Longitudinal Epidemiologic Study of Poor Mental Health Status in Japanese Adolescents:

Incidence of Predictive Lifestyle Factors

Osamu Itani, MD, PhD[a]; Yoshitaka Kaneita, MD, PhD[b,*]; Kazuto Doi, MS[c]; Mikiko Tokiya, MS[a]; Maki Jike, PhD[b]; Sachi Nakagome, MD, PhD[b]; Yuichiro Otsuka, MD, PhD[b]; and Takashi Ohida, MD, PhD[b]

ABSTRACT

Objective: To clarify the incidence of predictive risk factors for poor mental health status in Japanese adolescents.

Methods: In 2010, baseline surveys of first-year junior and senior high school students were conducted at 10 randomly selected junior high schools and 14 senior high schools in Japan. After 2 years, follow-up surveys were conducted on the same students. For both surveys, a self-administered questionnaire about mental health status and lifestyle, General Health Questionnaire-12 (GHQ-12), was provided to the students.

Results: In total, 1,304 junior and 4,383 senior high school students were enrolled at the start of the study, and 776 junior and 2,697 senior high school students responded to both surveys. The new incidence of poor mental health status (GHQ-12 ≥ 4 points), determined by changes between the baseline and follow-up surveys, was 17.1% (95% CI, 13.9% to 20.3%) of junior high school students and 22.6% (95% CI, 20.5% to 24.7%) of senior high school students. According to the multiple logistic regression analysis, in junior high school students, factors associated with the onset of poor mental health were not participating in sports activities (adjusted odds ratio, 3.13; $P = .035$) and spending ≥ 2 hours per day studying outside of school (2.18; $P = .010$). In senior high school students, factors associated with the onset of poor mental health were female sex (2.51; $P < .001$), difficulty initiating sleep (3.38; $P < .001$), poor sleep quality (1.83; $P = .034$), poor appetite (3.43; $P = .011$), spending less than 2 hours per day watching television (1.37; $P = .038$), being a victim of bullying (2.46; $P = .011$), and not having a sympathetic supporter (1.72; $P = .006$).

Conclusions: The findings of this study are valuable for formulating approaches aimed at addressing adolescent mental health.

J Clin Psychiatry 2018;79(4):17m11516

To cite: Itani O, Kaneita Y, Doi K, et al. Longitudinal epidemiologic study of poor mental health status in Japanese adolescents: incidence of predictive lifestyle factors. *J Clin Psychiatry*. 2018;79(4):17m11516.

To share: https://doi.org/10.4088/JCP.17m11516

[a]Department of Public Health and Epidemiology, Faculty of Medicine, Oita University, Yufu-city, Oita, Japan

[b]Department of Social Medicine, Division of Public Health, Nihon University School of Medicine, Itabashi-ward, Tokyo, Japan

[c]Department of Medical Engineering, Faculty of Health Sciences, Junshin Gakuen University, Fukuoka-city, Fukuoka, Japan

**Corresponding author:* Yoshitaka Kaneita, MD, PhD, Department of Social Medicine, Nihon University School of Medicine, 30-1 Ohyaguchikami-machi, Itabashi-ku, Tokyo 173-8610, Japan (nusmpublichealth@gmail.com).

In recent years, various epidemiologic studies have shown that the prevalence of poor mental health status in adolescents is not necessarily low. The National Survey on Drug Use and Health (NSDUH), which is an annual cross-sectional interview survey of the general US population, reports the point prevalence of at least 1 major depressive disorder in adolescents (age 12–17 years). (Major depressive disorder is defined according to the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* [*DSM-IV*], which specifies a period of > 2 weeks when a person has experienced mood changes or the loss of interest or pleasure in daily activities and had a majority of the specified depression symptoms in the previous 12 months.[1]) According to the 2016 NSDUH, the point prevalence of a major depressive disorder was 17.3% of girls and 5.7% of boys (12.8% of the entire sample). In addition, according to the results of a chronological analysis of data obtained between 2005 and 2014 by NSDUH, the point prevalence of a depressive disorder has significantly increased in adolescents in recent years.[2] Adolescent depression tends to recur,[3–5] have an adverse effect on quality of life (both academic and social),[6] and be accompanied by other mental disorders.[5,7,8] Furthermore, adolescent depression is closely linked to other mental health issues such as suicide,[9] substance abuse,[10] and eating[10] and sleep disorders.[11,12] Therefore, adolescent depression is an extremely important mental health issue in schools.

In Japan, a study of depressive symptoms in suburban junior high school children was performed using the Birleson Depression Self-Rating Scale for Children.[13,14] A total of 1,156 junior high school students were surveyed, and the prevalence of depressive symptoms was 22.8%. Furthermore, Kaneita et al[11] conducted a study that targeted approximately 100,000 junior and senior high school students who were randomly selected from across Japan. The study examined epidemiologic data on mental health status obtained using the General Health Questionnaire[15] and found that girls had significantly poorer mental health status than boys and that various lifestyle elements, of lifestyle such as sleep, eating habits, alcohol consumption, smoking, and extracurricular activities were associated with mental health status.

As previously mentioned, epidemiologic data on poor mental health status in Japanese adolescents have been gradually accumulating. However, all of these studies were cross-sectional sampling surveys that evaluated only 1 cross-section at a specific point in time. Therefore, these studies could not evaluate chronological changes or the temporal relationship between

Clinical Points

- Few longitudinal epidemiologic studies have been performed on poor mental health in adolescents.
- Specific lifestyle attributes (eg, lack of physical activity, sleep disorders, being a victim of bullying, or lack of support) may be associated with poor mental health.
- These findings may help in formulating measures for preventing poor mental health in adolescents.

events and factors, and the relationship between mental health status and relevant factors could not be investigated.

Therefore, we planned a new longitudinal epidemiologic study of the mental health status of junior and senior high school students in Japan. The present study aims to compensate for the shortcomings of previous studies by (1) enrolling a sufficiently large sample of students, (2) surveying a highly representative, nationwide sample, and (3) using a longitudinal study design. The study aim is to elucidate the prevalence and incidence of poor mental health status in adolescents and to identify risk factors for the deterioration of mental health status.

