

性別、中高別、学年別にみた使用する  
インターネット使用制限の失敗(質問67-3)

性別	中高別	インターネット使用制限の失敗				
		なかった	あった	不明	合計	
男	中学 学年	1年生 度数	1253	242	39	1534
		1年生 学年の%	81.7	15.8	2.5	100.0
		2年生 度数	1279	265	24	1568
		2年生 学年の%	81.6	16.9	1.5	100.0
		3年生 度数	1074	314	17	1405
	3年生 学年の%	76.4	22.3	1.2	100.0	
	不明 度数	13	4	1	18	
	不明 学年の%	72.2	22.2	5.6	100.0	
	合計 度数	3619	825	81	4525	
	合計 学年の%	80.0	18.2	1.8	100.0	
	高校 学年	1年生 度数	1561	481	22	2064
		1年生 学年の%	75.6	23.3	1.1	100.0
		2年生 度数	1575	435	15	2025
		2年生 学年の%	77.8	21.5	0.7	100.0
3年生 度数		1509	494	16	2019	
3年生 学年の%	74.7	24.5	0.8	100.0		
不明 度数	11	4	1	16		
不明 学年の%	68.8	25.0	6.3	100.0		
合計 度数	4656	1414	54	6124		
合計 学年の%	76.0	23.1	0.9	100.0		
女	中学 学年	1年生 度数	1100	285	22	1407
		1年生 学年の%	78.2	20.3	1.6	100.0
		2年生 度数	1129	325	11	1465
		2年生 学年の%	77.1	22.2	0.8	100.0
		3年生 度数	956	404	12	1372
	3年生 学年の%	69.7	29.4	0.9	100.0	
	不明 度数	25	10	0	35	
	不明 学年の%	71.4	28.6	0.0	100.0	
	合計 度数	3210	1024	45	4279	
	合計 学年の%	75.0	23.9	1.1	100.0	
	高校 学年	1年生 度数	1491	777	13	2281
		1年生 学年の%	65.4	34.1	0.6	100.0
		2年生 度数	1507	685	12	2204
		2年生 学年の%	68.4	31.1	0.5	100.0
3年生 度数		1592	760	18	2370	
3年生 学年の%	67.2	32.1	0.8	100.0		
不明 度数	21	5	0	26		
不明 学年の%	80.8	19.2	0.0	100.0		
合計 度数	4611	2227	43	6881		
合計 学年の%	67.0	32.4	0.6	100.0		

性別、中高別、学年別にみた使用する  
インターネットの使用制限に伴う不快感情(質問67-4)

性別	中高別	インターネット使用制限に伴う不快感情				
		いいえ	はい	不明	合計	
男	中学 学年	1年生 度数	1100	285	22	1407
		1年生 学年の%	78.2	20.3	1.6	100.0
		2年生 度数	1129	325	11	1465
		2年生 学年の%	77.1	22.2	0.8	100.0
		3年生 度数	956	404	12	1372
	3年生 学年の%	69.7	29.4	0.9	100.0	
	不明 度数	25	10	0	35	
	不明 学年の%	71.4	28.6	0.0	100.0	
	合計 度数	3210	1024	45	4279	
	合計 学年の%	75.0	23.9	1.1	100.0	
	高校 学年	1年生 度数	1491	777	13	2281
		1年生 学年の%	65.4	34.1	0.6	100.0
		2年生 度数	1507	685	12	2204
		2年生 学年の%	68.4	31.1	0.5	100.0
3年生 度数		1592	760	18	2370	
3年生 学年の%	67.2	32.1	0.8	100.0		
不明 度数	21	5	0	26		
不明 学年の%	80.8	19.2	0.0	100.0		
合計 度数	4611	2227	43	6881		
合計 学年の%	67.0	32.4	0.6	100.0		
女	中学 学年	1年生 度数	1238	147	22	1407
		1年生 学年の%	88.0	10.4	1.6	100.0
		2年生 度数	1256	200	9	1465
		2年生 学年の%	85.7	13.7	0.6	100.0
		3年生 度数	1141	219	12	1372
	3年生 学年の%	83.2	16.0	0.9	100.0	
	不明 度数	30	5	0	35	
	不明 学年の%	85.7	14.3	0.0	100.0	
	合計 度数	3665	571	43	4279	
	合計 学年の%	85.7	13.3	1.0	100.0	
	高校 学年	1年生 度数	1826	447	8	2281
		1年生 学年の%	80.1	19.6	0.4	100.0
		2年生 度数	1789	404	11	2204
		2年生 学年の%	81.2	18.3	0.5	100.0
3年生 度数		1952	402	16	2370	
3年生 学年の%	82.4	17.0	0.7	100.0		
不明 度数	21	5	0	26		
不明 学年の%	80.8	19.2	0.0	100.0		
合計 度数	5588	1258	35	6881		
合計 学年の%	81.2	18.3	0.5	100.0		

性別、中高別、学年別にみた使用する  
意図したよりも長いインターネット使用(質問67-5)

