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ORIGINAL ARTICLE

A nationwide cross-sectional study of difficulty waking up for school among adolescents

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Abstract

Study Objectives: To determine the prevalence of and risk-factors for difficulty waking up for school among adolescents.

Methods: We used a self-administered questionnaire (140 junior high schools [JHSs]; 124 senior high schools [SHSs]) selected randomly in 2012 from throughout Japan.

Results: Total response rate: 60.7%. Data from 38 494 JHS and 61 556 SHS students were analyzed. The prevalence of at least one instance of school tardiness/absence due to difficulty waking up over a 30-day period was 10.9 (95% confidence-interval:10.5–11.3)%/2.9(2.7–3.1)% for JHS-boys and 7.7(7.3–8.1)%/2.0(1.8–2.2)% for JHS-girls. The prevalence was 15.5(15.1–15.9)%/5.6(5.3–5.9)% for SHS-boys and 14.4(14.0–14.8)%/5.9(5.6–6.2)% for SHS-girls. We used ordinal regression to identify the risk factors associated with the experience of school tardiness/absence. Factors significantly associated with school tardiness in all four groups (JHS boys/girls, SHS boys/girls) were "no-participation-in-club-activities," "early-morning-awakening," "feeling bad throughout a morning," "drinking," and "smoking." Among associated factors, the highest odds ratio was found for monthly smoking-days (none vs. at least one-day or more) for JHS-girls at 5.30(3.57–7.85). Factors significantly associated with school absence in all four groups were "no wishing to go to university," "no participation in club activities," "disorders of initiating and maintaining sleep," "long internet use," "drinking," "smoking," "poor-mental-health" and "feeling bad throughout a morning." Among associated factors, the highest odds ratio was found for monthly smoking-days (none vs. at least one-day or more) for JHS-girls at 4.60(3.45–6.15).

Conclusions: These results suggest that the risk factors for difficulty waking up among adolescents are sleep status, lifestyle, and mental health, which can indicate the presence of an underlying disease.

Statement of Significance

Throughout adolescence, the most prevalent sleep complaints are related to difficulty waking up for school in the morning. We conducted a novel nationwide epidemiological study of difficulty waking up for school among adolescents in Japan. Previous sleep epidemiological studies of adolescents have mainly surveyed sleep duration and insomnia; this is the first study from the perspective of difficulty waking up. The associated risk factors (sleep status, lifestyle, mental health status) identified here form a basic knowledge source that can be utilized in research on the diagnosis and treatment of difficulty waking up among adolescents and in the examination of social policies. Future research should examine unmeasured potential confounders, such as socioeconomic status and medical history, using more objective measurement methods.

Key words: sleep wake disorders; circadian rhythm; autonomic nervous system diseases; prevalence; students; risk factors; epidemiology; Japan

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Introduction

Sleep is an important daily habit that helps maintain adolescents' physical and mental health [1]. Multiple previous studies have reported that sleep disorder during adolescence is a risk factor for future onset of physical diseases such as obesity, hypertension, and diabetes mellitus [2]. Sleep disorders have also been linked to decreased cognitive/academic performance through cognitive impairment, difficulties with focus, memory, and attention, impaired decision-making, decreased reaction time, impaired academic performance, and decreased creativity [3, 4]. Moreover, sleep disorders have been associated with increased risk of psychiatric/psychological problems such as alcohol and drug use, aggression, irritability, risky behaviors, anxiety, depression, suicidal thoughts and behaviors, poor impulse control and social skills, and low motivation [3–7].

Thus, sleep is a daily life habit that is important to adolescents' health; accordingly, epidemiological studies of sleep disorders have been vigorously conducted. Nevertheless, many previous epidemiological studies of sleep disorders among adolescents have only focused on sleep duration and insomnia [8].

In the present study, we focused on difficulty waking up for school as a sleep-related problem among adolescents in Japan. Various physical changes occur during adolescence. There are changes in hormonal balance, which lead to physical changes in both boys and girls that mark their transition from childhood to adulthood. Moreover, adolescence is characterized by profound changes in sleep timing and composition [9–14]. In addition to these biological and physiological factors, there are also associated social factors such as changes in their living environment. Thus, difficulty waking up for school is a popular issue in the study of adolescents. Once difficulty waking up becomes increasingly severe and chronic, adolescents become maladapted to school life, possibly leading to more serious problems such as poor grades, poor behavior, and school absenteeism. Even though it has long been known that "after the onset of puberty and throughout the adolescent period, the most prevalent sleep complaints tend to center on difficulty waking up for school in the morning" [15], epidemiological studies with difficulty waking up for school as the primary outcome measure have almost never been conducted previously.

Therefore, we decided to conduct a nationwide epidemiological study with difficulty waking up for school among adolescents as the primary outcome measure. We aimed to determine the prevalence of difficulty waking up for school among adolescents. As a secondary issue, we intended to identify the risk factors associated with the experience of difficulty waking up for school. In planning and carrying out this study, after formulating the hypothesis that the adolescent attributes (sex, age, intelligence, and mental health status) and various lifestyle factors (school life, sleep pattern, sleep disorders, smoking, drinking, and media use) are driving or moderating factors for their difficulty waking up, we carried out an epidemiological analysis of the relationship between these factors and adolescent difficulty waking up. In this study, tardiness and absence due to difficulty waking up were used as outcome measures to evaluate the experience of difficulty waking up for school.