METHODS

Participants and Sampling

In the Japanese education system, a child enters junior high school at the age of 12. Junior high school is compulsory and lasts 3 years, and students who want additional education may go to senior high school for another 3 years.

Our study group previously conducted cross-sectional nationwide surveys of the lifestyle habits of 240 Japanese junior and senior high school students who were randomly selected and sampled in 2008.[16] In January 2010, we asked the principals of 170 schools to allow their schools to participate. Of these 170 schools, 10 junior and 14 senior high schools agreed to participate.

In these 24 schools, there were 5,687 students who participated (1,304 seventh and 4,383 tenth graders). The baseline survey was conducted from October to November 2010, and the follow-up survey was conducted from October to November 2012. A teacher delivered a self-administered questionnaire and envelope to each student during class. The students completed the questionnaire on their own during homeroom. After completing the questionnaire, the questionnaire was sealed in the envelope by the student.

The following 5 common items were included in the questionnaires used in both surveys: (1) basic attributes including name, sex, and birth date; (2) sleep status including sleep duration, difficulty initiating sleep, difficulty maintaining sleep, subjective sleep quality, and incidence of early morning awakening, half-sleeping, nightmares, and sleep paralysis; (3) lifestyle factors including incidence of eating breakfast every day, appetite, coffee- and tea-drinking habits, athletic activities during school hours, cultural extracurricular activities during school hours, period spent studying after school hours, hours spent watching television, hours spent playing video games, and hours spent using a mobile phone; (4) social relationship factors. Subjects who answered "yes" to the question, "Do you feel that you were bullied during the past month?" were classified as "victim of bullying." Subjects who answered "yes" to the question, "Do you feel that you bullied someone during the past month?" were classified as having exhibited "bullying behavior toward other students." Subjects who answered "yes" to the question, "Do you have someone to consult with about your problems?" were determined to have a "confidant." Subjects who answered "yes" to the question, "Is there someone you feel understands you?" were determined to have a "sympathetic supporter." (5) Mental health status was determined using the Japanese version of the 12-item General Health Questionnaire (GHQ-12).[15,17]

The GHQ-12 consists of 12 questions, and the total score (range, 0–12) is calculated by summing the scores for each question (0 or 1). A higher score indicates worse mental health status. Although the GHQ was created for adult surveys, valid results can be obtained when administered to adolescents.[18] In accordance with previous studies, the cutoff point for GHQ-12 was set to 4 points[19]: ≥ 4 points was defined as "poor mental health status," and < 4 points was defined as "good mental health status."

Ethical Considerations

In this survey, ethical considerations were taken into account: (1) participation in the survey was voluntary, and informed consent was required; (2) willingness to cooperate was confirmed in writing; and (3) permission to conduct the survey was obtained from the Ethics Committee of Nihon University School of Medicine.

Statistical Analysis

All analyses were separately performed for junior and senior high school students. First, the prevalence of poor mental health status at the baseline survey was calculated.

Second, new incidence was only recorded when the mental health status of a student was "good" at the time of the baseline survey but "poor" at the time of the follow-up survey. After calculating the new incidence of each attribute, we used the χ^2 test to test statistical significance.

Third, the factors associated with the new incidence of poor mental health status were explored using logistic regression analysis. For this analysis, only students who did not have poor mental health status at baseline were selected. The incidence of poor mental health status at the time of the follow-up survey was set as the independent variable. Sex, sleep duration, difficulty initiating sleep, difficulty maintaining sleep, early morning awakening, subjective sleep quality, half-sleep, nightmares, sleep paralysis, eating breakfast every day, appetite, coffee- and tea-drinking habits, athletic activities at school, cultural extracurricular activities, hours spent studying outside of school, hours spent watching television, hours spent playing video games, hours spent using a mobile phone, being a victim of bullying, bullying behavior toward other students, having a confidant, and

Table 1. Characteristics of the Analyzed Subjects at Baseline

Characteristic	Junior High School n	Junior High School %	Senior High School n	Senior High School %
Sex				
Male	372	47.9	1,556	57.7
Female	404	52.1	1,141	42.3
Unknown	0	0.0	0	0.0
Sleep duration				
<6 h/d	65	8.4	697	25.8
≥6 h/d	708	91.2	1,994	73.9
Unknown	3	0.4	6	0.2
Difficulty initiating sleep				
No	718	92.5	2,515	93.3
Yes	52	6.7	172	6.4
Unknown	6	0.8	10	0.4
Difficulty maintaining sleep				
No	748	96.4	2,590	96.0
Yes	24	3.1	101	3.7
Unknown	4	0.5	6	0.2
Early morning awakening				
No	758	97.7	2,612	96.8
Yes	17	2.2	82	3.0
Unknown	1	0.1	3	0.1
Subjective sleep quality				
Good or normal	712	91.8	2,401	89.0
Poor	61	7.9	294	10.9
Unknown	3	0.4	2	0.1
Half sleeping				
No	731	94.2	2,530	93.8
Yes	42	5.4	165	6.1
Unknown	3	0.4	2	0.1
Nightmare				
No	747	96.3	2,614	96.9
Yes	26	3.4	81	3.0
Unknown	3	0.4	2	0.1
Sleep paralysis				
No	678	87.4	2,247	83.3
Yes	30	3.9	156	5.8
Unknown	68	8.8	294	10.9
Eating breakfast every day				
Yes	727	93.7	2,325	86.2
No	44	5.7	367	13.6
Unknown	5	0.6	5	0.2
Appetite				
Good or moderate	751	96.8	2,597	96.3
Poor	20	2.6	93	3.4
Unknown	5	0.6	7	0.3
Coffee- or tea-drinking habits				
No	669	86.2	2,101	77.9
Yes	103	13.3	590	21.9
Unknown	4	0.5	6	0.2
Athletic activities during school hours				
No	167	21.5	1,164	43.2
Yes	576	74.2	1,472	54.6
Unknown	33	4.3	61	2.3
Cultural extracurricular activities during school hours				
No	491	63.3	1,778	65.9
Yes	188	24.2	708	26.3
Unknown	97	12.5	211	7.8
Period spent studying after school hours				
<2 h/d	592	76.3	2,531	93.8
≥2 h/d	172	22.2	153	5.7
Unknown	12	1.5	13	0.5
Hours spent watching television				
<2 h/d	443	57.1	1,802	66.8
≥2 h/d	329	42.4	880	32.6
Unknown	4	0.5	15	0.6
Hours spent playing video game				
<2 h/d	670	86.3	2,300	85.3
≥2 h/d	97	12.5	374	13.9
Unknown	9	1.2	23	0.9
Hours spent using mobile phone				
<2 h/d	660	85.1	1,520	56.4
≥2 h/d	106	13.7	1,165	43.2
Unknown	10	1.3	12	0.4
Victim of bullying				
No	653	84.1	2,516	93.3
Yes	117	15.1	158	5.9
Unknown	6	0.8	23	0.9
Bullying behavior toward other students				
No	687	88.5	2,558	94.8
Yes	85	11.0	123	4.5
Unknown	4	0.5	16	0.6
Confidant[a]				
None	128	16.5	466	17.3
Yes	644	83.0	2,207	81.8
Unknown	4	0.5	24	0.9
Sympathetic supporter				
None	99	12.8	407	15.1
Yes	672	86.6	2,250	83.4
Unknown	5	0.6	40	1.5

