性別、中高別、学年別にみた最近3カ月のうち1ヶ月あたりの腹痛・腹部不快感頻度（質問71）

性別	中高別			最近３カ月のうち１ヶ月あたりの腹痛・腹部不快感頻度					
				まったくなかった	１日あった	２日あった	３日以上あった	不明	合計
男	中学 学年	1年生	度数	387	167	138	176	9	877
			学年 の %	44.1	19.0	15.7	20.1	1.0	100.0
		2年生	度数	371	174	137	200	6	888
			学年 の %	41.8	19.6	15.4	22.5	0.7	100.0
		3年生	度数	345	144	141	238	7	875
			学年 の %	39.4	16.5	16.1	27.2	0.8	100.0
		不明	度数	5	3	3	5	1	17
			学年 の %	29.4	17.6	17.6	29.4	5.9	100.0
		合計	度数	1108	488	419	619	23	2657
			学年 の %	41.7	18.4	15.8	23.3	0.9	100.0
	高校 学年	1年生	度数	427	232	219	384	15	1277
			学年 の %	33.4	18.2	17.1	30.1	1.2	100.0
		2年生	度数	431	212	166	348	16	1173
			学年 の %	36.7	18.1	14.2	29.7	1.4	100.0
		3年生	度数	343	186	142	324	11	1006
			学年 の %	34.1	18.5	14.1	32.2	1.1	100.0
		不明	度数	1	2	1	7	0	11
			学年 の %	9.1	18.2	9.1	63.6	0.0	100.0
		合計	度数	1202	632	528	1063	42	3467
			学年 の %	34.7	18.2	15.2	30.7	1.2	100.0
女	中学 学年	1年生	度数	302	174	164	228	9	877
			学年 の %	34.4	19.8	18.7	26.0	1.0	100.0
		2年生	度数	252	157	160	225	7	801
			学年 の %	31.5	19.6	20.0	28.1	0.9	100.0
		3年生	度数	268	137	180	311	6	902
			学年 の %	29.7	15.2	20.0	34.5	0.7	100.0
		不明	度数	7	0	2	2	0	11
			学年 の %	63.6	0.0	18.2	18.2	0.0	100.0
		合計	度数	829	468	506	766	22	2591
			学年 の %	32.0	18.1	19.5	29.6	0.8	100.0
	高校 学年	1年生	度数	503	280	298	588	14	1683
			学年 の %	29.9	16.6	17.7	34.9	0.8	100.0
		2年生	度数	447	270	266	601	17	1601
			学年 の %	27.9	16.9	16.6	37.5	1.1	100.0
		3年生	度数	390	206	224	616	16	1452
			学年 の %	26.9	14.2	15.4	42.4	1.1	100.0
		不明	度数	8	5	3	10	0	26
			学年 の %	30.8	19.2	11.5	38.5	0.0	100.0
		合計	度数	1348	761	791	1815	47	4762
			学年 の %	28.3	16.0	16.6	38.1	1.0	100.0

性別、中高別、学年別にみた腹部症状が排便により軽快するか（質問71－1）

性別	中高別			腹部症状が排便により軽快するか				
				はい	いいえ	非該当	不明	合計
男	中学 学年	1年生	度数	363	111	387	16	877
			学年 の %	41.4	12.7	44.1	1.8	100.0
		2年生	度数	404	105	371	8	888
			学年 の %	45.5	11.8	41.8	0.9	100.0
		3年生	度数	409	104	345	17	875
			学年 の %	46.7	11.9	39.4	1.9	100.0
		不明	度数	10	0	6	1	17
			学年 の %	58.8	0.0	35.3	5.9	100.0
		合計	度数	1186	320	1109	42	2657
			学年 の %	44.6	12.0	41.7	1.6	100.0
	高校 学年	1年生	度数	668	164	427	18	1277
			学年 の %	52.3	12.8	33.4	1.4	100.0
		2年生	度数	572	147	433	21	1173
			学年 の %	48.8	12.5	36.9	1.8	100.0
		3年生	度数	527	113	343	23	1006
			学年 の %	52.4	11.2	34.1	2.3	100.0
		不明	度数	8	2	1	0	11
			学年 の %	72.7	18.2	9.1	0.0	100.0
		合計	度数	1775	426	1204	62	3467
			学年 の %	51.2	12.3	34.7	1.8	100.0
女	中学 学年	1年生	度数	363	190	302	22	877
			学年 の %	41.4	21.7	34.4	2.5	100.0
		2年生	度数	322	213	252	14	801
			学年 の %	40.2	26.6	31.5	1.7	100.0
		3年生	度数	401	221	268	12	902
			学年 の %	44.5	24.5	29.7	1.3	100.0
		不明	度数	1	3	7	0	11
			学年 の %	9.1	27.3	63.6	0.0	100.0
		合計	度数	1087	627	829	48	2591
			学年 の %	42.0	24.2	32.0	1.9	100.0
	高校 学年	1年生	度数	760	394	503	26	1683
			学年 の %	45.2	23.4	29.9	1.5	100.0
		2年生	度数	795	334	447	25	1601
			学年 の %	49.7	20.9	27.9	1.6	100.0
		3年生	度数	718	313	390	31	1452
			学年 の %	49.4	21.6	26.9	2.1	100.0
		不明	度数	12	5	8	1	26
			学年 の %	46.2	19.2	30.8	3.8	100.0
		合計	度数	2285	1046	1348	83	4762
			学年 の %	48.0	22.0	28.3	1.7	100.0

性別、中高別、学年別にみた腹部症状による排便回数の変化（質問71－2）

性別	中高別		腹部症状による排便回数の変化					
			増える	減る	変わらない	非該当	不明	合計
男	中学 学年	1年生 度数	182	31	263	387	14	877
		1年生 学年の％	20.8	3.5	30.0	44.1	1.6	100.0
		2年生 度数	236	32	244	371	5	888
		2年生 学年の％	26.6	3.6	27.5	41.8	0.6	100.0
		3年生 度数	247	19	252	345	12	875
		3年生 学年の％	28.2	2.2	28.8	39.4	1.4	100.0
		不明 度数	5	0	6	6	0	17
		不明 学年の％	29.4	0.0	35.3	35.3	0.0	100.0
		合計 度数	670	82	765	1109	31	2657
		合計 学年の％	25.2	3.1	28.8	41.7	1.2	100.0
	高校 学年	1年生 度数	398	42	391	427	19	1277
		1年生 学年の％	31.2	3.3	30.6	33.4	1.5	100.0
		2年生 度数	366	49	303	433	22	1173
		2年生 学年の％	31.2	4.2	25.8	36.9	1.9	100.0
		3年生 度数	354	38	248	343	23	1006
		3年生 学年の％	35.2	3.8	24.7	34.1	2.3	100.0
		不明 度数	5	1	4	1	0	11
		不明 学年の％	45.5	9.1	36.4	9.1	0.0	100.0
		合計 度数	1123	130	946	1204	64	3467
		合計 学年の％	32.4	3.7	27.3	34.7	1.8	100.0
女	中学 学年	1年生 度数	171	55	329	302	20	877
		1年生 学年の％	19.5	6.3	37.5	34.4	2.3	100.0
		2年生 度数	189	51	298	252	11	801
		2年生 学年の％	23.6	6.4	37.2	31.5	1.4	100.0
		3年生 度数	240	52	331	268	11	902
		3年生 学年の％	26.6	5.8	36.7	29.7	1.2	100.0
		不明 度数	2	0	2	7	0	11
		不明 学年の％	18.2	0.0	18.2	63.6	0.0	100.0
		合計 度数	602	158	960	829	42	2591
		合計 学年の％	23.2	6.1	37.1	32.0	1.6	100.0
	高校 学年	1年生 度数	426	128	602	503	24	1683
		1年生 学年の％	25.3	7.6	35.8	29.9	1.4	100.0
		2年生 度数	489	123	514	447	28	1601
		2年生 学年の％	30.5	7.7	32.1	27.9	1.7	100.0
		3年生 度数	451	125	457	390	29	1452
		3年生 学年の％	31.1	8.6	31.5	26.9	2.0	100.0
		不明 度数	11	1	6	8	0	26
		不明 学年の％	42.3	3.8	23.1	30.8	0.0	100.0
		合計 度数	1377	377	1579	1348	81	4762
		合計 学年の％	28.9	7.9	33.2	28.3	1.7	100.0