The epidemiological findings related to difficulty waking up obtained through this study can provide valuable insight and suggestions for future efforts to create public health policies for high school students' lifestyle and health guidance. They may also provide a scientific basis for the future consideration of effective public health interventions.

Methods

Study design and participants

We conducted a cross-sectional study of students enrolled in junior/senior high schools selected through random sampling from among schools throughout Japan. In the Japanese education system, students enter JHS, which is the last stage of compulsory education, at the age of 12 years. After 3 years of study (grades 7–9), they graduate from JHS. Those who wish to continue their studies then complete a selection process for entering SHS that consists of taking an entrance exam, after which they are enrolled in SHS. Once again, they study for 3 years (grades 10–12), following which they graduate from SHS. In May 2012, our study group used the single-stage cluster sampling method to randomly sample 140 JHSs (65 053 students) and 124 SHSs (101 591 students) from among 10 018 JHSs and 4603 SHSs located throughout Japan. Students from these schools participated in our survey.

Questionnaire

Our survey involved distributing self-administered questionnaires to participating students, after which the students themselves completed the questionnaire. The questionnaires were distributed mainly in October 2012 to all participating schools. Subsequently, each school distributed the questionnaires to individual students enrolled in their school. The students completed the questionnaires on their own, and each school collected the questionnaires completed by their students. The questionnaires were returned to us in March 2013.

The questionnaire began with two questions and their response options regarding "difficulty waking up for school": (1) "During the past 30 days, have you been late to school because you were unable to wake up in the morning?" Responses: none, 1–3 times, 4–7 times, 8 times, or more. (2) "During the past 30 days, have you been absent from school because you were unable to wake up in the morning?" Responses: none, 1–3 times, 4–7 times, 8 times, or more. The students chose one response from the four options provided. The basic attributes portion of the questionnaire asked the students to identify their sex, age, type of school they attended (junior/senior high school), and grade.

The lifestyle factors portion of the questionnaire asked the students to respond to questions regarding the following: (1) sleep status: sleep duration, presence or absence of insomnia symptoms (disorders of initiating and maintaining sleep (DIMS), and early morning awakening (EMA)), bedtime, and wake-up time; (2) media use: hours spent watching television/using the internet; (3) school life and study: whether they participated in extracurricular activities, whether they wished to continue their education; and (4) monthly drinking and smoking frequency (days).

In our questionnaire, we used the simplified version of the Japanese version of the 12-item General Health Questionnaire (GHQ-12) [16, 17], known as the GHQ-2 [18], which contains only the question that evaluates depression/anxiety factors (asking

whether respondents felt an anxiety and depression in the previous 30 days; response options were "not at all," "no more than usual," "more than usual," and "much more than usual") and the question that evaluates factors reflecting a possible decrease in positive feelings (asking whether respondents could enjoy normal activities in the previous 30 days; response options were "more so than usual," "same as usual," "less than usual," and "much less than usual") to survey participants' mental health status. Previous research has shown that the ability of the GHQ-2 to evaluate mental health status is comparable to that of the GHQ-12 [18]. The GHQ-2 has been indicated to show good sensitivity and specificity (87.0% and 85.1%, respectively) and to provide a cut-off score of ≥1 [18].

Finally, a question regarding subjective symptoms was also included: "During the past 30 days, have you felt bad during the morning?" Responses: never, seldom, sometimes, often, and always. The students chose one response from the five options provided.

Ethical considerations

In conducting this study, the following ethical considerations were made. (1) Prior to implementing the survey, all school principals and associated boards of education were provided with a detailed description of the survey, and their consent to participate in the survey was obtained. (2) Each participating student was provided with a full description of the specifics and objectives of the survey and informed that participation was voluntary, after which written informed consent to participate in this survey was obtained from each individual. (3) After each individual student completed the questionnaire, the anonymous questionnaires were placed into an envelope, which was then sealed and sent back to the researchers. All efforts were made to protect the privacy of all students. (4) Approval for this study was obtained from the Ethics Committee of Nihon University School of Medicine prior to the implementation of the study. (5) This study was conducted in strict accordance with the Ethical Guidelines for Epidemiological Research determined by the Ministry of Education, Culture, Sports, Science and Technology and the Ministry of Health, Labour and Welfare of Japan [19].

Statistical analysis

First, we collected data related to the prevalence of difficulty waking up for school. Specifically, responses to question (1) school tardiness due to difficulty waking up and question (2) school absence due to difficulty waking up, both of which are related to "difficulty waking up for school," were stratified by sex (boys/girls) and type of school (JHS/SHS). Subsequently, we performed a chi-square test to determine the relationship of the prevalence of school tardiness/absence due to difficulty waking up with sex (m/f) and type of school (JHS/SHS).

Next, we performed an ordinal logistic regression analysis with "school tardiness due to difficulty waking up" (none, 1–3 times, 4–7 times, 8 times, or more) as the dependent variable. The following explanatory variables were entered into the model: bedtime, symptoms of insomnia, lifestyle factors (2)–(4), mental health status, and subjective symptoms (feeling bad in the morning). Logit was used as the model formula of ordinal regression analysis. Participants with missing data were excluded from the analysis. Using the same method, we also analyzed "school absence due to difficulty waking up." For the above analyses, participants were divided into four groups (JHS boys, JHS girls, SHS boys, SHS girls), and analysis was performed for each respective group.