性別	中高別	意図したよりも長いインターネット使用				
		いいえ	はい	不明	合計	
男	中学 学年	1年生 度数	1291	199	44	1534
		1年生 学年の%	84.2	13.0	2.9	100.0
		2年生 度数	1236	312	20	1568
		2年生 学年の%	78.8	19.9	1.3	100.0
		3年生 度数	1038	346	21	1405
	3年生 学年の%	73.9	24.6	1.5	100.0	
	不明 度数	13	4	1	18	
	不明 学年の%	72.2	22.2	5.6	100.0	
	合計 度数	3578	861	86	4525	
	合計 学年の%	79.1	19.0	1.9	100.0	
	高校 学年	1年生 度数	1362	681	21	2064
		1年生 学年の%	66.0	33.0	1.0	100.0
		2年生 度数	1308	699	18	2025
		2年生 学年の%	64.6	34.5	0.9	100.0
3年生 度数		1296	710	13	2019	
3年生 学年の%	64.2	35.2	0.6	100.0		
不明 度数	10	5	1	16		
不明 学年の%	62.5	31.3	6.3	100.0		
合計 度数	3976	2095	53	6124		
合計 学年の%	64.9	34.2	0.9	100.0		
女	中学 学年	1年生 度数	1096	277	34	1407
		1年生 学年の%	77.9	19.7	2.4	100.0
		2年生 度数	1019	426	20	1465
		2年生 学年の%	69.6	29.1	1.4	100.0
		3年生 度数	933	423	16	1372
	3年生 学年の%	68.0	30.8	1.2	100.0	
	不明 度数	28	7	0	35	
	不明 学年の%	80.0	20.0	0.0	100.0	
	合計 度数	3076	1133	70	4279	
	合計 学年の%	71.9	26.5	1.6	100.0	
	高校 学年	1年生 度数	1284	986	11	2281
		1年生 学年の%	56.3	43.2	0.5	100.0
		2年生 度数	1227	961	16	2204
		2年生 学年の%	55.7	43.6	0.7	100.0
3年生 度数		1307	1036	27	2370	
3年生 学年の%	55.1	43.7	1.1	100.0		
不明 度数	14	12	0	26		
不明 学年の%	53.8	46.2	0.0	100.0		
合計 度数	3832	2995	54	6881		
合計 学年の%	55.7	43.5	0.8	100.0		

性別、中高別、学年別にみた  
インターネットによる日常の活動への問題(質問67-6)

性別	中高別	インターネットによる日常の活動への問題				
		なかった	あった	不明	合計	
男	中学 学年	1年生 度数	1449	49	36	1534
		1年生 学年の%	94.5	3.2	2.3	100.0
		2年生 度数	1502	45	21	1568
		2年生 学年の%	95.8	2.9	1.3	100.0
		3年生 度数	1317	70	18	1405
	3年生 学年の%	93.7	5.0	1.3	100.0	
	不明 度数	15	2	1	18	
	不明 学年の%	83.3	11.1	5.6	100.0	
	合計 度数	4283	166	76	4525	
	合計 学年の%	94.7	3.7	1.7	100.0	
	高校 学年	1年生 度数	1914	131	19	2064
		1年生 学年の%	92.7	6.3	0.9	100.0
		2年生 度数	1895	117	13	2025
		2年生 学年の%	93.6	5.8	0.6	100.0
3年生 度数		1884	122	13	2019	
3年生 学年の%	93.3	6.0	0.6	100.0		
不明 度数	13	2	1	16		
不明 学年の%	81.3	12.5	6.3	100.0		
合計 度数	5706	372	46	6124		
合計 学年の%	93.2	6.1	0.8	100.0		
女	中学 学年	1年生 度数	1350	34	23	1407
		1年生 学年の%	95.9	2.4	1.6	100.0
		2年生 度数	1397	60	8	1465
		2年生 学年の%	95.4	4.1	0.5	100.0
		3年生 度数	1289	70	13	1372
	3年生 学年の%	94.0	5.1	0.9	100.0	
	不明 度数	32	3	0	35	
	不明 学年の%	91.4	8.6	0.0	100.0	
	合計 度数	4068	167	44	4279	
	合計 学年の%	95.1	3.9	1.0	100.0	
	高校 学年	1年生 度数	2114	161	6	2281
		1年生 学年の%	92.7	7.1	0.3	100.0
		2年生 度数	2019	176	9	2204
		2年生 学年の%	91.6	8.0	0.4	100.0
3年生 度数		2186	169	15	2370	
3年生 学年の%	92.2	7.1	0.6	100.0		
不明 度数	25	1	0	26		
不明 学年の%	96.2	3.8	0.0	100.0		
合計 度数	6344	507	30	6881		
合計 学年の%	92.2	7.4	0.4	100.0		

性別、中高別、学年別にみた  
インターネットへの熱中を隠すための嘘(質問67-7)

性別	中高別	インターネットへの熱中を隠すための嘘				
		なかった	あった	不明	合計	
男	中学 学年	1年生 度数	1427	72	35	1534
		学年の%	93.0	4.7	2.3	100.0
		2年生 度数	1490	64	14	1568
		学年の%	95.0	4.1	0.9	100.0
		3年生 度数	1262	126	17	1405
	学年の%	89.8	9.0	1.2	100.0	
	不明 度数	15	2	1	18	
	学年の%	83.3	11.1	5.6	100.0	
	合計 度数	4194	264	67	4525	
	学年の%	92.7	5.8	1.5	100.0	
	高校 学年	1年生 度数	1840	206	18	2064
		学年の%	89.1	10.0	0.9	100.0
		2年生 度数	1812	201	12	2025
		学年の%	89.5	9.9	0.6	100.0
3年生 度数		1811	197	11	2019	
学年の%	89.7	9.8	0.5	100.0		
不明 度数	13	2	1	16		
学年の%	81.3	12.5	6.3	100.0		
合計 度数	5476	606	42	6124		
学年の%	89.4	9.9	0.7	100.0		
女	中学 学年	1年生 度数	1305	85	17	1407
		学年の%	92.8	6.0	1.2	100.0
		2年生 度数	1333	125	7	1465
		学年の%	91.0	8.5	0.5	100.0
		3年生 度数	1232	128	12	1372
	学年の%	89.8	9.3	0.9	100.0	
	不明 度数	28	7	0	35	
	学年の%	80.0	20.0	0.0	100.0	
	合計 度数	3898	345	36	4279	
	学年の%	91.1	8.1	0.8	100.0	
	高校 学年	1年生 度数	1990	283	8	2281
		学年の%	87.2	12.4	0.4	100.0
		2年生 度数	1959	234	11	2204
		学年の%	88.9	10.6	0.5	100.0
3年生 度数		2103	253	14	2370	
学年の%	88.7	10.7	0.6	100.0		
不明 度数	24	2	0	26		
学年の%	92.3	7.7	0.0	100.0		
合計 度数	6076	772	33	6881		
学年の%	88.3	11.2	0.5	100.0		