性別、中高別、学年別にみた腹部症状による便性状の変化（質問71－3）

性別	中高別			腹部症状による便性状の変化							
				かたい便	ゆるい便	かたい/ゆるいの交替	その他	変化なし	非該当	不明	合計
男	中学 学年	1年生	度数	42	210	49	20	152	387	17	877
			学年 の %	4.8	23.9	5.6	2.3	17.3	44.1	1.9	100.0
		2年生	度数	51	241	49	17	148	371	11	888
			学年 の %	5.7	27.1	5.5	1.9	16.7	41.8	1.2	100.0
		3年生	度数	48	247	50	23	146	345	16	875
			学年 の %	5.5	28.2	5.7	2.6	16.7	39.4	1.8	100.0
		不明	度数	2	3	1	0	5	6	0	17
			学年 の %	11.8	17.6	5.9	0.0	29.4	35.3	0.0	100.0
		合計	度数	143	701	149	60	451	1109	44	2657
			学年 の %	5.4	26.4	5.6	2.3	17.0	41.7	1.7	100.0
	高校 学年	1年生	度数	63	405	86	29	241	427	26	1277
			学年 の %	4.9	31.7	6.7	2.3	18.9	33.4	2.0	100.0
		2年生	度数	45	350	97	31	191	433	26	1173
			学年 の %	3.8	29.8	8.3	2.6	16.3	36.9	2.2	100.0
		3年生	度数	55	338	77	32	134	343	27	1006
			学年 の %	5.5	33.6	7.7	3.2	13.3	34.1	2.7	100.0
		不明	度数	1	6	0	0	2	1	1	11
			学年 の %	9.1	54.5	0.0	0.0	18.2	9.1	9.1	100.0
		合計	度数	164	1099	260	92	568	1204	80	3467
			学年 の %	4.7	31.7	7.5	2.7	16.4	34.7	2.3	100.0
女	中学 学年	1年生	度数	61	181	93	21	197	302	22	877
			学年 の %	7.0	20.6	10.6	2.4	22.5	34.4	2.5	100.0
		2年生	度数	60	161	88	21	199	252	20	801
			学年 の %	7.5	20.1	11.0	2.6	24.8	31.5	2.5	100.0
		3年生	度数	79	216	83	16	217	268	23	902
			学年 の %	8.8	23.9	9.2	1.8	24.1	29.7	2.5	100.0
		不明	度数	0	0	2	0	2	7	0	11
			学年 の %	0.0	0.0	18.2	0.0	18.2	63.6	0.0	100.0
		合計	度数	200	558	266	58	615	829	65	2591
			学年 の %	7.7	21.5	10.3	2.2	23.7	32.0	2.5	100.0
	高校 学年	1年生	度数	143	382	196	37	386	503	36	1683
			学年 の %	8.5	22.7	11.6	2.2	22.9	29.9	2.1	100.0
		2年生	度数	166	358	219	41	334	447	36	1601
			学年 の %	10.4	22.4	13.7	2.6	20.9	27.9	2.2	100.0
		3年生	度数	148	372	238	32	234	390	38	1452
			学年 の %	10.2	25.6	16.4	2.2	16.1	26.9	2.6	100.0
		不明	度数	2	10	2	1	3	8	0	26
			学年 の %	7.7	38.5	7.7	3.8	11.5	30.8	0.0	100.0
		合計	度数	459	1122	655	111	957	1348	110	4762
			学年 の %	9.6	23.6	13.8	2.3	20.1	28.3	2.3	100.0

性別、中高別、学年別にみた医師による腹部症状の器質因の診断（質問71－4）

性別	中高別			医師による腹部症状の器質因の診断				
				診断あり	診断なし	非該当	不明	合計
男	中学 学年	1年生	度数	67	398	387	25	877
			学年 の %	7.6	45.4	44.1	2.9	100.0
		2年生	度数	68	431	371	18	888
			学年 の %	7.7	48.5	41.8	2.0	100.0
		3年生	度数	79	429	345	22	875
			学年 の %	9.0	49.0	39.4	2.5	100.0
		不明	度数	3	8	6	0	17
			学年 の %	17.6	47.1	35.3	0.0	100.0
		合計	度数	217	1266	1109	65	2657
			学年 の %	8.2	47.6	41.7	2.4	100.0
	高校 学年	1年生	度数	136	680	427	34	1277
			学年 の %	10.6	53.2	33.4	2.7	100.0
		2年生	度数	100	612	433	28	1173
			学年 の %	8.5	52.2	36.9	2.4	100.0
		3年生	度数	90	543	343	30	1006
			学年 の %	8.9	54.0	34.1	3.0	100.0
		不明	度数	1	8	1	1	11
			学年 の %	9.1	72.7	9.1	9.1	100.0
		合計	度数	327	1843	1204	93	3467
			学年 の %	9.4	53.2	34.7	2.7	100.0
女	中学 学年	1年生	度数	74	459	302	42	877
			学年 の %	8.4	52.3	34.4	4.8	100.0
		2年生	度数	70	453	252	26	801
			学年 の %	8.7	56.6	31.5	3.2	100.0
		3年生	度数	87	520	268	27	902
			学年 の %	9.6	57.6	29.7	3.0	100.0
		不明	度数	1	2	7	1	11
			学年 の %	9.1	18.2	63.6	9.1	100.0
		合計	度数	232	1434	829	96	2591
			学年 の %	9.0	55.3	32.0	3.7	100.0
	高校 学年	1年生	度数	123	1008	503	49	1683
			学年 の %	7.3	59.9	29.9	2.9	100.0
		2年生	度数	103	1008	447	43	1601
			学年 の %	6.4	63.0	27.9	2.7	100.0
		3年生	度数	91	936	390	35	1452
			学年 の %	6.3	64.5	26.9	2.4	100.0
		不明	度数	5	13	8	0	26
			学年 の %	19.2	50.0	30.8	0.0	100.0
		合計	度数	322	2965	1348	127	4762
			学年 の %	6.8	62.3	28.3	2.7	100.0

論文・学会発表

Sleep Medicine 12 (2011) 56–64

Contents lists available at ScienceDirect

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep

Original Article

Nightmare and sleep paralysis among Japanese adolescents: A nationwide representative survey

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ARTICLE INFO

Article history:
Received 14 December 2009
Received in revised form 6 April 2010
Accepted 27 April 2010

Keywords:
Parasomnia
Nightmare
Sleep paralysis
Epidemiology
Adolescents
Japan

ABSTRACT

Objective: The objective of this study was to clarify the prevalence of nightmares and sleep paralysis and associated factors among Japanese adolescents.
Methods: This study was designed as a cross-sectional sampling survey. The targets were junior and senior high schools throughout Japan. Self-reported anonymous questionnaires were sent to schools for all students to complete.
Results: A total of 90,081 questionnaires were analyzed. The overall response rate was 62.6%, and the prevalence of nightmares and sleep paralysis was 35.2% and 8.3%, respectively. Multiple logistic analyses revealed that female sex, drinking alcohol, poor mental health, difficulty initiating sleep, low subjective sleep assessment, presence of excessive daytime sleepiness, and presence of sleep paralysis had higher odds ratios than others for nightmares. Male sex, poor mental health, drinking alcohol, taking a long daytime nap, early or late bedtime, difficulty initiating sleep, low subjective sleep assessment, presence of excessive daytime sleepiness, and presence of nightmares had higher odds ratios than other factors for sleep paralysis.
Conclusions: This study has revealed the prevalence of nightmares and sleep paralysis among Japanese adolescents. Furthermore, the results of this study suggest that it is important to maintain regular sleep habits for preventing these symptoms. We propose that health education about regular sleep habits should be promoted among Japanese adolescents.