For all statistical analyses, the significance level was set at $P < 0.05$. The analyses were performed using IBM SPSS Statistics version 22.0 for Windows (IBM Corp., Armonk, NY, USA).

Results

Participants number and characteristics

Figure 1 shows how participating schools and students were selected. Participation was requested from 140 JHS and 124 SHS. Of these, 94 JHS and 85 SHS agreed to participate in the survey. Thus, the JHS school participation rate was 67.1%, and the SHS school participation rate was 68.5%. Of the 41 965 students enrolled at the 94 JHS, 38 871 students responded to the questionnaire. Of the 67 882 students enrolled at the 85 SHS, 62 263 students responded to the questionnaire. Thus, the JHS student response rate was 92.6%, and the SHS student response rate was 91.7%. Then, the percentage of students who ultimately responded compared to the number of students who were originally selected was used as the "total student response rate" to yield a JHS of 59.8%, a SHS total student response rate of

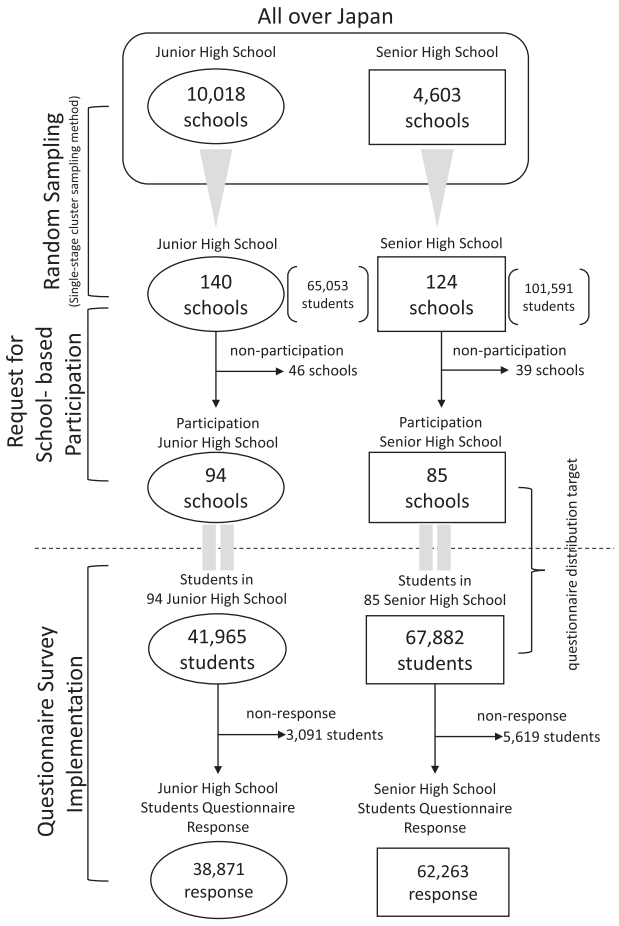

Figure 1. Flowchart of the selection of schools, request for participation, and students' response.

Table 1. Characteristics of the analyzed subjects

	Junior high school		Senior high school	
	Boys n = 19 662	Girls n = 18 832	Boys n = 31 925	Girls n = 29 631
Grade				
Junior high school				
7th	35.2%	34.4%		
8th	33.3%	33.6%		
9th	31.5%	32.0%		
Senior high school				
10th			35.2%	34.6%
11th			32.8%	32.2%
12th			32.0%	33.2%
Wishing to go to university				
Yes	12.4%	9.3%	38.6%	54.0%
No	84.8%	89.4%	38.6%	44.1%
Unknown	2.7%	1.3%	2.9%	1.8%
Participation in club activities				
Yes	80.0%	78.0%	65.9%	62.2%
No	17.0%	20.2%	31.1%	35.8%
Unknown	2.9%	1.8%	3.0%	2.0%
Bedtime				
Before 10 pm	12.6%	7.0%	5.4%	3.2%
Before 0 am	59.5%	59.4%	40.0%	39.5%
Before 2 am	22.0%	29.0%	44.2%	48.7%
After 2 am	3.7%	3.7%	7.9%	6.9%
Unknown	2.2%	1.0%	2.5%	1.7%
Wake up time				
Before 5 am	3.3%	1.7%	5.7%	4.3%
Before 7 am	65.6%	73.0%	66.0%	74.6%
Before 9 am	28.3%	23.8%	25.2%	18.9%
After 9 am	0.4%	0.3%	0.5%	0.3%
Unknown	2.3%	1.1%	2.7%	1.8%
Disorders of initiating and maintaining sleep				
Never/seldom	43.7%	41.4%	41.3%	38.8%
Sometimes	36.5%	39.7%	38.8%	40.8%
Often/always	16.7%	17.3%	16.8%	18.2%
Unknown	3.1%	1.6%	3.1%	2.2%
Early morning awakening				
Never/seldom	81.9%	83.8%	80.4%	80.8%
Sometimes	10.6%	10.4%	12.0%	12.6%
Often/always	5.1%	4.7%	4.8%	4.7%
Unknown	2.3%	1.1%	2.7%	1.8%
Feeling bad throughout a morning				
Never/seldom	63.3%	55.6%	56.0%	49.2%
Sometimes	25.8%	32.6%	30.6%	36.8%
Often/always	8.6%	10.7%	10.7%	12.3%
Unknown	2.3%	1.1%	2.7%	1.8%
Hours spent watching television				
<2 h/d	40.6%	37.6%	59.9%	53.3%
>2 ~ <5 h/d	44.3%	48.6%	30.6%	37.3%
>5 h/d	12.5%	12.6%	6.8%	7.5%
Unknown	2.5%	1.3%	2.7%	1.9%
Hours spent using internet				
<2 h/d	64.8%	63.9%	51.8%	46.8%
>2 ~ <5 h/d	23.9%	25.8%	31.7%	36.2%
>5 h/d	8.9%	9.2%	13.8%	15.2%
Unknown	2.4%	1.1%	2.7%	1.8%
Monthly drinking days				
None	91.9%	91.8%	85.3%	84.3%
1–5 d	6.3%	6.8%	11.8%	13.4%
6–19 d	0.9%	0.7%	2.1%	1.6%
20-d	0.3%	0.2%	0.5%	0.3%
Unknown	0.7%	0.5%	0.4%	0.4%