(continued)

[a]Someone with whom the adolescent could consult about his or her problems.

having a sympathetic supporter at the time of the baseline were dependent variables. The backward elimination method was used for the logistic regression analysis. Significance was set at $P < .05$. All analyses were performed using SPSS 22 for Windows (IBM Corp, Armonk, New York).

RESULTS

In total, 5,687 students (1,304 junior and 4,383 senior high school students) agreed to participate in the baseline study, and 3,473 students (776 junior and 2,697 senior high school students) agreed to participate in the follow-up study. The overall response rate was 61.1% (59.5% of junior high school students and 61.5% of senior high school students).

The baseline characteristics of the analyzed participants are shown in Table 1. Of junior high school participants, 47.9% and 52.1% of the participants were boys and girls, respectively; of senior high school participants, 57.7% and 42.3% of the participants were boys and girls, respectively.

Table 2. Prevalence of Poor Mental Health Status[a] at Baseline

Mental Health Status at Baseline	Junior High School n	Junior High School %	Senior High School n	Senior High School %	Total n	Total %
Good	543	70.0	1,568	58.1	2,111	60.8
Poor	211	27.2	1,081	40.1	1,292	37.2
Unknown	22	2.8	48	1.8	70	2.0

[a]General Health Questionnaire-12 score ≥4 points was defined as "poor mental health status."

The prevalence of poor mental health status at baseline is shown in Table 2. Poor mental health status was observed in 211 of 776 junior high school students, and its prevalence

Table 3. New Incidence of Poor Mental Health Status[a] at Follow-Up (2 Years)

Mental Health Status at Follow-Up	Junior High School		Senior High School		Total	
	n	%	n	%	n	%
Good	441	81.2	1,182	75.4	1,623	76.9
Poor	93	17.1	355	22.6	448	21.2
Unknown	9	1.7	31	2.0	40	1.9

[a]General Health Questionnaire-12 score ≥ 4 points was defined as "poor mental health status." Only students whose mental health status was "good" at the time of the baseline survey were included in the analysis.

was 27.2% (95% CI, 24.1% to 30.3%). Of 2,697 senior high school students, 1,081 participants exhibited poor mental health status, and its prevalence was 40.1% (95% CI, 38.3% to 41.9%).

Table 3 shows the new incidence of poor mental health status, which was determined by changes between the baseline survey and the follow-up survey 2-year study period. The incidence of poor mental health status was 17.1% (95% CI, 13.9% to 20.3%) and 22.6% (95% CI, 20.5% to 24.7%) in junior and senior high school students, respectively.

Table 4 shows the results of the χ^2 analysis of the factors associated with the new incidence of poor mental health status. In junior high school students, hours spent studying after school exhibited a significant association with poor mental health status ($P = .001$). In senior high school students, female sex ($P < .001$), difficulty initiating sleep ($P = .006$), difficulty maintaining sleep ($P = .016$), poor subjective sleep quality ($P = .004$), no participation in extracurricular athletic activities ($P = .015$), participation in extracurricular cultural activities ($P = .001$), being a victim of bullying ($P = .022$), having no confidant ($P = .003$), and having no sympathetic supporter ($P = .029$) exhibited significant associations with poor mental health status.

Table 5 shows the results of the logistic regression analysis of new incidence of poor mental health status. In junior high school students, not participating in extracurricular athletic activities ($P = .035$) and studying ≥ 2 hours per day after school ($P = .010$) were significantly associated with new incidence of poor mental health status. Relevant factors such as subjective sleep quality and cultural activities were included in the final model but did not exhibit statistical significance. In senior high school students, the following factors were found to be significantly associated with the incidence of poor mental health status: female sex ($P < .001$), difficulty initiating sleep ($P < .001$), poor subjective sleep quality ($P = .034$), poor appetite ($P = .011$), being a victim of bullying ($P = .011$), and absence of a sympathetic supporter ($P = .006$). Number of hours spent using a mobile phone, a relevant factor, was included in the final model but did not reach statistical significance.

DISCUSSION

In this study, the incidence of poor mental health status after 2 years was 17.1% and 22.6% in junior and senior high school students, respectively. Few previous studies on adolescents calculated the de novo incidence of poor mental health status by using GHQ-12. However, several longitudinal studies have determined the incidence of mental health disorders such as depression.[20–24] However, most of these studies were community surveys with poor nationwide representation. Furthermore, few countries have conducted such studies, and international comparison of findings has been complicated because the targeted disorders and evaluation methods have not been standardized. Future studies should be performed after resolving these issues.