性別、中高別、学年別にみた  
不快感の回避としてのインターネット使用(質問67-8)

性別	中高別	不快感の回避としてのインターネット使用				
		いいえ	はい	不明	合計	
男	中学 学年	1年生 度数	1447	60	27	1534
		学年の%	94.3	3.9	1.8	100.0
		2年生 度数	1477	76	15	1568
		学年の%	94.2	4.8	1.0	100.0
		3年生 度数	1283	106	16	1405
	学年の%	91.3	7.5	1.1	100.0	
	不明 度数	14	3	1	18	
	学年の%	77.8	16.7	5.6	100.0	
	合計 度数	4221	245	59	4525	
	学年の%	93.3	5.4	1.3	100.0	
	高校 学年	1年生 度数	1804	242	18	2064
		学年の%	87.4	11.7	0.9	100.0
		2年生 度数	1770	243	12	2025
		学年の%	87.4	12.0	0.6	100.0
3年生 度数		1770	237	12	2019	
学年の%	87.7	11.7	0.6	100.0		
不明 度数	14	1	1	16		
学年の%	87.5	6.3	6.3	100.0		
合計 度数	5358	723	43	6124		
学年の%	87.5	11.8	0.7	100.0		
女	中学 学年	1年生 度数	1293	96	18	1407
		学年の%	91.9	6.8	1.3	100.0
		2年生 度数	1264	193	8	1465
		学年の%	86.3	13.2	0.5	100.0
		3年生 度数	1178	185	9	1372
	学年の%	85.9	13.5	0.7	100.0	
	不明 度数	28	7	0	35	
	学年の%	80.0	20.0	0.0	100.0	
	合計 度数	3763	481	35	4279	
	学年の%	87.9	11.2	0.8	100.0	
	高校 学年	1年生 度数	1850	424	7	2281
		学年の%	81.1	18.6	0.3	100.0
		2年生 度数	1723	470	11	2204
		学年の%	78.2	21.3	0.5	100.0
3年生 度数		1842	516	12	2370	
学年の%	77.7	21.8	0.5	100.0		
不明 度数	22	4	0	26		
学年の%	84.6	15.4	0.0	100.0		
合計 度数	5437	1414	30	6881		
学年の%	79.0	20.5	0.4	100.0		

**Sleep drunkenness and sleep-related bruxism**  
**among Japanese adolescents: A nationwide representative survey**

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## ABSTRACT

**Objective:** The main objective of this study was to clarify the prevalence of sleep drunkenness and sleep-related bruxism and their associated factors among Japanese adolescents.

**Method:** This study was cross-sectional survey. The targets were students attending junior and senior high schools throughout Japan. Sample schools were selected by cluster sampling. Self-reported anonymous questionnaires were sent to schools for all students to fill out. The questionnaire asked for personal data as well as information on lifestyle, mental health status, and sleep status, including the frequency of experiencing sleep drunkenness and sleep-related bruxism. A total of 99,416 adolescents responded. The overall response rate was 63.7%, and 98,411 questionnaires were subjected to analysis. The survey period was from October 2010 to March 2011.

**Results:** The prevalence of sleep drunkenness was 7.1% (95% confidence interval [CI]: 6.9%–7.3%) among boys and 7.7% (95% CI: 7.5%–7.9%) among girls. The prevalence of sleep-related bruxism was 2.3% (95% CI: 2.2%–2.4%) among boys and 3.0% (95% CI: 2.8%–3.2%) among girls. The factors associated with sleep drunkenness were smoking, drinking, and depression (all  $p < 0.001$ ); the factors associated with sleep-related bruxism were smoking, drinking alcohol, decrease in positive feelings, and depressive feelings (all  $p < 0.001$ ).

**Conclusions:** If sleep drunkenness or sleep-related bruxism is observed in an adolescent, his or her smoking habit, alcohol-drinking habit, sleep status, and mental status should be considered.

**Keywords:** disorders of arousal, confusional arousal, parasomnia, epidemiology, risk factor



## INTRODUCTION

Many studies have indicated that sleep disturbance might cause physical and mental problems.<sup>1-4</sup> Sleep disturbance is observed not only among adults but also among adolescents, with a reported prevalence in adolescents of 10%–40%.<sup>5-7</sup> Previous epidemiological studies of sleep disturbance among adolescents have focused on sleep deprivation and insomnia, and only a few epidemiological studies have investigated other types sleep disturbance worldwide.

Parasomnia is a generic term for abnormal behavior during sleep. In the present study, we focused on sleep drunkenness and sleep-related bruxism, which are classified as parasomnias.