Table 1. Continued

	Junior high school		Senior high school	
	Boys n = 19 662	Girls n = 18 832	Boys n = 31 925	Girls n = 29 631
Monthly smoking days				
None	97.7%	98.8%	94.9%	97.8%
1–5 d	0.9%	0.6%	1.3%	0.8%
6–19 d	0.5%	0.2%	0.7%	0.3%
20-d	0.8%	0.3%	3.0%	1.0%
Unknown	0.1%	0.1%	0.1%	0.1%
Mental health status				
Good (GHQ-2 score < 1 point)	72.2%	59.6%	61.2%	47.8%
Poor (GHQ-2 score > 1 point)	25.4%	39.3%	36.0%	50.3%
Unknown	2.4%	1.2%	2.8%	1.9%
School tardiness due to difficulty waking up over a 30-day period				
None	86.7%	91.2%	81.7%	83.8%
At least one instance	10.9%	7.7%	15.5%	14.4%
Unknown	2.4%	1.1%	2.7%	1.8%
School absence due to difficulty waking up over a 30-day period				
None	94.7%	96.9%	91.5%	92.2%
At least one instance	2.9%	2.0%	5.6%	5.9%
Unknown	2.4%	1.1%	2.8%	1.9%

GHQ, general health questionnaire.

61.3%, and an overall total student response rate of 60.7%. Of the data obtained from the returned questionnaires, those of 1084 students were invalid due to missing data relating to basic attributes, such as sex and grade, and due to contradictory responses. Data from the remaining 100 050 students were used for the final analysis.

The characteristics of the participants (JHS boys/girls, SHS boys/girls) included in the final analysis are shown in Table 1; 51.6% were boys and 48.4% were girls, and their age ranged from 12 to 19 years.

Prevalence of difficulty waking up for school

Figure 2 shows the prevalence of school tardiness due to difficulty waking up by sex and grade. The percentage of boys who responded that they had at least one experience during the past 30 days of school tardiness due to difficulty waking up was 10.9% (95% confidence interval: 10.5–11.3%) for JHS students, and the percentage of SHS students in this category was 15.5% (15.1–15.9%). The percentage of girls who responded that they had at least one experience during the past 30 days of school tardiness due to difficulty waking up was 7.7% (7.3–8.1%) for JHS students and 14.4% (14.0–14.8%) for SHS students. Thus, a significant relationship was found between sex and prevalence of school tardiness due to difficulty waking up ($P < 0.001$). A significant relationship was also found between grade and prevalence of school tardiness due to difficulty waking up for both boys ($P < 0.001$) and girls ($P < 0.001$).

Figure 3 shows the prevalence of school absence due to difficulty waking up by sex and grade. The percentage of boys who responded that they had at least one experience during the past 30 days of school absence due to difficulty waking up was 2.9% (2.7–3.1%) for JHS students, and the percentage of SHS students in this category was 5.6% (5.3–5.9%). For girls, the percentage for JHS students was 2.0% (1.8–2.2%) and that for SHS students was 5.9% (5.6–6.2%). Thus, a significant relationship was found between sex and prevalence of school absence due to difficulty waking up ($P < 0.001$). Moreover, a significant relationship was also found between grade and prevalence of school absence due to difficulty waking up for both boys ($P < 0.001$) and girls ($P < 0.001$).

Associated risk factors of difficulty waking up for school

Figure 4 shows the results of the ordinal logistic regression analysis (*n*, odds ratio, 95% confidence interval, and *P*-values) with school tardiness due to difficulty waking up (none, 1–3 times, 4–7 times, 8 times, or more) used as the dependent variable.

Factors significantly associated with school tardiness due to difficulty waking up in all four groups (JHS boys/girls, SHS boys/girls) were "not participation in club activities," "EMA," "feeling bad throughout a morning," and "Not wishing to go to university" was not significantly associated with school tardiness in the JHS groups, but the association was significant for the SHS groups. Among the associated factors, the highest odds ratio was found for monthly smoking days (none vs. one day or more) for JHS-girls at 4.60 (3.45–6.15).

Figure 5 shows the results of the ordinal logistic regression analysis (*n*, odds ratio, 95% confidence interval, and *P*-values) with school absence due to difficulty waking up (none, 1–3 times, 4–7 times, 8 times, or more) used as the dependent variable.