1. Introduction

Various reports indicate that sleep disturbances increase the risk of various physical and mental problems [1–4] and that one-fifth of Japanese adults suffer from some kind of sleep disturbance [2]. Sleep disturbances are prevalent not only among adults but also among 10–40% of adolescents [5–7]. The research team of Ohida et al. has performed large-scale epidemiological studies on the sleep status of Japanese adolescents [8,9]. In a survey of approximately 106,300 Japanese junior high and high school students, 30.6% reported an average sleep duration of less than 6 h per night. Of these, 12.5% reported excessive daytime sleepiness (EDS), and 40% were not satisfied with their sleep quality [8]. Another survey reported that 23.5% of adolescents experienced symptoms of insomnia [9]. However, most studies of sleep disturbances among adolescents have focused on sleep deprivation and insomnia; other types of sleep disturbances have not been adequately addressed.

Parasomnias are a group of symptoms associated with problematic behavior or phenomena during sleep and can be divided into non-REM (rapid eye movement) and REM sleep parasomnias [10]. REM sleep parasomnias include REM sleep behavior disorder, nightmares, and sleep paralysis. Parasomnias disturb nighttime sleep [10]. Among these, the interrelated phenomena of nightmares and sleep paralysis are more important because their prevalence is higher than that of REM sleep behavior disorder [11]. The

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doi:10.1016/j.sleep.2010.04.015

concepts of nightmares and sleep paralysis are well-known in Japanese culture; sleep paralysis is referred to as "kanashibari" [12].

A nightmare is the disruption of sleep by a dream associated with negative emotions (anxiety, fear, anger, etc.) during REM sleep, which results in frequent awakening [10]. The pathophysiological mechanisms of nightmares have not been clarified in detail. It has been reported that the heart and respiration rates increase during REM sleep, which is disturbed by nightmares [13]. Approximately 50–90% of the general population experience nightmares at some time [11,14,15]. Two surveys conducted on children aged 5–12 years revealed that 20–30% of the children had experienced nightmares at least once during the previous 6 months [16,17], indicating that nightmares are common in childhood. In a study of adolescents, Nielsen et al. found that those who had experienced nightmares in the previous year accounted for 25% and 40% of 13-year-old boys and girls, respectively, and 20% and 40% of 16-year-old boys and girls, respectively [18]. In addition, some reports have indicated that the occurrence of nightmares increases in early adolescence and decreases from late adolescence to early adulthood [19–22].

Sleep paralysis, a state in which the patient is unable to move the limbs and trunk although he/she is conscious, is often experienced by narcoleptic patients [11]. Hishikawa et al. reported that, in narcoleptic patients, sleep paralysis occurs during sleep onset REM (SOREM) [23]. However, it has been clarified that sleep paralysis affects normal individuals in addition to narcoleptic patients and tends to occur during SOREM in normal individuals too [24]. The lifetime prevalence of sleep paralysis was also found to be high (6–40%) [12,25–28]; although the range varied in different studies. The rate of onset of a first episode of sleep paralysis was reported to begin increasing at approximately 14 years of age and to peak at 17–19 years [12,27].

On the basis of these findings, it is inferred that nightmares and sleep paralysis are experienced not only by adults but also by adolescents, and that the rates of onset of first episodes of these disturbances increase among adolescents. One of the reasons for this could be that developmental factors and lifestyle-related and environmental changes affect the occurrence of nightmares and sleep paralysis. To date, however, no nationwide study of nightmares and sleep paralysis has been conducted using large-scale samples of adolescents; in fact, little is known about the factors associated with these disturbances. Therefore, in the present study, we conducted a nationwide survey of Japanese junior high and high school students in order to examine the prevalence of nightmares and sleep paralysis and to examine other associated factors.

2. Methods

2.1. Subjects and sampling

We previously conducted three cross-sectional nationwide surveys (1996, 2000, and 2004) of lifestyle habits such as alcohol drinking, smoking, eating, and sleeping among Japanese adolescents. The present study was the fourth such survey.

For this study, of the 10,921 junior high schools and 4500 senior high schools registered in Japan in May 2006, 130 junior high schools (selection rate: 1.2%) and 109 senior high schools (selection rate: 2.4%) were sampled. We used a stratified, single-stage cluster sampling method. Using this method, we divided Japan into regional blocks and randomly selected schools from each block. To avoid sampling bias toward any regional blocks, stratified sampling was performed with regional blocks as the strata. All the students enrolled in the sampled schools were the subjects of this study. The sample size was determined by referring to the response rate and confidence intervals (CIs) based on the variance of the results obtained from the three previous studies.

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

2.2. Survey procedure

We sent a letter to the principal of each selected school asking for cooperation in our survey, along with the same number of questionnaires and envelopes as the number of students enrolled at the school. At each school that agreed to participate in our survey, each class teacher was instructed to protect the privacy of the respondents, and — as stated on the questionnaire — to explain to the students that the completed questionnaires would not be seen by the teachers, and that it was not necessary for students to participate if they were not willing. After the questionnaires had been filled in, they were placed in the envelopes provided, which were then sealed with an adhesive flap. Delivery and collection of the questionnaires were entrusted to the teachers, who were instructed to follow the guidelines for conducting the survey. The teachers collected and sent the sealed envelopes back to the Nihon University School of Medicine without opening them. The survey period was from December 2007 to the end of January 2008. This survey was approved by the Ethics Committee of the Nihon University School of Medicine.

2.3. Response rates

Replies were obtained from 89 of the 130 junior high schools (school response rate = 68.5%) and 79 of the 109 senior high schools (school response rate = 72.5%; combined junior high and senior high school response rate = 70.3%). A total of 90,361 envelopes were collected. The student response rate as a proportion of students enrolled at the sampled schools was 93.8% for the junior high schools, 87.8% for the senior high schools, and 90.1% as a whole. Accordingly, the overall response rate was 62.8% for the junior high schools, 62.3% for the senior high schools, and 62.6% as a whole. The response rates obtained in this study are similar to those obtained in previous studies using the same study method [8,9]. In the calculation of this response rate, the denominator represented the number of all the students enrolled in the sampled schools; the number of students absent from the schools on the day of the survey was not subtracted from the total number of enrolled students but was treated as the number of invalid responses. This may have potentially lowered the response rate.

Of the collected questionnaires, 280 were excluded because the sex or grade was not specified or the answers were inconsistent. The data for the remaining 90,081 questionnaires were analyzed.

2.4. Measures

The major areas that were included in the questionnaire were (1) personal data, (2) lifestyle (3) sleep status, and (4) mental health status. The following questions about nightmares and sleep paralysis were embedded in the questionnaire.