In this study, senior high school students exhibited an increased incidence of poor mental health status after 2 years compared with junior high school students. A compilation of interview data (10,123 adolescents between 13 and 18 years) by the National Comorbidity Study—Adolescent Supplement reports differences in the onset of mental disorders by age group.[25] According to the National Comorbidity Survey, anxiety disorders suddenly occurred early in childhood but leveled off after age 12; risk was fairly low for mood and behavior disorders until early adolescence, when risk began to steadily rise; substance use disorders appeared to have the latest age at onset with a steep increase in incidence after age 15; and the median age at disorder onset was 6 years for anxiety disorders, 11 years for behavior disorders, 13 years for mood disorders, and 15 years for substance use disorders.[25] In essence, this survey reports the median age at mental disorder onset for adolescents who are 15 years and younger. In our study, because the incidence of mental disorder onset was higher for participants 16 years and older compared with those under, our results diverge from those of prior studies. This difference is due to differences in the social conditions of the target participants, survey methods (interviews versus questionnaires), and evaluation methods used to determine the incidence of mental disorders (*DSM-IV*, GHQ-12, etc). In the future, a multilateral comparison that incorporates various evaluation methods should be performed.

In this study, we observed a significant association between participation in extracurricular athletic activities and the incidence of poor mental health status in junior high school students. Several reviews have also suggested that physical activity and participation in sports in adolescence prevent the onset depression.[26–30] However, these previous studies were not necessarily high quality.[29] In comparison with previous studies, the present study was high quality in terms of its design and sampling methodology. It could be argued that this study provides stronger epidemiologic evidence of the relationship between physical activity and mental health. According to previous studies, the physiologic effects of physical activity on mental health can be explained by the increased production of neurotransmitters during physical activity, such as endorphins[31] and monoamines.[32]

We established that studying for a long period after school was a factor associated with the incidence of poor mental health status in junior high school students. Several studies have also suggested the relationship between

Table 4. De Novo Incidence of Poor Mental Health Status[a] at the Time of the Follow-Up Survey (2 Years) by Attribute[b]

	Junior High School			Senior High School		
Characteristic at Baseline	%	95% CI	*P*[c]	%	95% CI	*P*[c]
All	17.4	14.2 to 20.6		23.1	21.0 to 25.2	
Sex			.111			<.001***
Male	14.9	10.7 to 19.1		18.9	16.5 to 21.3	
Female	20.2	15.3 to 25.1		31.0	27.1 to 34.9	
Sleep duration			.212			.426
<6 h/d	26.7	10.9 to 42.5		24.7	20.2 to 29.2	
≥6 h/d	17.0	13.7 to 20.3		22.6	20.2 to 25.0	
Difficulty initiating sleep			.366			.006**
No	17.1	13.8 to 20.4		22.5	20.4 to 24.6	
Yes	25.0	6.0 to 44.0		39.3	26.5 to 52.1	
Difficulty maintaining sleep			.349			.016*
No	17.2	14.0 to 20.4		22.7	20.6 to 24.8	
Yes	28.6	−4.9 to 62.1		39.5	24.9 to 54.1	
Early morning awakening			1.000			.260
No	17.5	14.3 to 20.7		22.9	20.8 to 25.0	
Yes	0.0	0.0 to 0.0		32.1	14.8 to 49.4	
Subjective sleep quality			.079			.004**
Good or normal	17.0	13.8 to 20.2		22.3	20.2 to 24.4	
Poor	35.7	10.6 to 60.8		36.6	26.2 to 47.0	
Half sleeping			.535			.623
No	17.3	14.0 to 20.6		23.0	20.9 to 25.1	
Yes	22.2	3.0 to 41.4		25.9	14.2 to 37.6	
Nightmare			1.000			.227
No	17.4	14.2 to 20.6		22.9	20.8 to 25.0	
Yes	20.0	−15.1 to 55.1		33.3	14.4 to 52.2	
Sleep paralysis			.274			.467
No	16.8	13.4 to 20.2		23.9	21.6 to 26.2	
Yes	28.6	4.9 to 52.3		27.9	17.2 to 38.6	
Eating breakfast every day			1.000			.697
Yes	17.5	14.2 to 20.8		23.3	21.1 to 25.5	
No	16.7	1.8 to 31.6		21.7	15.4 to 28.0	
Appetite			.282			.054
good or moderate	17.3	14.1 to 20.5		22.8	20.7 to 24.9	
poor	33.3	−4.4 to 71.0		40.0	20.8 to 59.2	
Coffee- or tea-drinking habits			.112			.448
No	16.4	13.1 to 19.7		23.5	21.1 to 25.9	
Yes	25.0	14.4 to 35.6		21.3	16.7 to 25.9	
Athletic activities during school hours			.245			.015*
No	22.0	13.9 to 30.1		26.3	22.8 to 29.8	
Yes	16.9	13.3 to 20.5		20.8	18.1 to 23.5	
Cultural extracurricular activities during school hours			1.000			.001**
No	16.9	13.0 to 20.8		21.3	18.8 to 23.8	
Yes	16.7	9.9 to 23.5		30.1	25.3 to 34.9	
Period spent studying after school hours			.001**			.243
<2 h/d	14.2	10.8 to 17.6		22.7	20.5 to 24.9	
≥2 h/d	28.0	19.9 to 36.1		28.1	18.8 to 37.4	
Hours spent watching television			1.000			.312
<2 h/d	17.5	13.2 to 21.8		23.9	21.2 to 26.6	
≥2 h/d	17.5	12.6 to 22.4		21.6	18.1 to 25.1	
Hours spent playing video game			1.000			.488
<2 h/d	17.1	13.7 to 20.5		23.5	21.2 to 25.8	
≥2 h/d	16.9	7.8 to 26.0		21.1	15.7 to 26.5	
Hours spent using mobile phone			.361			.951
<2 h/d	16.5	13.1 to 19.9		23.0	20.3 to 25.7	
≥2 h/d	21.7	11.3 to 32.1		23.2	19.8 to 26.6	
Victim of bullying			.419			.022*
No	17.1	13.8 to 20.4		22.5	20.4 to 24.6	
Yes	21.7	9.8 to 33.6		37.5	23.8 to 51.2	
Bullying behavior toward other students			.293			.226
No	16.8	13.5 to 20.1		22.8	20.7 to 24.9	
Yes	23.3	10.7 to 35.9		30.6	17.7 to 43.5	
Confidant			1.000			.003**
None	17.4	8.5 to 26.3		31.1	25.0 to 37.2	
Yes	17.5	14.0 to 21.0		21.7	19.5 to 23.9	
Sympathetic supporter			.686			.029*
None	19.6	8.1 to 31.1		29.9	23.2 to 36.6	
Yes	17.3	13.9 to 20.7		22.3	20.1 to 24.5	

[a]General Health Questionnaire-12 score ≥4 points was defined as "poor mental health status." Only students whose mental health status was "good" at the time of the baseline survey were included in the analysis. [b]Subjects with missing data were excluded from the analysis. [c]*P* was calculated by χ^2 test.