Factors significantly associated with school absence due to difficulty waking up in all four groups (JHS boys/girls, SHS boys/girls) were "not wishing to go to university," "not participation in club activities," "DIMS," "feeling bad throughout a morning," "long internet use," "drinking," "smoking," and "poor mental health status." "EMA" was significantly associated with absence in boys, but the association was not significant for girls. Among the associated factors, the highest odds ratio was found for monthly smoking days (none vs. one day or more) for JHS-girls at 4.60 (3.45–6.15).

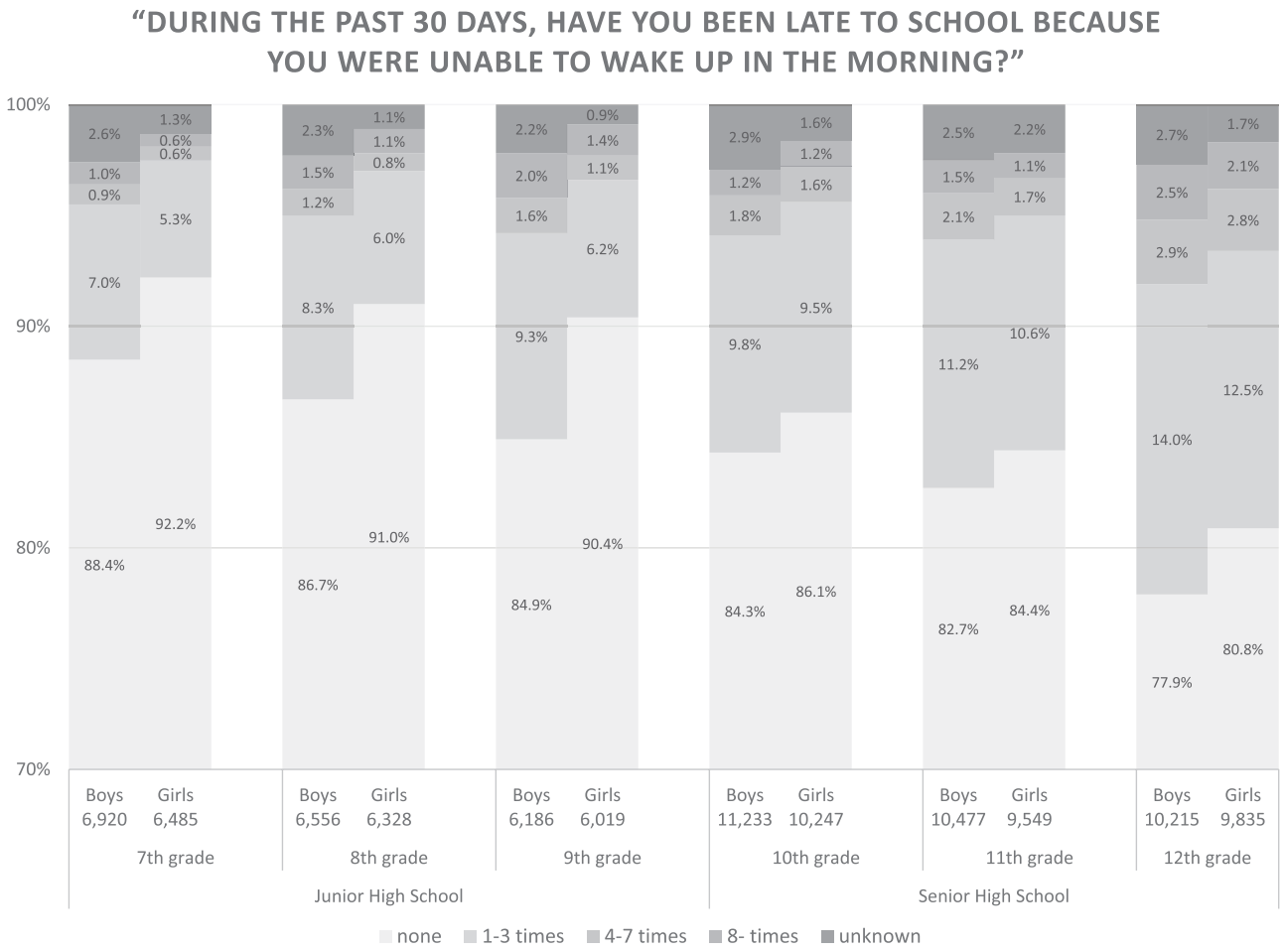

Figure 2. Prevalence of school tardiness due to difficulty waking up in the morning.

Discussion

This epidemiological study successfully determined the prevalence of difficulty waking up for school among adolescents. The prevalence of at least one instance of school tardiness/absence due to difficulty waking up over a 30-day period was 10.9%/2.9% for JHS boys, 7.7%/2.0% for JHS girls, 15.5%/5.6% for SHS boys, and 14.4%/5.9% for SHS girls. Furthermore, sleep status, lifestyles, and mental health were identified as risk factors associated with the experience of difficulty waking up for school. To the best of our knowledge, this study is the world's first epidemiological study with a high degree of national representation that investigated difficulty waking up for school among adolescents. By using big data consisting of over 100 000 cases obtained from participants selected through a strict random sampling method from among students throughout Japan, we were able to conduct a survey with an extremely high degree of statistical reliability.