The question about nightmares was "Have you been wakened by a nightmare during the previous month? (never/seldom/sometimes/often/always)." "Seldom," "sometimes," "often," and "always" were taken as affirmative answers to the question.

The question about sleep paralysis was "Have you experienced 'kanashibari' that hands and feet and body cannot move when waking up or falling asleep during the previous month? (yes/no)."

"Yes" was taken as an affirmative answer to the question. "Kanashibari" means sleep paralysis in Japanese.

2.4.1. Personal data

The personal data included sex, school grade, and type of school (junior high school/senior high school).

2.4.2. Lifestyle

The questions related to lifestyle were whether the student ate breakfast (daily/occasionally/never), and available amount of money (less than ¥5000/¥5000 or more [¥5000 is about $56]). Moreover, the question, "How many days did you smoke in the past month?" was included in the questionnaire. If the response to this question was "One day or more," then the student was defined as "smoking." Similarly, the question "How many days did you consume alcoholic beverages in the past month?" was asked, and if the response was "One day or more," then the student was defined as "drinking alcohol."

2.4.3. Sleep status

The sleep status items included sleep duration, bedtime, naptime, subjective sleep assessment, difficulty initiating sleep, and excessive daytime sleepiness (EDS). The question about sleep duration was "How many hours on average have you slept at night during the previous month? (less than 5 h/5 h or more but less than 6 h/6 h or more but less than 7 h/7 h or more but less than 8 h/8 h or more but less than 9 h/9 h or more." The question about bedtime was "What time did you go to bed on average during the previous month? (Before 10 p.m./10 p.m. or after but before 11 p.m./11 p.m. or after but before midnight/midnight or after but before 1 a.m./1 a.m. or after but before 2 a.m./2 a.m. or after)." The question about naptime was "How long was your naptime on average during the previous month?" (nothing/less than 15 min/15 min or more but less than 30 min/30 min or more but less than 1 h/1 h or more but less than 2 h /2 h or more)." The question about subjective sleep assessment was "How do you assess the quality of your sleep during the previous month? (very good/good/bad/very bad)." The question about difficulty initiating sleep was "Have you had difficulty initiating sleep at night during the previous month? (never/seldom/sometimes/often/always)." We evaluated EDS using the Japanese version of the Epworth Sleepiness Scale (ESS) [29,30]. The ESS comprises eight questions. By summing the scores (0–3) for each question, the total scores (0–24) were calculated. The higher the total score, the more severe daytime sleepiness was considered to be. People with ESS scores of 11 or higher are considered to have excessive daytime sleepiness. This cutoff point was also adopted in the present study.

2.4.4. Mental health status

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) [31,32] were used, and one item from each factor was selected for the total score. One of the items from the "depression/anxiety" factor (whether the respondent had felt an unusual amount of unhappiness and depression in the previous 30 days) was evaluated (possible options: 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 (whether the respondent was able to enjoy normal activities more than usual in the previous 30 days) was evaluated (possible options: more so than usual; same as usual; less than usual; much less than usual). Each item described a symptom, and there were four possible answers: the two answers that indicated absence of the symptom were assigned a rating of 0; the two answers that indicated presence of the symptom were assigned a rating of 1. Thus, the overall score fell within the range of 0–2, and accordingly, the higher the total score, the poorer the state of mental health. In the present study, participants who had total scores of 1 or more were considered to have poor mental health. 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% [33].

2.5. Statistical analyses

The presence of nightmares and sleep paralysis during the previous month was defined when an affirmative answer was obtained for each respective item.

First, the prevalence of nightmares and sleep paralysis and the 95% CI (confidence interval) were calculated. Then, the prevalences of both in relation to sex and grade were calculated. Moreover, the associations between nightmares and sleep paralysis during the previous month and personal, lifestyle, sleep status, and mental health status were examined. The significance of categorical data, such as the prevalence of nightmares and sleep paralysis, was analyzed using the chi-squared test. Finally, multiple logistic regression analyses were performed to examine separately the factors associated with nightmares or sleep paralysis during the previous month. We set the level of significance at $P < 0.001$. All analyses were performed using SPSS version 11.5 for Windows (SPSS, Inc., Chicago, IL).

3. Results

3.1. Prevalence of nightmares and sleep paralysis

The prevalence (95% CI) of nightmares was 35.2% (34.9–35.5%) in the total sample: 30.3% (29.9–30.7%) among males, and 39.9% (39.4–40.4%) among females (Table 1). A statistically significant difference was observed between males and females ($P < 0.001$) and grades ($P < 0.001$). Among males, the prevalence of nightmares increased gradually from 10th to 12th grade. Among females, the prevalence of nightmares increased gradually from 7th to 9th grade, decreased in the 10th grade, and then gradually increased again toward the 12th grade.

The prevalence (95% CI) of sleep paralysis was 8.3% (8.1–8.5%) in the total sample: 8.2% (7.9–8.5%) among males, and 8.3% (8.0–8.6%) among females (Table 1). No statistically significant difference was observed between males and females ($P = 0.49$). A statistically significant difference was observed between grades ($P < 0.001$). Among both males and females, the prevalence of sleep paralysis increased gradually from 7th to 12th grade, except only in the 11th grade among males.

3.2. Associations between nightmares and personal, lifestyle, sleep status, and mental health status

The associations between the prevalence of nightmares and personal, lifestyle, sleep status, and mental health status are shown in Table 2. Significant associations were observed between occurrence of nightmares and all variables.

Multiple logistic regression analysis in which nightmares were considered a dependent variable showed significant associations between nightmares and all variables, except for smoking (Table 2). In particular, a substantially higher odds ratio was observed for difficulty initiating sleep, low subjective sleep assessment, poor mental health status, and the presence of sleep paralysis.

Table 1
The prevalence of nightmare and sleep paralysis among Japanese adolescents.

Population	Nightmare				Sleep paralysis			
	N	Prevalence (%)	95% CI	*P* value[a]	*N*	Prevalence (%)	95% CI	*P* value[a]
Male				<0.001				<0.001
Junior high school								
7th Grade	6331	29.6	28.5–30.7		6541	6.0	5.4–6.6	
8th Grade	5959	28.6	27.5–29.7		6134	7.6	6.9–8.3	
9th Grade	6163	31.8	30.6–33.0		6244	8.4	7.7–9.1	
Senior high school								
10th Grade	8555	29.4	28.4–30.4		8690	8.7	8.1–9.3	
11th Grade	8078	30.5	29.5–31.5		8183	8.4	7.8–9.0	
12th Grade	7492	31.9	30.8–33.0		7588	9.9	9.2–10.6	
Total	42 578	30.3	29.9–30.7		43 380	8.2	7.9–8.5	
Female				<0.001				<0.001
Junior high school								
7th Grade	5961	36.0	34.8–37.2		6005	5.5	4.9–6.1	
8th Grade	5553	38.4	37.1–39.7		5616	6.5	5.9–7.1	
9th Grade	5532	40.4	39.1–41.7		5556	7.8	7.1–8.5	
Senior high school								
10th Grade	9459	39.5	38.5–40.5		9515	8.8	8.2–9.4	
11th Grade	9164	41.2	40.2–42.2		9213	8.9	8.3–9.5	
12th Grade	8820	42.1	41.1–43.1		8864	10.6	10.0–11.2	
Total	44 489	39.9	39.4–40.4		44 769	8.3	8.0–8.6	

[a] *P* value was calculated by the chi-squared test. CI: confidence interval. Subject with missing date were excluded from the analysis.

Table 2
Association of nightmare with personal, lifestyle, sleep status, and mental health status among Japanese adolescents.