*P<.05. **P<.01. ***P<.001.

Abbreviation: CI=confidence interval.

Table 5. Factors Associated With the Incidence of Poor Mental Health Status[a] in Junior and Senior High School Students[b]

Junior High School				Senior High School			
Factor	AOR	95% CI	*P*[c]	Factor	AOR	95% CI	*P*[c]
Subjective sleep quality			.067	Sex			<.001***
Good or normal	1.00			Male	1.00		
Poor	3.72	0.91 to 15.15		Female	2.51	1.89 to 3.33	
Athletic activities during school hours			.035*	Difficulty initiating sleep			<.001***
No	1.00			No	1.00		
Yes	0.32	0.11 to 0.92		Yes	3.38	1.73 to 6.58	
Cultural extracurricular activities during school hours			.080	Subjective sleep quality			.034*
No	1.00			Good or normal	1.00		
Yes	0.37	0.12 to 1.13		Poor	1.83	1.05 to 3.19	
Period spent studying after school hours			.010*	Appetite			.011*
<2 h/d	1.00			good or moderate	1.00		
≥2 h/d	2.18	1.21 to 3.92		poor	3.43	1.32 to 8.90	
				Hours spent watching television			.038*
				<2 h/d	1.00		
				≥2 h/d	0.73	0.54 to 0.98	
				Hours spent using mobile phone			.059
				<2 h/d	1.00		
				≥2h/d	0.75	0.56 to 1.01	
				Victim of bullying			.011*
				No	1.00		
				Yes	2.46	1.23 to 4.92	
				Sympathetic supporter			.006**
				None	1.00		
				Yes	0.58	0.39 to 0.86	

[a]General Health Questionnaire-12 score ≥4 points was defined as "poor mental health status." Only students whose mental health status was "good" at the time of the baseline survey were included in the analysis.
[b]Subjects with missing data were excluded from the analysis.
[c]*P* was calculated by the multiple logistic regression analysis (backward elimination method). The independent variable was incidence of poor mental health status at the time of the follow-up survey.
*$P < .05$.
**$P < .01$.
***$P < .001$.
Abbreviations: AOR = adjusted odds ratio, CI = confidence interval.

schoolwork and mental health.[33–35] The findings of the present longitudinal study suggest that schoolwork may be a risk factor for poor mental health. However, we were only able to evaluate time spent doing homework, and their academic performance at school and the content of their schoolwork were not considered. Future studies will need to evaluate these components as well.

We found that female sex was associated with the incidence of poor mental health status in senior high school students. A large-scale cross-sectional study that surveyed 100,000 students with GHQ-12, similar to the present study, also found a significant association between sex and poor mental health status.[11] Furthermore, a study on sex differences in adolescent mental health disorders concluded that the dramatic female preponderance of depression that first emerges in puberty may be mediated by increases in estradiol and testosterone.[36]

We found that difficulty initiating sleep and poor subjective sleep quality were associated with the incidence of poor mental health status in senior high school students. The aforementioned cross-sectional study, in which 100,000 adolescents were surveyed using GHQ-12, also found significant associations between sleep duration, subjective sleep assessment and GHQ-12 score.[11] The systematic review and meta-analysis also found a consistent relationship between getting an adequate amount of sleep during adolescence and reduced risk of subsequent depression.[30] Our findings do not contradict those of the aforementioned studies.

We established that poor appetite was associated with the incidence of poor mental health status in senior high school students. Some previous studies of the relationship between abnormal appetite loss and mental health disorders also investigated anorexia nervosa. Mental health disorders such as depression, anxiety, and obsessive-compulsive disorder are known to co-occur with anorexia nervosa.[37–39] With regard to the physiologic mechanism of these relationships, it is assumed that depressive symptoms and anxiety are the sequelae of malnutrition due to anorexia nervosa.[40] However, epidemiologic evidence-based data are very rare.[41]

In this study, we found that spending many hours watching television was negatively associated with poor mental health in senior high school students. The potential benefits of watching television to improve mental health have been mentioned in several previous studies. Humor is a common feature of television programs.[42,43] Biomedical studies have shown that laughter can reduce stress,[44] and laughter therapy has emerged as a potential therapy.[45] Humor has been found to benefit depressed and terminally ill patients.[46,47] Life-affirming media messages may similarly protect against depression. The review by Cairns et al[30] included 3 studies on the relationship between depression and media use (such as television and video). One study[48] suggested that media use was associated with a significantly lower incidence of

depression, but another study[49] suggested that media use is associated with the onset of depression and 1 study[50] found no association between media use and depression. Therefore, Cairns et al[30] concluded that the number of cohort studies on the relationship between media use and depression was insufficient and that future studies needed to consider differences in media-associated effects. Media include mobile phones, video games, and television in the present study, and the effects of each type of media were separately analyzed. No association between poor mental health and the use of mobile phones and video games was found. More research is needed on the different effects of various types of media on mental health.