In this study, we calculated the prevalence of difficulty waking up among high school students. The prevalence of school tardiness/absence due to difficulty waking up in the morning was significantly higher in males than in females and was significantly higher in higher grades. In 2005, the US National Sleep Foundation reported the results of a telephone interview survey of 1602 randomly sampled participants aged 11 to 17 across the entire US [20]. Arriving late or missing school at least once a week within the last 2 weeks was reported by 11% (JHS students 8% and SHS students 12%) [15]. Meanwhile, a study using a web-based questionnaire administered to 8347 participants between the ages of 16 and 19 in the county of Hordaland, Norway found that "5.5% of the adolescents reported oversleeping often (many times a week) or always (every day)" [21]. While the exact questions used differ, the prevalence of difficulty waking up was higher in Japan than in the US or Norway for young people in the same age range. There are likely to be cultural and social factors that also mediate the primary outcome.

In addition, we identified several factors that were significantly related to the experience of difficulty waking up. First, we found that a late bedtime was a significant risk factor for difficulty waking up for school. The onset of puberty triggers "evening preference" in approximately 40% of teenagers [10, 12]. Progression to extreme evening preference leads to the onset of delayed sleep-wake phase disorder (DSWPD) [15]. Second, we found a significant relationship between the frequency of experiencing the subjective symptom "feeling bad in the morning" and the experience of difficulty waking up for school. Difficulty waking up and feeling bad in the morning are the main symptoms of a disorder called orthostatic dysregulation (OD) [22]. Difficulty waking up in the morning is also a main symptom of OD [22]. Third, we found that media use (e.g. television, internet) was significantly related to difficulty waking up. Recent studies have reported that there is a link between excessive internet usage and sleep disorders [23–26]. A study

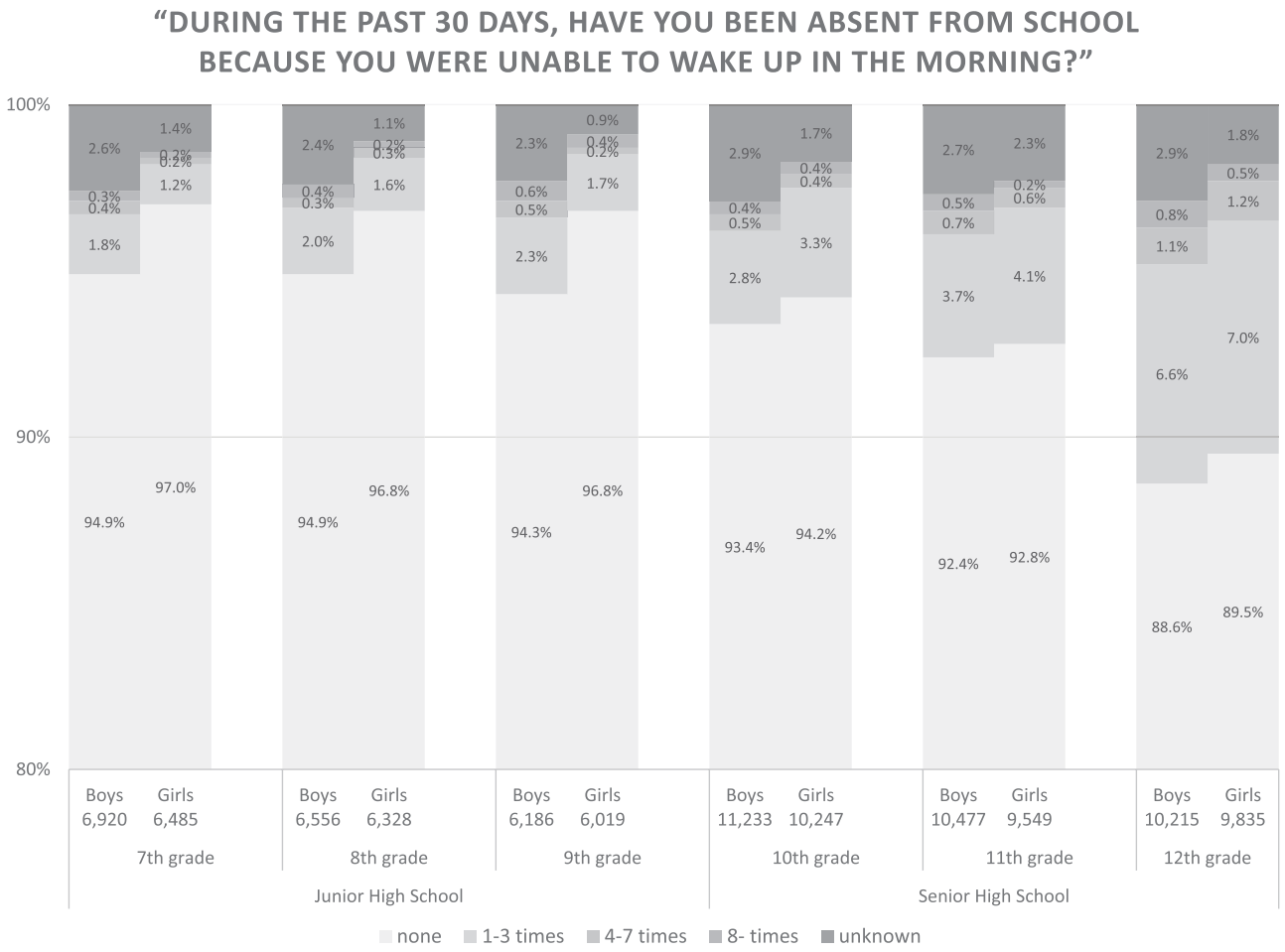

Figure 3. Prevalence of school absence due to difficulty waking up in the morning.

of adolescents reported a significant link between the Internet Addiction Scale [27] and difficulty waking up in the morning [28]. Fourth, smoking and drinking habits were found to be significantly related to difficulty waking up. Finally, we also found a significant link between mental health and difficulty waking up. In psychiatric disorders, hypersomnia is a frequently observed symptom [29].