Variables	Prevalence				Odds ratios			
	N	%	95% CI	*P* value[a]	*N*	AOR	95% CI	*P* value[b]
Sex				<0.001				<0.001
Male	42 880	30.3	29.9–30.7		37 128	1.00		
Female	45 083	39.9	39.4–40.4		39 457	1.39	1.34–1.43	
Grade				<0.001				<0.001
7th Grade	12 292	32.7	31.9–33.5		10 672	1.00		
8th Grade	11 512	33.3	32.4–34.2		10 130	0.99	0.93–1.05	
9th Grade	11 695	35.9	35.0–36.8		10 149	1.08	1.02–1.15	
10th Grade	18 014	34.7	34.0–35.4		16 256	0.92	0.87–0.98	
11th Grade	17 242	36.2	35.5–36.9		15 323	0.97	0.91–1.03	
12th Grade	16 312	37.4	36.7–38.1		14 055	1.02	0.95–1.08	
Smoking				<0.001				0.049
No	80 383	34.7	34.4–35.0		74 267	1.00		
Yes	2585	46.3	44.4–48.2		2318	1.10	1.00–1.20	
Drinking alcohol				<0.001				<0.001
No	67 743	33.1	32.7–33.5		60 803	1.00		
Yes	18 697	42.9	42.2–43.6		15 782	1.20	1.16–1.25	
Eating breakfast				<0.001				<0.001
Daily	73 531	33.9	33.6–34.2		64 801	1.00		
Occasional	8822	42.0	41.0–43.0		7425	1.17	1.11–1.23	
Never	5485	42.8	41.5–44.1		4359	1.09	1.02–1.16	
Available amount of money				<0.001				0.001
Less than ¥5000	61 973	33.6	33.2–34.0		55 191	1.00		
¥5000 or more	25 145	39.4	38.8–40.0		21 394	1.07	1.03–1.11	
Sleep duration (h)				<0.001				<0.001
<5	15 620	36.4	35.6–37.2		13 419	0.93	0.88–0.99	
>5, 6<	14 570	37.3	36.5–38.1		12 910	0.93	0.88–0.99	
>6, 7<	34 987	34.6	34.1–35.1		30 944	0.95	0.91–1.00	
>7, 8<	13 423	33.4	32.6–34.2		11 786	1.00		
>8, 9<	6309	33.2	32.0–34.4		5505	1.03	0.96–1.11	
>9	2531	40.2	38.3–42.1		2021	1.18	1.06–1.32	
Nap time (m)				<0.001				<0.001
Nothing	32 649	30.8	30.3–31.3		28 638	1.00		
<15	9101	37.7	36.7–38.7		8097	1.13	1.07–1.20	
>15, 30<	19 850	36.5	35.8–37.2		17 564	1.10	1.05–1.15	
>30, 60<	9802	37.4	36.4–38.4		8589	1.07	1.01–1.13	
>60, 120<	10 729	38.3	37.4–39.2		9411	1.09	1.03–1.15	
>120	5225	43.2	41.9–44.5		4286	1.18	1.10–1.27	

(*continued on next page*)

Table 2 (*continued*)

Variables	Prevalence				Odds ratios			
	N	%	95% CI	*P* value[a]	*N*	AOR	95% CI	*P* value[b]
Bedtime				<0.001				<0.001
Before 10 p.m.	5460	26.0	24.8–27.2		4604	1.00		
10–11 p.m.	11 673	32.8	31.9–33.7		10 295	1.03	0.94–1.12	
11 p.m.–Midnight	31 665	34.5	34.0–35.0		28 037	0.95	0.88–1.03	
Midnight–1 a.m.	21 588	36.7	36.1–37.3		19 111	0.85	0.78–0.93	
1–2 a.m.	11 174	37.9	37.0–38.8		9652	0.75	0.69–0.82	
After 2 a.m.	5963	42.1	40.8–43.4		4886	0.77	0.69–0.85	
Difficulty initiating sleep				<0.001				<0.001
Never	32 903	18.4	18.0–18.8		28 906	1.00		
Seldom/sometimes/often/always	54 925	45.3	44.9–45.7		47 679	2.96	2.86–3.08	
Subjective sleep assessment				<0.001				<0.001
Very good/good	61 626	29.8	29.4–30.2		54 221	1.00		
Bad/very bad	26 025	48.1	47.5–48.7		22 364	1.51	1.45–1.56	
Excessive daytime sleepiness				<0.001				<0.001
Absence	57 595	31.8	31.4–32.2		51 173	1.00		
Presence	28 904	42.0	41.4–42.6		25 412	1.23	1.19–1.28	
Mental health				<0.001				<0.001
Good	47 809	26.7	26.3–27.1		42 020	1.00		
Poor	39 678	45.5	45.0–46.0		34 565	1.68	1.63–1.74	
Sleep paralysis				<0.001				<0.001
No	80 152	32.9	32.6–33.2		70 536	1.00		
Yes	7256	61.2	60.1–62.3		6049	2.51	2.37–2.66	

CI: confidence interval and AOR: adjusted odds ratio.
¥5000 is about $56.
The presence of excessive daytime sleepiness was defined as an Epworth Sleepiness Scale score of ⩾11.
Poor mental health was defined as the 12-item of General Health Questionnaire-12 score of ⩾1.
Subjects with missing date were excluded from the analysis.
[a] *P* value was calculated by the chi-squared test.
[b] *P* value was calculated by the multiple logistic regression analysis.

3.3. *Associations between sleep paralysis and personal, lifestyle, sleep status, and mental health status*

The associations between the prevalence of sleep paralysis and personal, lifestyle, sleep status, and mental health status are shown in Table 3. Significant associations were observed between the prevalence of sleep paralysis and all variables, except for sex.

Multiple logistic regression analysis in which sleep paralysis during the previous month was considered as a dependent variable showed significant associations with all variables, except for school grade, smoking, eating breakfast, and available amount of money (Table 3). In particular, a higher odds ratio was observed among those whose sleep duration was ⩾9 h. In addition, a higher odds ratio was observed in case of poor mental health, and the odds ratio increased with an increase in the frequency of nightmares.

Table 3
Association of sleep paralysis with personal, lifestyle, sleep status, and mental health status among Japanese adolescents.

Variables	Prevalence				Odds ratios			
	N	%	95% CI	*P* value[a]	N	AOR	95% CI	*P* value[b]
Sex				0.490				<0.001
Male	43 683	8.2	7.9–8.5		37 128	1.00		
Female	45 360	8.4	8.1–8.7		39 457	0.85	0.81–0.90	
Grade				<0.001				0.061
7th Grade	12 546	5.8	5.4–6.2		10 672	1.00		
8th Grade	11 750	7.1	6.6–7.6		10 130	1.08	0.96–1.21	
9th Grade	11 800	8.1	7.6–8.6		10 149	1.06	0.94–1.19	
10th Grade	18 205	8.7	8.3–9.1		16 256	1.10	0.99–1.23	
11th Grade	17 396	8.7	8.3–9.1		15 323	1.06	0.95–1.18	
12th Grade	16 452	10.3	9.8–10.8		14 055	1.17	1.05–1.31	
Smoking				<0.001				0.024
No	81 388	7.8	7.6–8.0		74 267	1.00		
Yes	2640	15.3	13.9–16.7		2318	1.16	1.02–1.32	
Drinking alcohol				<0.001				<0.001
No	67 430	7.1	6.9–7.3		60 803	1.00		
Yes	18 622	12.2	11.7–12.7		15 782	1.23	1.16–1.32	
Eating breakfast				<0.001				0.021
Daily	73 181	7.5	7.3–7.7		64 801	1.00		
Occasional	8791	10.8	10.2–11.4		7425	1.06	0.97–1.15	