We found that being a victim of bullying was associated with the incidence of poor mental health status in senior high school students. A number of cross-sectional epidemiologic studies of adolescents have established a relationship between being a victim of bullying and depression.[51–60] Furthermore, a number of longitudinal studies have reported that victimization from bullying significantly increases future mental health problems.[61–63] Another study suggested that peer victimization may be more common in persons with a high cortisol response to a laboratory-based social stressor.[64] Peer victimization hinders the development of friendships,[65] thereby leading to social isolation and loneliness.[66–68] This may hinder the ability to form strong prosocial bonds with others and limit opportunities to develop social skills or receive support.[63]

We established that having a sympathetic supporter was negatively associated with the incidence of poor mental health status in senior high school students. Several child psychology studies on the relationship between depression and social support have suggested that having sufficient social support[69] in a social environment, including support from family members, prevents depression,[70,71] whereas a lack of perceived support is associated with the onset of depression.[72] Few previously published studies have classified different types of social supporters. We classified social supporters as confidants or sympathetic supporters. We found no relationship between having a confidant and the incidence of poor mental health, but having a sympathetic supporter was associated with poor mental health. It has been suggested that when physicians clearly express sympathy toward patients during treatment for depression, this may have a more therapeutic effect than a normal doctor-patient relationship or the patient's own opinion of the doctor.[73] Physiologically, a study that used functional magnetic resonance imaging reported that active listening positively changes the emotional appraisal of a recounted personal life experience, which activates the reward system of the brain.[74] We found that merely having access to a confidant had no ameliorating effects on mental health but the presence of a sympathetic supporter did have such an effect, thus suggesting the importance of sympathy when providing support.

In this study, we separately analyzed risk factors for poor mental health in junior and senior high school students, and different risk factors were identified in the 2 groups. One reason for this may be the small number of junior high school students who participated (ie, the analysis of the junior high school students did not have sufficiently high statistical power). Another reason might be the nature of poor mental health status in junior and senior high school students. The surveyed junior and senior high school students were mainly 13 and 16 years of age, respectively, thereby corresponding to childhood and adolescence, respectively. Over the past few years, important differences in clinical depression in children and adolescents have been suggested.[75]

Some limitations affected this study. First, not all issues associated with mental health were covered. For example, because of space limitations in the questionnaire, questions regarding drinking and smoking habits were not included. Furthermore, we are unaware of the content of the television programs and video games. These issues may affect mental health. In addition, we did not obtain any information about the participants' medical, psychiatric, or family history on follow-up. We need to include these factors in future investigations. Second, self-evaluation tools such as GHQ-12 were used to evaluate mental health. However, this method can yield biased information. It must be noted that some participants may unaware of the problem of poor mental health, and in such cases problems cannot be evaluated with GHQ-12. Third, because some of the terms used in our survey, such as "confidant" and "sympathetic supporter," are not clearly defined, individual participants may understand these terms differently.

In this study, we were able to obtain epidemiologic data on factors that are predictive of poor mental health status in Japanese high school students. These findings provide valuable suggestions for the development of future educational approaches on lifestyle and health and serve as a scientific basis for developing future measures aimed at maintaining good adolescent mental health.

Furthermore, the results of this study could be used to design future epidemiologic studies. First, we identified predictive factors of poor mental health in this observational study, and our findings may be useful for identifying the types of factors that require intervention when planning future interventional and epidemiologic studies. Second, this study may provide evidence for future epidemiologic studies on poor mental health, such as meta-analyses.

Submitted: February 9, 2017; accepted December 8, 2017.

Published online: July 3, 2018.

Potential conflicts of interest: The authors report no financial or other relationships related to the subject to of this article.

Funding/support: This study was supported by The Ministry of Education, Culture, Sports, Science and Technology (MEXT) KAKENHI Grant Number 21390208.

Role of the sponsor: The funding agency had no role in the design and conduct of the study; in the collection, management, analysis, and interpretation of the data; or in the preparation, review, or approval of the manuscript.

Previous presentation: Results of this study were presented at the 40th annual meeting of Japanese Society of Sleep Research; July 3–4, 2014; Tokushima-city, Tokushima, Japan.

Acknowledgment: The authors thank Yukiko Abe (Department of Public Health and Epidemiology, Faculty of Medicine, Oita University) for her help in this study. Ms Abe has no potential conflicts of interest to disclose.