Study strength and limitations

One of the great strengths of our study is high response rate and national representativeness of the sample. In our study, response rate was calculated in two steps. The first stage is what proportion of schools said yes (school response rate). And then second state is each school what proportion of students said yes (student response rate). Dividing response rate into two steps is advantageous in that it makes the breakdown of nonresponses evident. The survey's total response rate was 60.7%, but this breaks down into a school response rate of approximately 70% in the first step and a student response rate of over 90% in the second step. In other words, the cause of non-response was more so nonparticipation at the school level than non-participation in the survey by students themselves. As this survey addresses students, not schools, the extremely high response rate for students is a strength and signifies high reliability.

This study has several limitations. First, we used a subjective assessment method in the form of a self-administered questionnaire rather than objective measurement methods such as a polygraph or actigraph test. Second, although we asked multiple questions to identify the associated risk factors for difficulty waking up, we were unable to include more questions due to ethical considerations and space restrictions. For example, we could have asked about students' socioeconomic status (household finances, academic records), their sleeping environment (e.g. the temperature and humidity of their bedrooms, the number of people with whom they sleep), and their medical history. We cannot rule out the possibility that these factors may be unmeasured confounders related to the experience of difficulty waking up, and therefore, they should be considered in future research on this issue. Finally, due to the cross-sectional design of the study, we were unable to address the issue of causality in the relationship between the experience of difficulty waking up and the associated risk factors [30]. Despite these limitations, this study provides novel epidemiological data on the experience of difficulty waking up among high school students.

Clinical utility and future research

In our study, we performed sex-specific analyses in JHS and SHS. This analysis identified some important differences in correlates

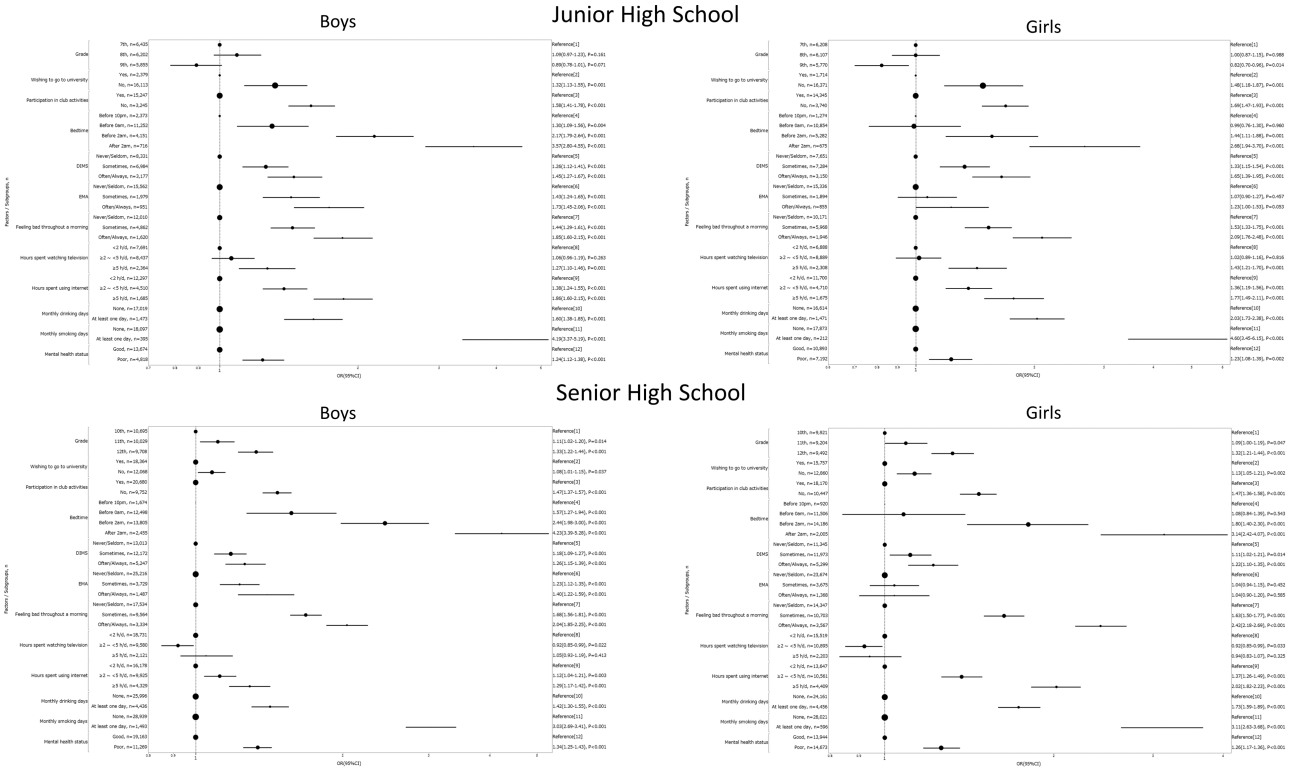

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Figure 4. Associated factors of school tardiness due to difficulty waking up in the morning. Subjects with missing data were excluded from the analysis. The dependent variable was the experience of school tardiness due to difficulty waking up (none, 1–3 times, 4–7 times, 8 times, or more) over the past 30 days. OR(95%CI) was calculated by ordinal logistic regressions. The circle size represents sample size.