Sleep drunkenness is a generic term for symptoms arising from incomplete arousal from sleep. According to the Second Edition of the International Classification of Sleep Disorders (ICSD-2), sleep drunkenness is a disorder of arousal among parasomnias.<sup>8</sup> In addition, disorders of arousal are divided into three symptoms: confusional arousal, sleepwalking, and sleep terrors.<sup>8</sup> Confusional arousal is a condition in which an individual awakens from sleep and remains in a sleep-fogged state for periods ranging from several minutes to sometimes several hours, in

contrast to only several seconds in healthy individuals. Sleepwalking is a series of complex behaviors such as walking around while an individual is actually asleep. It may involve a wide range of behaviors, including just sitting up, going up and down stairs, or going to another room to get a drink of water, as if the individual intends to do so. Sleep terrors are characterized by abrupt arousals with screaming and shouting. Some common genetic predispositions are suspected to be onset factors for sleep drunkenness, and sleep deprivation is considered to induce sleep drunkenness.<sup>9-11</sup>

Sleep-related bruxism is defined by the ICSD-2 as an oral activity characterized by grinding (generating noise) or clenching (not generating noise) of the teeth during sleep and usually associated with sleep arousal. Factors that have conventionally been thought to contribute to sleep-related bruxism include mental factors,<sup>12,13</sup> and factors associated with the peripheral nervous system, such as an occlusal abnormality.<sup>14</sup> In addition, from the aspect of dysfunction of the central nervous system, associations with an abnormality of neurotransmitter receptors in the brain have been reported.<sup>15</sup>

To date, few nationwide epidemiological data are available on these disorders in adolescents. Therefore, we conducted a nationwide survey on sleep drunkenness and sleep-related bruxism among

adolescents in Japan. The primary purpose of this study was to clarify the prevalence of sleep drunkenness and sleep-related bruxism among Japanese adolescents; the secondary purpose was to clarify the factors associated with sleep drunkenness and sleep-related bruxism in this population.

## METHOD

### Subjects and sampling

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 at senior high school. In this report, the first to third years of junior high school are referred to as the 7th to 9th grades, and the first to third years of senior high school as the 10th to 12th grades.

For this study, of the 10,785 junior high schools and 4,991 senior high schools registered in Japan, 131 junior high schools and 113 senior high schools were sampled. We used a stratified, single-stage cluster sampling method in which. All the students enrolled in the sampled schools were the subjects of this study. We sent the same number of questionnaires as the number of students enrolled at the school. In this study, the following ethical considerations were taken into account: (1) subjects' participation in the study was

voluntary, and their informed consent was required; (2) subjects' willingness to cooperate was confirmed in writing; and (3) permission to conduct the study was obtained from the Ethics Committee of the institution to which the authors belonged. This survey was approved by the Ethics Committee of the Nihon University School of Medicine. The survey period was from October 2010 to March 2011.

### Measures

The major areas that were included in the questionnaire were (1) personal data and lifestyle (2) sleep status, including sleep drunkenness and sleep-related bruxism, and (3) mental health status. The personal data included sex and school grade. The questions related to lifestyle were whether eating breakfast everyday (No/Yes), participation in club activities (No/Yes), wishing to go to university (No/Yes), smoking (No/Yes), and alcohol-drinking (No/Yes). The sleep status items included sleep duration (less than 6 h/6 h or more but less than 8 h/8 h or more), naptime (less than 15 min/15 min or more but less than 60 min /60min or more), subjective sleep assessment (very good/good/bad/very bad), and difficulty initiating sleep (never/seldom/sometimes/often/always).

The question on sleep drunkenness focused on whether the students had told their family members or

friends they had had sleep drunkenness in the previous 30 days; the answer options were never/seldom/sometimes/often/always. For statistical analyses, two definitions were prepared in relation to experience of sleep drunkenness. (1) The respondents who selected “never” or “seldom” were classified into the “no experience of sleep drunkenness” category, and those who selected “sometimes,” “often,” or “always” were classified into the “with experience of sleep drunkenness” category. (2) The respondents who selected “never,” “seldom,” or “sometimes” were classified into the “no experience of sleep drunkenness” category, and those who selected “often” or “always” were classified into the “with experience of sleep drunkenness” category. The question on sleep-related bruxism focused on whether the students had told their family members or friends that they had had bruxism while asleep in the previous 30 days; the answer options were never/seldom/sometimes/often/always. For statistical analyses, two definitions were also prepared in relation to experience of sleep-related bruxism. (1) The respondents who selected “never” or “seldom” were classified into the “no experience of sleep-related bruxism” category, and those who selected “sometimes,” “often,” or “always” were classified into the “with experience of sleep-related bruxism” category. (2) The respondents who selected “never,” “seldom,” or “sometimes” were classified into

the “no experience of sleep-related bruxism” category, and those who selected “often” or “always” were classified into the “with experience of sleep-related bruxism” category.

To evaluate the mental health statuses of the respondents, two independent factors (depression/anxiety and decrease in positive feeling) included in the 12-item General Health Questionnaire (GHQ-12)<sup>16,17</sup> were used. One of the items from the depression/anxiety factor (having depressive feelings) was evaluated (not at all/no more than usual/more than usual/much more than usual). One of the items from the decrease in positive feeling factor (enjoyed normal activities) was also evaluated (more so than usual/same as usual/less than usual/much less than usual). Previous studies have shown that evaluation of mental health status using depression symptoms with the GHQ-12 and with this cutoff point has a sensitivity of 87.0% and a specificity of 85.1%.<sup>18</sup>

### **Statistical analyses**

We calculated the frequency of sleep drunkenness based on the sex of the student and the student’s grade in school. Calculations and analyses of sleep-related bruxism were performed using the same approach.