REFERENCES

1. Center for Behavioral Health Statistics and Quality. *2016 National Survey on Drug Use and Health: Detailed Tables*. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2017.
2. Mojtabai R, Olfson M, Han B. National trends in the prevalence and treatment of depression in adolescents and young adults. *Pediatrics*. 2016;138(6):e20161878.
3. Kovacs M. Presentation and course of major depressive disorder during childhood and later years of the life span. *J Am Acad Child Adolesc Psychiatry*. 1996;35(6):705–715.
4. Fombonne E, Wostear G, Cooper V, et al. The Maudsley long-term follow-up of child and adolescent depression, 2: suicidality, criminality and social dysfunction in adulthood. *Br J Psychiatry*. 2001;179(3):218–223.
5. Birmaher B, Axelson D. Course and outcome of bipolar spectrum disorder in children and adolescents: a review of the existing literature. *Dev Psychopathol*. 2006;18(4):1023–1035.
6. Bastiaansen D, Koot HM, Ferdinand RF, et al. Quality of life in children with psychiatric disorders: self-, parent, and clinician report. *J Am Acad Child Adolesc Psychiatry*. 2004;43(2):221–230.
7. Lewinsohn PM, Rohde P, Seeley JR. Major depressive disorder in older adolescents: prevalence, risk factors, and clinical implications. *Clin Psychol Rev*. 1998;18(7):765–794.
8. Scheffer RE, Kowatch RA, Carmody T, et al. Randomized, placebo-controlled trial of mixed amphetamine salts for symptoms of comorbid ADHD in pediatric bipolar disorder after mood stabilization with divalproex sodium. *Am J Psychiatry*. 2005;162(1):58–64.
9. Bridge JA, Goldstein TR, Brent DA. Adolescent suicide and suicidal behavior. *J Child Psychol Psychiatry*. 2006;47(3–4):372–394.
10. Angold A, Costello EJ. The epidemiology of depression in children and adolescents. In: Goodyer IM, ed. *Cambridge Child and Adolescent Psychiatry. The Depressed Child and Adolescent*. 2001:143–178.
11. Kaneita Y, Ohida T, Osaki Y, et al. Association between mental health status and sleep status among adolescents in Japan: a nationwide cross-sectional survey. *J Clin Psychiatry*. 2007;68(9):1426–1435.
12. Kaneita Y, Yokoyama E, Harano S, et al. Associations between sleep disturbance and mental health status: a longitudinal study of Japanese junior high school students. *Sleep Med*. 2009;10(7):780–786.
13. Birleson P. The validity of depressive disorder in childhood and the development of a self-rating scale: a research report. *J Child Psychol Psychiatry*. 1981;22(1):73–88.
14. Denda K, Kako Y, Sasaki Y, et al. Depressive symptoms in a school sample of children and adolescents: using the Birleson Depression Self-Rating Scale for Children (DSRS-C). *Jpn J Child Adolesc Psychiatry*. 2004;45:424–436.
15. Goldberg D. *Manual of the General Health Questionnaire*. Windsor, UK: NFER Nelson; 1978.
16. Munezawa T, Kaneita Y, Osaki Y, et al. The association between use of mobile phones after lights out and sleep disturbances among Japanese adolescents: a nationwide cross-sectional survey. *Sleep (Basel)*. 2011;34(8):1013–1020.
17. Doi Y, Minowa M. Factor structure of the 12-item General Health Questionnaire in the Japanese general adult population. *Psychiatry Clin Neurosci*. 2003;57(4):379–383.
18. D'Arcy C, Siddique CM. Psychological distress among Canadian adolescents. *Psychol Med*. 1984;14(3):615–628.
19. Shimbo M, Nakamura K, Jing Shi H, et al. Green tea consumption in everyday life and mental health. *Public Health Nutr*. 2005;8(8):1300–1306.
20. Lewinsohn PM, Duncan EM, Stanton AK, et al. Age at first onset for nonbipolar depression. *J Abnorm Psychol*. 1986;95(4):378–383.
21. McGee R, Feehan M, Williams S, et al. *DSM-III* disorders from age 11 to age 15 years. *J Am Acad Child Adolesc Psychiatry*. 1992;31(1):50–59.
22. Lewinsohn PM, Rohde P, Seeley JR, et al. Age-cohort changes in the lifetime occurrence of depression and other mental disorders. *J Abnorm Psychol*. 1993;102(1):110–120.
23. Lewinsohn PM, Seeley JR, Buckley ME, et al. Bipolar disorder in adolescence and young adulthood. *Child Adolesc Psychiatr Clin N Am*. 2002;11(3):461–475, vii.
24. Merikangas KR, Nakamura EF, Kessler RC. Epidemiology of mental disorders in children and adolescents. *Dialogues Clin Neurosci*. 2009;11(1):7–20.
25. Merikangas KR, He JP, Burstein M, et al. Lifetime prevalence of mental disorders in US adolescents: results from the National Comorbidity Survey Replication—Adolescent Supplement (NCS-A). *J Am Acad Child Adolesc Psychiatry*. 2010;49(10):980–989.
26. Biddle SJ, Asare M. Physical activity and mental health in children and adolescents: a review of reviews. *Br J Sports Med*. 2011;45(11):886–895.
27. Johnson KE, Taliaferro LA. Relationships between physical activity and depressive symptoms among middle and older adolescents: a review of the research literature. *J Spec Pediatr Nurs*. 2011;16(4):235–251.
28. Mammen G, Faulkner G. Physical activity and the prevention of depression: a systematic review of prospective studies. *Am J Prev Med*. 2013;45(5):649–657.
29. Eime RM, Young JA, Harvey JT, et al. A systematic review of the psychological and social benefits of participation in sport for children and adolescents: informing development of a conceptual model of health through sport. *Int J Behav Nutr Phys Act*. 2013;10(1):98.
30. Cairns KE, Yap MB, Pilkington PD, et al. Risk and protective factors for depression that adolescents can modify: a systematic review and meta-analysis of longitudinal studies. *J Affect Disord*. 2014;169:61–75.
31. Goldfarb AH, Jamurtas AZ. Beta-endorphin response to exercise: an update. *Sports Med*. 1997;24(1):8–16.
32. Meeusen R. Exercise and the brain: insight in new therapeutic modalities. *Ann Transplant*. 2005;10(4):49–51.
33. Brown JM, Armstrong R. The structure of pupils' worries during transition from junior to secondary school. *Br Educ Res J*. 1982;8(2):123–131.
34. Yousefi F, Mansor MB, Juhari RB, et al. The relationship between gender, age, depression and academic achievement. *Curr Res Psychol*. 2010;1(1):61–66.
35. Low NC, Dugas E, O'Loughlin E, et al. Common stressful life events and difficulties are associated with mental health symptoms and substance use in young adolescents. *BMC Psychiatry*. 2012;12(1):116.
36. Angold A, Costello EJ, Worthman CM. Puberty and depression: the roles of age, pubertal status and pubertal timing. *Psychol Med*. 1998;28(1):51–61.
37. Casper RC. Depression and eating disorders. *Depress Anxiety*. 1998;8(suppl 1):96–104.
38. Godart NT, Flament MF, Perdereau F, et al. Comorbidity between eating disorders and anxiety disorders: a review. *Int J Eat Disord*. 2002;32(3):253–270.
39. Godart NT, Perdereau F, Rein Z, et al. Comorbidity studies of eating disorders and mood disorders: critical review of the literature. *J Affect Disord*. 2007;97(1-3):37–49.
40. American Psychiatric Association. Treatment of patients with eating disorders,third edition. *Am J Psychiatry*. 2006;163(7 suppl):4–54.
41. Mattar L, Huas C, Duclos J, et al. Relationship between malnutrition and depression or anxiety in Anorexia Nervosa: a critical review of the literature. *J Affect Disord*. 2011;132(3):311–318.
42. Christenson PG, Henriksen L, Roberts DF. *Substance Use in Popular Prime-Time Television*. Washington, DC: Office of National Drug Control Policy; 2000.
43. Fisher DA, Hill DL, Grube JW, et al. Gay, lesbian, and bisexual content on television: a quantitative analysis across two seasons. *J Homosex*. 2007;52(3–4):167–188.
44. Bennett MP, Zeller JM, Rosenberg L, et al. The effect of mirthful laughter on stress and natural killer cell activity. *Altern Ther Health Med*. 2003;9(2):38–45.
45. MacDonald CM. A chuckle a day keeps the doctor away: therapeutic humor and laughter. *J Psychosoc Nurs Ment Health Serv*. 2004;42(3):18–25.
46. Richman J. The lifesaving function of humor with the depressed and suicidal elderly. *Gerontologist*. 1995;35(2):271–273.
47. Saper B. The therapeutic use of humor for psychiatric disturbances of adolescents and adults. *Psychiatr Q*. 1990;61(4):261–272.
48. Chen SY, Lu L. After-school time use in Taiwan: effects on educational achievement and well-being. *Adolescence*. 2009;44(176):891–909.
49. Ohannessian CM. Media use and adolescent psychological adjustment: an examination of gender differences. *J Child Fam Stud*. 2009;18(5):582–593.
50. Primack BA, Swanier B, Georgiopoulos AM, et al. Association between media use in adolescence and depression in young adulthood: a longitudinal study. *Arch Gen Psychiatry*. 2009;66(2):181–188.
51. Kaltiala-Heino R, Rimpelä M, Marttunen M, et al. Bullying, depression, and suicidal ideation in Finnish adolescents: school survey. *BMJ*. 1999;319(7206):348–351.
52. Kaltiala-Heino R, Rimpelä M, Rantanen P, et al. Bullying at school—an indicator of adolescents at risk for mental disorders. *J Adolesc*. 2000;23(6):661–674.
53. Fekkes M, Pijpers FI, Verloove-Vanhorick SP. Bullying behavior and associations with psychosomatic complaints and depression in victims. *J Pediatr*. 2004;144(1):17–22.
54. 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(8):760–765.
55. Kim YS, Koh YJ, Leventhal B. School bullying and suicidal risk in Korean middle school students. *Pediatrics*. 2005;115(2):357–363.
56. Brunstein Klomek A, Marrocco F, Kleinman M, et al. Bullying, depression, and suicidality in adolescents. *J Am Acad Child Adolesc Psychiatry*. 2007;46(1):40–49.
57. Carlyle KE, Steinman KJ. Demographic differences in the prevalence, co-occurrence, and correlates of adolescent bullying at school. *J Sch Health*. 2007;77(9):623–629.
58. Fleming LC, Jacobsen KH. Bullying and symptoms of depression in Chilean middle