Table 3 (*continued*)

Variables	Prevalence				Odds ratios			
	N	%	95% CI	*P* value[a]	N	AOR	95% CI	*P* value[b]
Never	5459	14.4	13.5–15.3		4359	1.14	1.04–1.27	
Available amount of money				<0.001				0.017
Less than ¥5000	61 679	7.3	7.1–7.5		55 191	1.00		
¥5000 or more	25 021	10.9	10.5–11.3		21 394	1.08	1.01–1.15	
Sleep duration (h)				<0.001				<0.001
<5	15 543	12.3	11.8–12.8		13 419	1.47	1.32–1.63	
>5, 6<	14 506	9.2	8.7–9.7		12 910	1.27	1.14–1.42	
>6, 7<	34 820	7.1	6.8–7.4		30 944	1.14	1.03–1.25	
>7, 8<	13 349	5.6	5.2–6.0		11 786	1.00		
>8, 9<	6273	5.9	5.3–6.5		5505	1.00	0.87–1.16	
>9	2514	15.8	14.4–17.2		2021	1.71	1.44–2.01	
Naptime (m)				<0.001				0.001
Nothing	32 461	6.9	6.6–7.2		28 638	1.00		
<15	9064	7.5	7.0–8.0		8097	0.98	0.89–1.09	
>15, 30<	19 765	8.2	7.8–8.6		17 564	1.05	0.97–1.13	
>30, 60<	9754	8.7	8.1–9.3		8589	1.03	0.94–1.14	
>60, 120<	10 681	9.8	9.2–10.4		9411	1.11	1.01–1.21	
>120	5198	15.5	14.5–16.5		4286	1.26	1.13–1.40	
Bedtime				<0.001				<0.001
Before 10 p.m.	5406	7.5	6.8–8.2		4604	1.00		
10–11 p.m.	11 604	4.9	4.5–5.3		10 295	0.69	0.59–0.80	
11 p.m.–Midnight	31 523	6.5	6.2–6.8		28 037	0.81	0.71–0.93	
Midnight–1 a.m.	21 480	8.5	8.1–8.9		19 111	0.89	0.78–1.02	
1–2 a.m.	11 120	11.2	10.6–11.8		9652	1.03	0.89–1.19	
After 2 a.m.	5931	19.1	18.1–20.1		4886	1.36	1.17–1.58	
Difficulty initiating sleep				<0.001				<0.001
Never	32 712	5.4	5.2–5.6		28 906	1.00		
Seldom/sometimes/often/always	54 644	10.0	9.7–10.3		47 679	1.22	1.14–1.30	
Subjective sleep assessment				<0.001				<0.001
Very good/good	61 305	6.3	6.1–6.5		54 221	1.00		
Bad/very bad	25 882	13.1	12.7–13.5		22 364	1.22	1.15–1.29	
Excessive daytime sleepiness				<0.001				<0.001
Absence	58 494	6.8	6.6–7.0		51 173	1.00		
Presence	29 311	8.3	8.0–8.6		25 412	1.23	1.16–1.30	
Mental health				<0.001				<0.001
Good	48 662	5.3	5.1–5.5		42 020	1.00		
Poor	40 165	11.9	11.6–12.2		34 565	1.54	1.45–1.63	
Nightmare				<0.001				<0.001
Never	56 604	5.0	4.8–5.2		49 947	1.00		
Seldom	12 746	8.4	7.9–8.9		11 290	1.52	1.40–1.65	
Sometimes	13 145	15.2	14.6–15.8		11 327	2.76	2.57–2.96	
Often	3464	22.4	21.0–23.8		2924	4.06	3.67–4.49	
Always	1449	41.8	39.3–44.3		1097	7.64	6.68–8.75	

CI: confidence interval and AOR: adjusted odds ratio.
¥5000 is about $56.
The presence of excessive daytime sleepiness was defined as an Epworth Sleepiness Scale score of ⩾11.
Poor mental health was defined as the 12-item of General Health Questionnaire-12 score of ⩾1.
Subjects with missing date were excluded from the analysis.
[a] *P* value was calculated by the chi-squared test.
[b] *P* value was calculated by the multiple logistic regression analysis.

4. Discussion

The results obtained from this study revealed that the prevalence of nightmares in adolescents was 35.2% (of the total sample); furthermore, the prevalence of nightmares among girls (39.9%) was found to be higher than that among boys (30.3%). To date, few studies have investigated the prevalence of nightmares in adolescents. Previous studies of the prevalence of nightmares in adults found that the range was 8–30% of the sample studied [34–37]. The results of our study showed a higher prevalence; this may support the results of previous studies indicating that the occurrence of nightmares increases in early adolescence and decreases from late adolescence to early adulthood [19–22]. However, it must be noted that the observed prevalence of nightmares may vary according to the study methods; this is evidenced by a previous study which reported that only 4% of patients spontaneously complained of nightmares to physicians [38]. The prevalence of sleep paralysis was 8.3% (no significant difference was observed between boys and girls). To date, no study on the prevalence of sleep paralysis in adolescents has been reported. However, a previous study on sleep paralysis in adults reported a range of 7–8% [39]. From this, we suggest that there is not much difference in the prevalence of sleep paralysis between adolescents and adults. Our results suggest that the prevalence of nightmares and sleep paralysis tends to increase from the lowest school grade (7th) to the highest (12th) for both genders. Among girls especially, the prevalence of sleep paralysis in the 12th grade was almost twice that in the 7th. Developmental factors and lifestyle changes may affect these characteristics.

In this study, we found that the prevalence of sleep paralysis increased with an increase in the frequency of nightmares, and that the prevalence of nightmares was high (61.2%) among those who

experienced sleep paralysis. In addition, logistic regression analysis that considered nightmares as a dependent variable showed that the odds ratio of those who experienced sleep paralysis was high. Logistic regression analysis that considered sleep paralysis as a dependent variable demonstrated a dose–response relationship between the frequency and the odds ratio of nightmares. From these results, we suggest the presence of a strong association between nightmares and sleep paralysis. It has been reported that nightmares and sleep paralysis frequently occur concurrently [10,40]. The strong association between nightmares and sleep paralysis may be explained by a common pathophysiological characteristic: both these phenomena occur during REM sleep. It has been reported that an individual's physiological characteristics, such as heart rate and respiration rate, change if nightmares associated with negative emotions occur during REM sleep [13]. Such changes in physiological characteristics may induce sleep paralysis. Conversely, sleep paralysis, in which the patient is unable to move the limbs and trunk although he/she is conscious, may be accompanied by anxiety and terror, which may also induce nightmares. It is not possible to discuss the causal relationship between nightmares and sleep paralysis on the basis of the results of this study. However, it may be appropriate to think that these phenomena are interrelated, rather than thinking that one precedes the other.

With regard to the association between gender and nightmares/sleep paralysis, our logistic regression analyses showed that the odds ratio of nightmares was significantly higher in girls than in boys, whereas the odds ratio of sleep paralysis was significantly higher in boys than in girls. A study conducted on adults reported that the risk of nightmares was higher in women than in men [41]. The results of our present study confirm the same tendency in adolescents. In contrast, our results indicated that the risk of sleep paralysis was higher in boys than in girls. In any event, any gender-based difference in the risk of sleep paralysis has not been examined previously for adolescents or adults. Further epidemiological studies will be required to clarify this point.