Next, a multiple logistic regression analysis was performed to examine factors associated with sleep

drunkenness. Specifically, definitions 1 and 2 with regard to sleep drunkenness were used as the response variables, and the following factors were considered independent variables: sex, grade in school, with/without smoking habit, with/without alcohol-drinking habit, with/without eating breakfast, with/without participation in club activities, wishing/not wishing to go to university, sleep duration, nap time, frequency of difficulty initiating sleep, frequency of difficulty maintaining sleep, frequency of early-morning awakening, subjective sleep sufficiency assessment, assessment of positive feelings, and assessment of depressive feelings. Analyses of sleep-related bruxism were also performed using the same approach.

## RESULTS

### Response rates

Replies were obtained from 89 of the 131 junior high schools (school response rate = 67.9%) and 81 of the 113 senior high schools (school response rate = 71.7%). A total of 99,416 envelopes were collected. Accordingly, the overall response rate was 61.9% for the junior high schools, 64.9% for the senior high schools, and 63.7% as a whole. Of the collected questionnaires, 1,005 were excluded because the sex or grade was not specified or the answers were

inconsistent. The data for the remaining 98,411 questionnaires were analyzed.

### Prevalence of sleep drunkenness and sleep-related bruxism

The results of responses regarding sleep drunkenness based on sex and grade in school are shown in Table 1. With regard to the entire study population, 24.5% (95% confidence interval [CI]: 24.2%–24.8%) of the respondents selected “sometimes,” “often,” or “always” when asked about the frequency of experiencing sleep drunkenness, whereas 7.4% (95% CI: 7.2%–7.6%) selected “often” or “always.”

The results of responses regarding sleep-related bruxism based on sex and grade in school are shown in Table 2. With regard to the entire study population, 6.5% (95% CI: 6.3%–6.7%) of the respondents selected “sometimes,” “often,” or “always” when asked about the frequency of experiencing sleep-related bruxism, whereas 2.7% (95% CI: 2.6%–2.8%) selected “often” or “always.”

### Associations between sleep drunkenness and personal data, lifestyle, sleep status and mental health status

The results of multiple logistic regression analysis of associations between sleep drunkenness and

personal data, lifestyle, sleep status, and mental health status are shown in Table 3. Significant associations were observed between sleep drunkenness and each variable except “sex” and “wish to go to university” when either definition 1 or definition 2 was used. The factors with higher adjusted odds ratios were as follows: with smoking habit (than “without”), with alcohol-drinking habit (than “without”), and having depressive feelings much more than usual (than not at all).

#### **Associations between sleep-related bruxism and personal data, lifestyle, sleep status and mental health status**

The results of multiple logistic regression analysis of associations between sleep-related bruxism and personal data, lifestyle, sleep status, and mental health status are shown in Table 4. The factors that indicated significant associations with sleep-related bruxism when either definition 1 or definition 2 was used were as follows: with smoking habit (than “without”), with alcohol-drinking habit (than “without”), enjoyed normal activities much less than usual (than more so than usual), and having depressive feelings much more than usual (than not at all).

## **DISCUSSION**

The present study examined the prevalence of sleep drunkenness and sleep-related bruxism and their associated factors among modern Japanese adolescents using representative samples. To date, no epidemiological study on sleep drunkenness and sleep-related bruxism has included nearly 100,000 participants; to our knowledge, this is the first such study in the world.

#### **Sleep drunkenness**

A previous epidemiological study on sleep drunkenness was conducted by Hublin et al. and included 11,220 adults.<sup>19</sup> According to the findings of that study, when asked about the frequency of sleepwalking in childhood and adulthood, 2.0%, 5.7%, and 17.9% of men and 2.8%, 5.7%, and 17.0% of women responded “often,” “sometimes,” and “a few times,” respectively. The results of a telephone survey conducted by Ohayon et al. showed that the prevalence of confusional arousal, sleepwalking, and sleep terrors among participants aged 15–24 years was 8.9%, 4.9%, and 2.6%, respectively, in a study of 4,972 general members of the population living in the United Kingdom.<sup>20</sup> The prevalence values reported in these studies as well as our study might have varied because different questions were used in each study. For example, with regard to sleep drunkenness, we did not ask separate questions on confusional arousal,

sleepwalking, and sleep terrors. For international development of future epidemiological studies on sleep drunkenness, standardization of the diagnosis and definition methods must be considered.

We also analyzed factors associated with sleep drunkenness, and the results indicated that smoking, drinking alcohol, and depressive feelings were significantly associated with sleep drunkenness. Several epidemiological studies have already reported associations between smoking and sleep disturbance.<sup>21</sup> In addition, Ohayon reported that the odds ratio of confusional arousal among daily smokers was 1.7.<sup>20</sup> A significant association was observed between smoking and sleep drunkenness in our study, which concurs with the results of the previous studies. A possible physiological mechanism by which smoking affects sleep is that nicotine stimulates the secretion of dopamine, norepinephrine, serotonin, and acetylcholine; thus, it is involved with the regulation of wakefulness.<sup>23</sup>

With regard to the association between alcohol and sleep disturbance, it is known that alcohol intake raises the arousal threshold and thereby increases slow-wave sleep during the first half of nocturnal sleep, when sleep drunkenness can be most commonly observed.<sup>24</sup> According to a study by Ohayon et al., the prevalence of alcohol intake at bedtime was high among people with sleep drunkenness, and the odds

ratio of having sleep terrors in people consuming alcohol at bedtime was 3.9.<sup>20</sup> In our study, a significant association was also observed between drinking alcohol and sleep drunkenness.

