. Gender differences in the relationship between depression and suicidal ideation in young adolescents. Aust N Z J Psychiatry 2001;35:498–503
23. Pelkonen M, Marttunen M, Aro H. Risk for depression: a 6-year follow-up of Finnish adolescents. J Affect Disord 2003;77:41–51
24. Kaneita Y, Ohida T, Uchiyama M, et al. The relationship between depression and sleep disturbances: a Japanese nationwide general population survey. J Clin Psychiatry 2006;67:196–203
25. Hammond EC. Some preliminary findings on physical complaints from a prospective study of 1,064,004 men and women. Am J Public Health Nations Health 1964;54:11–23
26. Hammond EC, Garfinkel L. Coronary heart disease, roke, and aortic aneurysm: factors in the etiology. Arch Environ Health 1969;19:167–182
27. Kripke DF, Simons RN, Garfinkel L, et al. Short and long sleep and sleeping pills: is increased mortality associated? Arch Gen Psychiatry 1979;36:103–116
28. Kripke DF, Garfinkel L, Wingard DL, et al. Mortality associated with sleep duration and insomnia. Arch Gen Psychiatry 2002;59:131–136
29. Tamakoshi A, Ohno Y, JACC Study Group. Self-reported sleep duration as a predictor of all-cause mortality: results from the JACC study, Japan. Sleep 2004;27:51–54
30. Chang PP, Ford DE, Mead LA, et al. Insomnia in young men and subsequent depression: The Johns Hopkins Precursors Study. Am J Epidemiol 1997;146:105–114
31. Hartmann E, Baekeland F, Zwilling G, et al. Sleep need: how much sleep and what kind? Am J Psychiatry 1971;127:1001–1008
32. Patel SR, Malhotra A, Gottlieb DJ, et al. Correlates of long sleep

duration. Sleep 2006;29:881–889
33. Detre T, Himmelhoch J, Swartzburg M, et al. Hypersomnia and manic-depressive disease. Am J Psychiatry 1972;128:1303–1305
34. Giannotti F, Cortesi F, Sebastiani T, et al. Circadian preference, sleep and daytime behavior in adolescence. J Sleep Res 2002;11:191–199
35. Patten CA, Choi WS, Gillin JC, et al. Depressive symptoms and cigarette smoking predict development and persistence of sleep problems in US adolescents. Pediatrics 2000;106:E23
36. Roberts RE, Roberts CR, Chen IG. Impact of insomnia on future functioning of adolescents. J Psychosom Res 2002;53:561–569
37. Chang G, Sherritt L, Knight JR. Adolescent cigarette smoking and mental health symptoms. J Adolesc Health 2005;36:517–522
38. Verdurmen J, Monshouwer K, van Dorsselaer S, et al. Alcohol use and mental health in adolescents: interactions with age and gender-findings from the Dutch 2001 Health Behavior in School-Aged Children survey. J Stud Alcohol 2005;66:605–609
39. Hallfors DD, Waller MW, Ford CA, et al. Adolescent depression and suicide risk: association with sex and drug behavior. Am J Prev Med 2004;27:224–231
40. Sonstroem RJ. Exercise and self-esteem. Exerc Sport Sci Rev 1984; 12:123–155
41. Kirkcaldy BD, Shephard RJ, Siefen RG. The relationship between physical activity and self-image and problem behavior among adolescents. Soc Psychiatry Psychiatr Epidemiol 2002;37:544–550
42. Nagata K, Okubo H, Moji K, et al. Difference of the 28-item general health questionnaire scores between Japanese high school and university students. Jpn J Psychiatry Neurol 1993;47:575–583
43. Frankel BL, Coursey RD, Buchbinder R, et al. Recorded and reported sleep in chronic primary insomnia. Arch Gen Psychiatry 1976;33: 615–623
44. Hoch CC, Reynolds CF, Kupfer DJ, et al. Empirical note: self-report versus recorded sleep in healthy seniors. Psychophysiology 1987;24: 293–299
45. Carskadon MA. Patterns of sleep and sleepiness in adolescents. Pediatrician 1990;17:5–12
46. Carskadon MA. Sleep deprivation: health consequences and societal impact. Med Clin North Am 2004;88:767–776

Editor's Note: We encourage authors to submit papers for consideration as a part of our Focus on Childhood and Adolescent Mental Health section. Please contact Melissa P. DelBello, M.D., at delbelmp@email.uc.edu.