With regard to the association between nightmares/sleep paralysis and alcohol consumption, the odds ratios for alcohol consumers were high for both nightmares and sleep paralysis. Many studies have reported an association between the consumption of alcohol and sleep disorders among adolescents [42–44]. Alcohol is known to promote sleep onset, but the effect is short-lived; in fact, it makes sleep shallow and interrupted [43]. In our study, alcohol consumption may have affected the onset of nightmares and sleep paralysis. Increased REM sleep time is a symptom of alcohol withdrawal [43]. Since alcohol has clear pharmacological effects on REM sleep, it is possible that it also affect REM-sleep-related disorders such as nightmares and sleep paralysis.

With regard to the associations between sleep duration and nightmares/sleep paralysis, we found that the odds ratios of those whose sleep duration was $\geqslant$9 h were significantly high for both the prevalence of nightmares and sleep paralysis. For this group, sleep duration may have increased to compensate for the sleep that was interrupted because of nightmares and sleep paralysis. However, prolonged periods of normal wake following a sleep cycle may make nightmares easier to remember. In that case the nightmares may not be causing the sleep disturbance — remembering them may simply be a byproduct of the waking. With regard to sleep paralysis, there was a high odds ratio for those whose sleep duration was <7 h. Sleep paralysis has been reported to occur during a REM sleep period that occurs immediately after the SOREM [10,24], and SOREM tended to occur when sleep duration was short [45]. From these findings, it is inferred that sleep paralysis appears to be induced by short sleep duration. Nightmares and sleep paralysis were also associated with daytime naps; a relatively high odds ratio was observed in a group whose naptime was $\geqslant$120 min. It is not clear whether nightmares and sleep paralysis occur during long naps, or whether individuals who experience nightmares or sleep paralysis tend to have longer naptimes because of the lack of nighttime sleep.

With regard to the association between EDS and nightmares, Joo et al. found that the frequency of EDS tended to increase with an increase in the frequency of nightmares; the authors attributed this association to a degradation of sleep quality [46]. Based on this finding, a causal association can be inferred: EDS is induced by nighttime sleep that is interrupted by nightmares and sleep paralysis. In our study, we predicted associations among nightmares/sleep paralysis, sleep quality, and EDS; our logistic regression analyses considered subjective sleep assessment as a covariate. From this analysis, nightmares/sleep paralysis was found to be associated with EDS, independently of sleep quality. The inference is that degradation of sleep quality — at a level too subtle to be perceived by the subjects — was not reflected by the subjective sleep assessment; however, it may be involved in the association between nightmares/sleep paralysis and EDS.

With regard to the association between difficulty initiating sleep and nightmares/sleep paralysis, nightmares/sleep paralysis is possibly associated with insomnia because difficulty initiating sleep is a symptom of insomnia. People with insomnia, whose chief complaint is difficulty initiating sleep, tend to experience anxiety, depression, and their bodies feel tense at the initiation of sleep [47]. Since nightmares and sleep paralysis can be easily exacerbated by an individual's poor mental health status [18,28], such conditions at the initiation of sleep may influence the occurrence of nightmares and sleep paralysis.

With regard to the associations between nightmares and mental health status, Nielsen et al. studied adolescents (aged 13–16) and reported a significant association between the frequency of nightmares and the level of anxiety [18]. In addition, few studies have also reported an association between sleep paralysis and mental health status. For example, Ohayon et al. [28] conducted an epidemiological study on the general population and found associations between sleep paralysis and mental-health-related factors such as anxiolytic medication and bipolar disorder. Therefore, it can be said that our study has demonstrated a close association between poor mental health status and nightmares and sleep paralysis in adolescents.

There were some limitations to our study. The main one was the problems related to the definition of nightmares and sleep paralysis. The limited space in the questionnaires did not allow us to explain the details of nightmares and sleep paralysis to the participants; therefore, they understood the meaning of nightmares and sleep paralysis only on the basis of the information in the questions related to these phenomena. It is possible that the participating adolescents did understand the meaning of these terms because nightmares and sleep paralysis are well-known phenomena in Japan [12]. However, some participants may not have completely understood the meaning of nightmares and sleep paralysis only on the basis of the limited explanations provided in the study questionnaire. In particular, owing to the characteristics of the symptoms, sleep paralysis may have been confused with other phenomena such as sleep inertia or difficulty in waking up. It would be difficult to distinguish sleep paralysis from such phenomena only on the basis of the explanation provided in the relevant question. In addition, sleep paralysis is a symptom often observed among narcolepsy patients [23], and it has been reported that 0.16% of adolescents may have suspected narcolepsy [12,48]. Our study participants probably included a similar percentage of narcolepsy patients. Therefore, the results of this study may not necessarily represent the actual prevalence of pathological nightmare and sleep paralysis and must be considered only as epidemiological data. In a large-scale epidemiological study, owing to

methodological limitations, it is difficult to accurately select patients with only pathological nightmares and sleep paralysis. However, more accurate calculation of the prevalence might be possible by providing highly detailed information about the symptoms to the participants. Furthermore, with regard to sleep paralysis, it is possible to calculate the prevalence accurately by including additional questions that would rule out any confusion with other phenomena. We would like to resolve these methodological problems in a future study in order to clarify the prevalence of nightmares and sleep paralysis more accurately. Second, since this was a cross-sectional survey, a causal relationship could not be determined. Third, there may have been a nonresponse bias. The rate of response to the questionnaire in this study was 62.6%; therefore, approximately 37.4% of the subjects did not participate in the survey. Fourth, physiologic measurements such as electroencephalography could not be employed to obtain objective data for evaluation of sleep habit.

5. Conclusion

This study is a nationwide survey of nightmare and sleep paralysis among Japanese adolescents. The results of this study should be considered in the prevention of nightmares and sleep paralysis among Japanese adolescents. The findings of this study indicated a strong association between nightmares and sleep paralysis. These features are attributed to the pathophysiological background of REM sleep. Therefore, stable REM sleep seems to be important for the prevention of nightmares and sleep paralysis. In addition, nightmare and sleep paralysis related to the factors of sleep habits respectively. Maintenance of regular sleep habits is associated with stable REM sleep [45]. Therefore, it is important to maintain regular sleep habits to prevent these symptoms. Because daily rhythm is prone to be deranged in adolescence, we propose that health education about regular sleep habits should be promoted among Japanese adolescents.

6. Disclosure statement

This study was supported by a health science Research Grant from the Ministry of Health, Labor and Welfare of the Japanese Government. All of the authors have no potential conflicts of interest, including specific financial interests and relationships and affiliations relevant to the subject matter or materials discussed in the manuscript. There was no off-label or investigational use in this study.

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TC Online First, published on October 21, 2010 as 10.1136/tc.2010.036947

Age verification cards fail to fully prevent minors from accessing tobacco products

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Received 23 March 2010
Accepted 15 September 2010

ABSTRACT

Background Proper age verification can prevent minors from accessing tobacco products. For this reason, electronic locking devices based on a proof-of age system utilising cards were installed in almost every tobacco vending machine across Japan and Germany to restrict sales to minors.

Objective We aimed to clarify the associations between amount smoked by high school students and the usage of age verification cards by conducting a nationwide cross-sectional survey of students in Japan.

Methods This survey was conducted in 2008. We asked high school students, aged 13–18 years, in Japan about their smoking behaviour, where they purchase cigarettes, if or if not they have used age verification cards, and if yes, how they obtained this card.

Results As the amount smoked increased, the prevalence of purchasing cigarettes from vending machines also rose for both males and females. The percentage of those with experience of using an age verification card was also higher among those who smoked more. Somebody outside of family was the top source of obtaining cards. Surprisingly, around 5% of males and females belonging to the group with highest smoking levels applied for cards themselves.