With regard to associations between sleep drunkenness and mental disorders, Ohayon et al. reported that the prevalence of mental disorders, including depression, was higher among people with sleep drunkenness than those without.<sup>20</sup> In addition, Laberge et al. reported a significant association between anxiety level and sleep terrors in a study of 1,353 boys and girls aged 11–13 years.<sup>25</sup> In our study, sleep drunkenness was significantly associated with increased depressive feelings. Involvement of serotonin is considered to be one of the physiological mechanisms that link mental disorders and sleep drunkenness. Serotonin is a neurotransmitter that greatly affects human emotions, and its deficiency is known to induce mental disorders such as depression.<sup>26</sup> Juszczak et al. argued that sleep-disordered breathing lowers the activities of the serotonergic system (5-HT neurons), leading to sleepwalking.<sup>27</sup> There is also a report that the presence of sleepwalking was 4–9 times higher among patients with abnormalities of serotonin metabolism, such as Tourette's syndrome and migraine headaches.<sup>28-30</sup> Thus, serotonin may be involved in the onset of sleep drunkenness, including sleepwalking.

### **Sleep-related bruxism**

In a previous epidemiological study of 2,109 subjects in Canada on the prevalence of sleep-related bruxism, Lavigne et al. reported that 13% of the participants aged 18–29 years selected “often” or “very often” as responses to a question on the frequency of tooth-grinding (between the upper and lower teeth, generating noise) during sleep.<sup>31</sup> In addition, Gross et al. conducted a study of 1,119 patients in a dental office and reported that the prevalence of tooth-clenching (between the upper and lower teeth, without generating noise) during sleep was 9.6% and that of tooth-grinding during sleep was 12.1%.<sup>32</sup> Rugh et al. pointed out that there are 2 types of individuals with sleep-related bruxism: those who suffer from it almost every night and those who exhibit it temporarily.<sup>33</sup> In addition, sleep-related bruxism without generating noise has been reported,<sup>34</sup> and this type also may not be recognized by families or friends. The prevalence of sleep-related bruxism found in the present study may be lower than the actual prevalence, because our results were based merely on responses to a questionnaire survey.

Several previous studies have reported factors associated with sleep-related bruxism. Ohayon et al. conducted a study of 13,057 people aged 15 years or older in the United Kingdom, Germany, and Italy and found that the risk factors for sleep-related bruxism

were heavy alcohol consumption, smoking, and a highly stressful life.<sup>12</sup> An association of smoking with sleep-related bruxism was reported in studies by Ahlberg et al.<sup>35</sup> and Lavigne et al.<sup>36</sup> The present study also recognized a significant association between sleep-related bruxism and smoking. However, to date, the physiological mechanism by which smoking affects sleep-related bruxism has not been clarified, including how nicotine affects sleep-related bruxism as a neurochemically active substance.<sup>36</sup>

In our study, a significant association was observed between alcohol drinking and sleep-related bruxism. The level of sleep-related bruxism is usually evaluated using the masticatory muscle activity level.<sup>37</sup> Hojo et al., in a study of 60 women, found that the level of masticatory muscle activity increased with an increase in alcohol intake<sup>38</sup>; suggesting an association between alcohol drinking and sleep-related bruxism.

An association between depressive feelings and sleep-related bruxism was recognized in the present study. An association between mental stress and sleep-related bruxism has been noted for quite some time; Rugh et al. reported that the level of masticatory muscle activity increased in response to stressful events,<sup>33</sup> and Clark et al., using the urinary catecholamine level as an indicator of the psychological stress level, reported that the urinary catecholamine level was significantly higher in the group with high masseter muscle activity.<sup>39</sup>

There are also studies that have refuted any significant associations between mental stress and sleep-related bruxism<sup>40</sup>; to date, however, the evidence to support such associations is not strong.<sup>41</sup> Further studies to clarify the associations between psychological stress and sleep-related bruxism are expected.

#### **Daily life guidance for adolescents with recognized sleep drunkenness or sleep-related bruxism**

From a public health viewpoint, if sleep drunkenness or sleep-related bruxism is recognized in adolescents, problems of lifestyle habits (such as smoking and alcohol drinking) that may harm their health in the future, or problems of mental status, may be an issue. If psychosocial factors related to such problems can be elucidated and measures for modification of the family environment and school environment can be taken, then symptoms of sleep drunkenness or sleep-related bruxism may effectively improve.

#### **Limitations**

This study had some limitations. First, because the data were collected through a self-administered questionnaire and no physiological measurements were used, it is possible that there were differences between the prevalence found in this study and the actual prevalence. Second, the location where participants

slept might have affected whether symptoms could be easily recognized by their families. Third, because the questionnaire response rate was 63.7%, a certain degree of non-response bias may have existed. However, this response rate is considered to be sufficient for this type of epidemiological survey. Fourth, because this was a cross-sectional study, no causal relationship could be determined. Future studies will be needed to resolve these previously mentioned limitations.

## **CONCLUSION**

The present study revealed the prevalence of sleep drunkenness and sleep-related bruxism and their associated factors in Japanese adolescents. In addition to smoking and alcohol drinking, depressive feelings were significantly associated with sleep drunkenness and sleep-related bruxism. If sleep drunkenness or sleep-related bruxism is observed in an adolescent, his or her smoking habit, alcohol-drinking habit, and mental status should be considered as well.