OR, odds ratio; CI, confidence interval; DIMS, disorders of initiating and maintaining sleep; EMA, early morning awakening

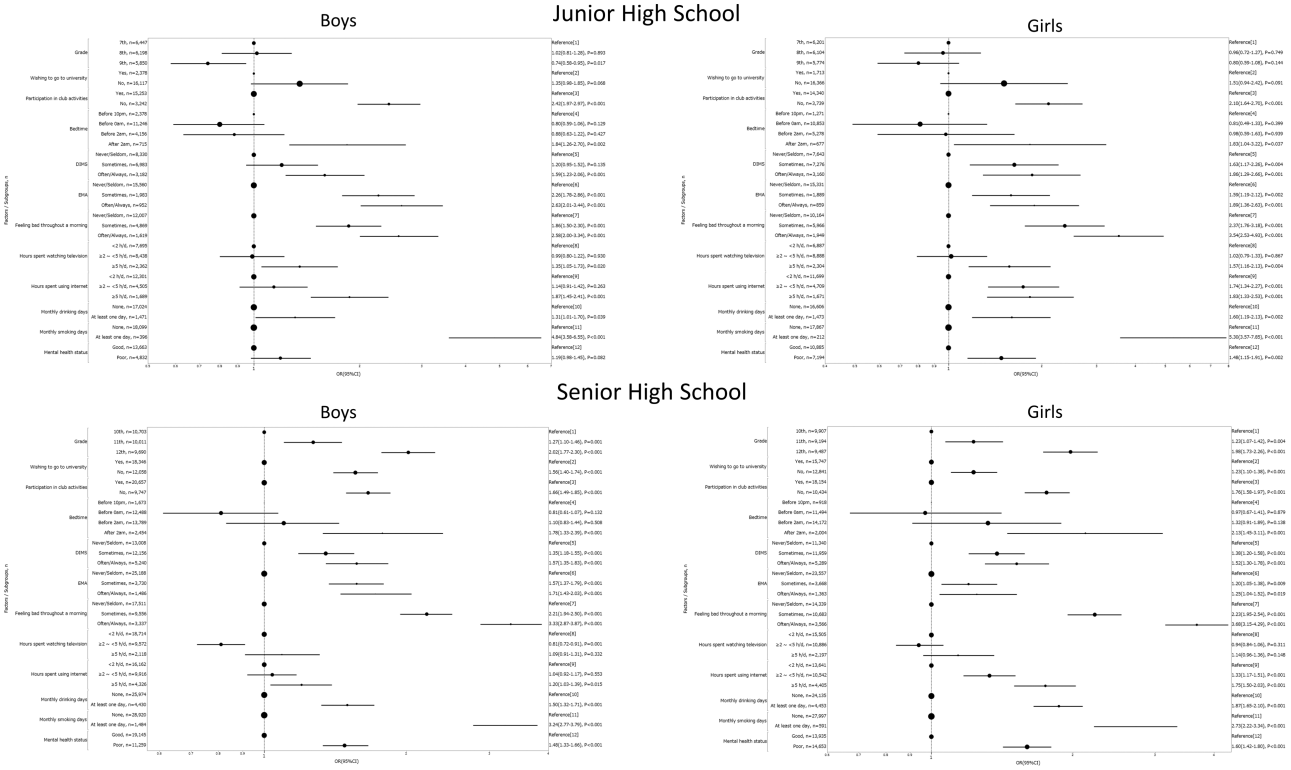

Figure 5. Associated factors of school absence due to difficulty waking up in the morning. Subjects with missing data were excluded from the analysis. The dependent variable was the experience of school absence due to difficulty waking up (none, 1–3 times, 4–7 times, 8 times, or more) over the past 30 days. OR(95%CI) was calculated by ordinal logistic regressions. The circle size represents sample size.

OR, odds ratio; CI, confidence interval; DIMS, disorders of initiating and maintaining sleep; EMA, early morning awakening

of difficulty waking. For example, in the analysis of factors associated with school tardiness due to difficulty waking up in JHS, EMA was found to have a significant relationship with absence in boys, but a significant relationship was not observed for girls. In the analysis of factors associated with school tardiness due to difficulty waking up in JHS, mental health status was not found to have a significant relationship for boys but was found to have a significant relationship for girls. Identification of modifiable risks/correlates in JHS will be important to optimize sleep health and school attendance in SHS. This analytical approach would allow the development of possible interventions for testing in trials of sleep hygiene to reduce difficulties awakening and develop policies on providing appropriate lifestyle and health guidance to high school students. For example, in this study, the lifestyle factors that correlated with difficulty waking up in all analysis categories were "drinking" and "smoking." If students to whom these factors applied were able to improve their situation, either through personal interventions involving smoking/drinking cessation guidance or population interventions consisting of general hygiene education, it is likely that this type of public health approach would be able to contribute substantially to solving problems related to difficulty waking up. Finally, our results can be used to inform the development of future epidemiological studies. First, the present findings may be useful when planning more advanced cohort and interventional epidemiological studies in the future. Second, the novel and important evidence reported here can be used when conducting research to provide high-level evidence through the systematic review and meta-analysis of multiple epidemiological studies on the issue of difficulty waking up.

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