school students. *J Sch Health*. 2009;79(3):130–137.
59. Fitzpatrick KM, Dulin A, Piko B. Bullying and depressive symptomatology among low-income, African-American youth. *J Youth Adolesc*. 2010;39(6):634–645.
60. Pittet I, Berchtold A, Akré C, et al. Are adolescents with chronic conditions particularly at risk for bullying? *Arch Dis Child*. 2010;95(9):711–716.
61. Barker ED, Arseneault L, Brendgen M, et al. Joint development of bullying and victimization in adolescence: relations to delinquency and self-harm. *J Am Acad Child Adolesc Psychiatry*. 2008;47(9):1030–1038.
62. Haltigan JD, Vaillancourt T. Joint trajectories of bullying and peer victimization across elementary and middle school and associations with symptoms of psychopathology. *Dev Psychol*. 2014;50(11):2426–2436.
63. Lereya ST, Copeland WE, Zammit S, et al. Bully/victims: a longitudinal, population-based cohort study of their mental health. *Eur Child Adolesc Psychiatry*. 2015;24(12):1461–1471.
64. Rudolph KD, Troop-Gordon W, Granger DA. Individual differences in biological stress responses moderate the contribution of early peer victimization to subsequent depressive symptoms. *Psychopharmacology (Berl)*. 2011;214(1):209–219.
65. Cook CR, Williams KR, Guerra NG, et al. Predictors of bullying and victimization in childhood and adolescence: a meta-analytic investigation. *Sch Psychol Q*. 2010;25(2):65–83.
66. Boulton MJ, Smith PK. Bully/victim problems in middle-school children: Stability, self-perceived competence, peer perceptions and peer acceptance. *Br J Dev Psychol*. 1994;12(3):315–329.
67. Veenstra R, Lindenberg S, Oldehinkel AJ, et al. Bullying and victimization in elementary schools: a comparison of bullies, victims, bully/victims, and uninvolved preadolescents. *Dev Psychol*. 2005;41(4):672–682.
68. Georgiou SN. Parental style and child bullying and victimization experiences at school. *Soc Psychol Educ*. 2008;11(3):213–227.
69. Monroe SM. Social support and disorder: toward an untangling of cause and effect. *Am J Community Psychol*. 1983;11(1):81–97.
70. Frese M. Social support as a moderator of the relationship between work stressors and psychological dysfunctioning: a longitudinal study with objective measures. *J Occup Health Psychol*. 1999;4(3):179–192.
71. Stice E, Ragan J, Randall P. Prospective relations between social support and depression: differential direction of effects for parent and peer support? *J Abnorm Psychol*. 2004;113(1):155–159.
72. Lewinsohn PM, Roberts RE, Seeley JR, et al. Adolescent psychopathology, II: psychosocial risk factors for depression. *J Abnorm Psychol*. 1994;103(2):302–315.
73. Barnicot K, Wampold B, Priebe S. The effect of core clinician interpersonal behaviours on depression. *J Affect Disord*. 2014;167:112–117.
74. Kawamichi H, Yoshihara K, Sasaki AT, et al. Perceiving active listening activates the reward system and improves the impression of relevant experiences. *Soc Neurosci*. 2015;10(1):16–26.
75. Harrington R. Affective disorders. In: Rutter M, Taylor EA, eds. *Child and Adolescent Psychiatry*. 4th ed. Oxford, UK: Blackwell Science; 2002:463–485.

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 Karen D. Wagner, MD, PhD, at kwagner@psychiatrist.com.