## REFERENCES

1. Chang PP, Ford DE, Mead LA, Cooper-Patrick L, Klag MJ. Insomnia in young men and subsequent depression. The Johns Hopkins Precursors Study. *Am J Epidemiol.* 1997;146(2):105-114.
2. Ford DE, Kamerow DB. Epidemiologic study of sleep disturbances and psychiatric disorders. *JAMA.* 1989;262(11):1479-1484.
3. Kim K, Uchiyama M, Okawa M, Liu XC, Ogihara R. An epidemiological study of insomnia among the Japanese general population. *Sleep.* 2000;23(1):41-47.
4. Motohashi Y, Takano T. Sleep habits and psychosomatic health complaints of bank workers in a megacity in Japan. *J Biosoc Sci.* 1995;27(4):467-472.
5. Gau SF, Soong WT. Sleep problems of junior high school students in Taipei. *Sleep.* 1995;18(8):667-673.
6. Liu XC, Uchiyama M, Okawa M, Kurita H. Prevalence and correlates of self-reported sleep problems among Chinese adolescents. *Sleep.* 2000;23(1):27-34.
7. Morrison DN, McGee R, Stanton WR. Sleep problems in adolescence. *J Am Acad Child Adolesc Psychiatry.* 1992;31(1):94-99.
8. The international classification of sleep disorders: diagnostic and coding manual. 2nd ed. Westchester, IL: American Academy of Sleep Medicine; 2005.
9. Joncas S, Zadra A, Paquet J, Montplaisir J. The value of sleep deprivation as a diagnostic tool in adult sleepwalkers. *Neurology.* 2002;58(6):936-940.
10. Mayer G, Neissner V, Schwarzmayr P, Meier-Ewert K. Sleep deprivation in somnambulism. Effect of arousal, deep sleep and sleep stage changes. *Nervenarzt.* 1998;69(6):495-501.
11. Rauch PK, Stern TA. Life-threatening injuries resulting from sleepwalking and night terrors. *Psychosomatics.* 1986;27(1):62-64.
12. Ohayon MM, Li KK, Guilleminault C. Risk Factors for Sleep Bruxism in the General Population\*. *Chest.* 2001;119(1):53-61.
13. Rosales VP, Ikeda K, Hizaki K, Naruo T, Nozoe S, Ito G. Emotional stress and brux-like activity of the masseter muscle in rats. *Eur J Orthod.* 2002;24(1):107-117.
14. Krogh-Poulsen WG, Olsson A. Occlusal disharmonies and dysfunction of the stomatognathic system. *Dent Clin North Am.* 1966:627-635.
15. Lobbezoo F, Lavigne GJ, Tanguay R, Montplaisir JY. The effect of catecholamine

- precursor L-dopa on sleep bruxism: a controlled clinical trial. *Mov Disord.* 1997;12(1):73-78.
16. 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.
17. Goldberg DP, Rickels K, Downing R, Hesbacher P. A comparison of two psychiatric screening tests. *Br J Psychiatry.* 1976;129:61-67.
18. Suzuki H, Kaneita Y, Osaki Y, et al. Clarification of the factor structure of the 12-item General Health Questionnaire among Japanese adolescents and associated sleep status. *Psychiatry Res.* 2011;188(1):138-146.
19. Hublin C, Kaprio J, Partinen M, Heikkila K, Koskenvuo M. Prevalence and genetics of sleepwalking: a population-based twin study. *Neurology.* 1997;48(1):177-181.
20. Ohayon MM, Guilleminault C, Priest RG. Night terrors, sleepwalking, and confusional arousals in the general population: their frequency and relationship to other sleep and mental disorders. *J Clin Psychiatry.* 1999;60(4):268-276.
21. Phillips BA, Danner FJ. Cigarette smoking and sleep disturbance. *Arch Intern Med.* 1995;155(7):734-737.
22. Wetter DW, Young TB. The relation between cigarette smoking and sleep disturbance. *Prev Med.* 1994;23(3):328-334.
23. Kenny PJ, Markou A. Neurobiology of the nicotine withdrawal syndrome. *Pharmacol Biochem Behav.* 2001;70(4):531-549.
24. Roehrs T, Roth T. Sleep, sleepiness, sleep disorders and alcohol use and abuse. *Sleep Med Rev.* 2001;5(4):287-297.
25. Laberge L, Tremblay RE, Vitaro F, Montplaisir J. Development of parasomnias from childhood to early adolescence. *Pediatrics.* 2000;106(1 Pt 1):67-74.
26. Price LH, Charney DS, Delgado PL, Heninger GR. Lithium and serotonin function: implications for the serotonin hypothesis of depression. *Psychopharmacology (Berl).* 1990;100(1):3-12.
27. Juszczak GR, Swiergiel AH. Serotonergic hypothesis of sleepwalking. *Med Hypotheses.* 2005;64(1):28-32.
28. Barabas G, Ferrari M, Matthews WS. Childhood migraine and somnambulism. *Neurology.* 1983;33(7):948-949.

29. Barabas G, Matthews WS, Ferrari M. Somnambulism in children with Tourette syndrome. *Dev Med Child Neurol.* 1984;26(4):457-460.
30. Giroud M, Nivelon JL, Dumas R. Somnambulism and migraine in children. A non-fortuitous association. *Arch Fr Pediatr.* 1987;44(4):263-265.
31. Lavigne GJ, Montplaisir JY. Restless Legs Syndrome and Sleep Bruxism - Prevalence and Association among Canadians. *Sleep.* 1994;17(8):739-743.
32. Gross AJ, Rivera-Morales WC, Gale EN. A prevalence study of symptoms associated with TM disorders. *J Craniomandib Disord.* 1988;2(4):191-195.
33. Rugh JD, Harlan J. Nocturnal bruxism and temporomandibular disorders. *Adv Neurol.* 1988;49:329-341.
34. Lavigne GJ, Rompre PH, Montplaisir JY. Sleep bruxism: validity of clinical research diagnostic criteria in a controlled polysomnographic study. *J Dent Res.* 1996;75(1):546-552.
35. Ahlberg J, Savolainen A, Rantala M, Lindholm H, Kononen M. Reported bruxism and biopsychosocial symptoms: a longitudinal study. *Community Dent Oral Epidemiol.* 2004;32(4):307-311.
36. Lavigne GJ, Lobbezoo F, Rompre PH, Nielsen TA, Montplaisir J. Cigarette smoking as a risk factor or an exacerbating factor for restless legs syndrome and sleep bruxism. *Sleep.* 1997;20(4):290-293.
37. Lavigne GJ, Rompre PH, Poirier G, Huard H, Kato T, Montplaisir JY. Rhythmic masticatory muscle activity during sleep in humans. *J Dent Res.* 2001;80(2):443-448.
38. Hojo A, Haketa T, Baba K, Igarashi Y. Association between the amount of alcohol intake and masseter muscle activity levels recorded during sleep in healthy young women. *Int J Prosthodon.* 2007;20(3):251-255.
39. Clark GT, Rugh JD, Handelman SL. Nocturnal masseter muscle activity and urinary catecholamine levels in bruxers. *J Dent Res.* 1980;59(10):1571-1576.
40. Pierce CJ, Chrisman K, Bennett ME, Close JM. Stress, anticipatory stress, and psychologic measures related to sleep bruxism. *J Orofac Pain.* 1995;9(1):51-56.
41. Lavigne G, Khoury S, Abe S, Yamaguchi T, Raphael K. Bruxism physiology and pathology: an overview for clinicians. *J Oral Rehabil.* 2008;35(7):476-494.

Table 1—Japanese adolescentsにおける学年別のsleep drunkennessの経験

	N	sleep drunkenness(%)					P value <sup>a</sup>	P value <sup>b</sup>
		never	seldom	sometimes	often	always		
Male							<0.001	<0.001
<i>Junior high school</i>								
7th Grade	6,343	66.5	13.3	13.9	4.1	2.2		
8th Grade	6,336	66.0	13.4	13.8	3.7	3.0		
9th Grade	6,131	63.8	13.5	15.5	4.0	3.2		
<i>Senior high school</i>								
10th Grade	10,381	59.7	14.6	17.8	4.9	2.9		
11th Grade	9,842	61.6	14.6	16.6	4.7	2.6		
12th Grade	8,948	64.7	13.3	15.1	4.4	2.5		
Total	47,981	63.3	13.9	15.7	4.4	2.7		
Female							<0.001	
<i>Junior high school</i>								
7th Grade	6,534	62.4	15.6	15.4	4.2	2.4		
8th Grade	6,369	58.4	16.4	17.8	4.6	2.8		
9th Grade	6,217	59.0	15.1	17.9	5.0	3.1		
<i>Senior high school</i>								
10th Grade	10,868	54.7	16.9	20.0	5.6	2.9		
11th Grade	10,108	55.8	16.3	19.9	5.4	2.5		
12th Grade	9,322	59.6	14.9	18.2	5.1	2.3		
Total	49,418	57.9	15.9	18.5	5.1	2.6		

<sup>a</sup> P value was calculated by  $\chi^2$  test, 5 (sleep drunkenness; never, seldom, sometimes, often, always)  $\times$  6 (Grade; 7th, 8th, 9th, 10th, 11th, 12th)

<sup>b</sup> P value was calculated by  $\chi^2$  test, 5 (sleep drunkenness; never, seldom, sometimes, often, always)  $\times$  2 (Sex; Male, Female)  
Subject with missing data were excluded from the analysis.

Table 2—Japanese adolescentsにおける学年別のsleep related bruxismの経験

	N	sleep related bruxism(%)					P value <sup>a</sup>	P value <sup>b</sup>
		never	seldom	sometimes	often	always		
Male							0.001	<0.001
<i>Junior high school</i>								
7th Grade	6,343	90.6	4.0	3.2	1.2	1.1		
8th Grade	6,336	90.5	3.6	3.5	1.2	1.2		
9th Grade	6,131	90.4	3.7	3.3	1.4	1.3		
<i>Senior high school</i>								
10th Grade	10,381	90.0	4.4	3.2	1.3	1.0		
11th Grade	9,842	89.1	5.2	3.4	1.3	1.0		
12th Grade	8,948	89.8	4.4	3.7	1.1	1.1		
Total	47,981	90.0	4.3	3.4	1.2	1.1		
Female							0.057	
<i>Junior high school</i>								
7th Grade	6,534	89.1	3.6	4.1	1.6	1.7		
8th Grade	6,369	88.7	3.7	4.3	1.6	1.7		
9th Grade	6,217	89.4	4.1	3.8	1.4	1.4		
<i>Senior high school</i>								
10th Grade	10,868	88.6	4.3	4.1	1.7	1.3		
11th Grade	10,108	88.7	4.1	4.3	1.4	1.6		
12th Grade	9,322	88.7	3.9	4.3	1.9	1.2		
Total	49,418	88.8	4.0	4.2	1.6	1.4		

<sup>a</sup> P value was calculated by  $\chi^2$  test, 5 (Sleep bruxism; never, seldom, sometimes, often, always)  $\times$  6 (Grade; 7th, 8th, 9th, 10th, 11th, 12th)

<sup>b</sup> P value was calculated by  $\chi^2$  test, 5 (Sleep bruxism; never, seldom, sometimes, often, always)  $\times$  2 (Sex; Male, Female)  
Subject with missing data were excluded from the analysis.