Conclusions Age verification cards cannot fully prevent minors from accessing tobacco products. These findings suggest that a total ban of tobacco vending machines, not an age verification system, is needed to prevent sales to minors.

Smoking among adolescents increases the risk of many diseases and also causes nicotine dependence.[1 2] Restricting tobacco product sales to minors has been identified as an effective form of prevention of tobacco use.[3–6] Countries that have ratified the Framework Convention on Tobacco Control (FCTC) must legally prohibit the introduction of tobacco vending machines to minors, and when appropriate, conduct a total ban of tobacco vending machines.[7] This restriction has spread all over the world together with the implementation of FCTC.

Age verification at both retail stores and vending machines is very important for protecting minors from tobacco marketing. For this reason, electronic locking devices based on a proof-of age system that utilises cards were installed in almost every tobacco vending machine across Japan and Germany to restrict the sales of cigarettes to minors. Cigarettes can now only be purchased upon presentation of the card at vending machines. In Japan, the card is issued by the Tobacco Institute of Japan to people of legal smoking age, which is 20 years or older. A photo of the applicant and a copy of their official identification such as their driving licence are required to apply for the card. Proof-of-age systems on tobacco vending machines in Japan were first introduced on a limited scale in May 2004. This card-based system was then expanded and gradually introduced throughout Japan starting in March 2008. By July 2008, this electronic locking device had been installed in nearly every tobacco vending machine across the nation.

However, few reports study the effects of this card-based age verification mechanism with regard to under-age smoking.[8 9] Thus, we aimed to clarify the relation between smoking behaviour among high school students and their usage of age verification cards by conducting a cross-sectional nationwide survey in Japan.

METHODS

This survey was a random sampling survey of high schools across Japan in 2008. The methodological details of this survey have been previously reported.[10–12] The number of schools sampled in the 2008 survey was 130 out of 10 955 junior high schools in Japan, and 110 out of 5115 senior high schools. Responses were obtained from 92 junior (school response rate 70.8%) and 80 senior high schools (72.7%). All students enrolled in the sampled schools were subjects of this study. Anonymous questionnaires and envelopes were handed to the students to complete during school hours. Upon completion, the questionnaires were sealed in the envelopes by the students themselves, collected by their teachers and returned to our research group unopened. Of 95 680 responses, 2980 did not have the complete data needed for analysis. Thus, 92 700 eligible responses (of which 46 975 males and 45 725 females) participated in this study. We conducted our survey in October 2008. Therefore, our results do not reflect a transitional phase, but rather a period that is 3 months following full national implementation of the age verification system.

Although Japanese laws forbid smoking by those younger than 20 years old, teenage smoking is frequently observed.[12] Smoking levels among high school students were divided into four categories (non-smokers, occasional smokers, low daily smokers and high daily smokers) based on the questionnaires. Occasional smokers were defined as those who had smoked at least once over the past 30 days, but not on a daily basis. Low and high daily smokers were defined as those who smoked 1–10 cigarettes (low) or 11 cigarettes or more (high) on a daily basis over the past 30 days. On the

questionnaire, we asked current smokers what their most common sources of cigarettes were, and gave examples such as vending machines. Responses pertaining to the prevalence of experiences using an age verification card, and the method of obtaining cards, were extracted from each questionnaire. For method of obtaining cards, we asked respondents to choose from four answers (took it from family without permission, borrowed it from family, borrowed it from somebody other than family and applied for card by him/herself). This study was reviewed and approved by the institutional review board of the Nihon University (No 19-5-0, approved 18 September, 2007).

Gender-specific analysis was performed. The distributions of the sample were also adjusted to reflect the distribution of all high schools in Japan using post-clustering weights. The weighted percentages in the table 1 were calculated by a weighting method based on one-stage stratified cluster sampling.[13] Trend tests were used to analyse the differences in responses per smoking level group. A trend test is used in categorical data analysis when the aim is to assess for the presence of an association between a variable with two categories and a variable with one or more category. The trend test has higher statistical power than a χ^2 test when the suspected trend is correct.[14] Trend tests were also used to adjust data by grade. The Statistical Package for the Social Sciences (SPSS Japan Inc, version 16.0J) was used for the analyses. All probability values were two-tailed and at a 5% level of significance.

RESULTS

The percentages of occasional smokers, low daily smokers and high daily smokers in this study were as follows. The percentage of occasional smoking among males, excluding those who smoke on a daily basis, was 1.9% for junior high school (JHS) and 4.8% for senior high school (SHS). The percentage of low daily smoking by males was 0.3% for JHS and 2.1% for SHS. The percentage of high daily smoking by males was 0.1% for JHS and 2.6% for SHS. The percentage of occasional smoking by females, excluding those who smoke on a daily basis, was 1.5% for JHS and 3.1% for SHS. The percentage of low daily smoking by females was 0.1% in JHS and 0.9% for SHS. The percentage of high daily smoking by males was 0.4% for JHS and 0.5% for SHS. These results were similar to recent studies on smoking rates among Japanese teenagers.[15] The prevalence of those who had used an age verification card in the past was 963 (30.5%) out of 3158 male smokers and 424 (28.5%) out of 1490 female smokers. The most common source of cards was from somebody other than family, with 442 (14.0%) out of 3158 males responding thus, and 212 (14.2%) of 1490 females answering yes. The second most common source was from family (203 (6.4%) out of 3158 males and 103 (6.9%) out of 1490 females) and the third most common was taking it from family without permission (138 (4.4%) out of 3158 males and 66 (4.4%) out of 1490 females). Applied for card by him/herself came last, with 89 (2.8%) out of 3158 males and 22 (1.5%) out of 1490 females responding thus.

Table 1 shows the usage of vending machines and age verification cards to purchase cigarettes by each category of amount smoked among high school students. The prevalence of purchasing cigarettes mainly from vending machines became higher as the amount smoked increased for both males and females. The percentage of those who had also used an age

Table 1 Use of vending machines and age verification cards for purchasing cigarettes, analysed by categories of smoking levels observed in a 2008 national survey of high school students in Japan

Male									
Category of smoker	Total		Occasional smokers		Low daily smokers 1–10 cigarettes per day		High daily smokers 11 cigarettes and more per day		
	Unweighted	Weighted*	Unweighted	Weighted*	Unweighted	Weighted*	Unweighted	Weighted*	p Value†
Number	3158 (100.0%)		1692 (100.0%)		660 (100.0%)		806 (100.0%)		
Purchases cigarettes mainly from vending machines	785 (24.9%)	30.6%	314 (18.6%)	22.9%	176 (26.7%)	32.8%	295 (36.6%)	45.0%	<0.01
Has used an age verification card before	963 (30.5%)	38.4%	363 (21.5%)	27.1%	208 (31.5%)	39.7%	392 (48.6%)	61.2%	<0.01
Method of obtaining verification card									
Took it from family without permission	138 (4.4%)	5.3%	59 (3.5%)	4.2%	20 (3.0%)	3.6%	59 (7.3%)	8.8%	<0.01
Borrowed it from family	203 (6.4%)	7.6%	61 (3.6%)	4.2%	49 (7.4%)	8.7%	93 (11.5%)	13.6%	<0.01
Borrowed it from somebody other than family	442 (14.0%)	17.2%	149 (8.8%)	10.8%	105 (15.9%)	19.6%	188 (23.3%)	28.7%	<0.01
Applied by himself	89 (2.8%)	2.9%	35 (2.1%)	2.2%	7 (1.1%)	1.1%	47 (5.5%)	5.7%	<0.01
Female									
Category of smoker	Total		Occasional smokers		Low daily smokers 1–10 cigarettes per day		High daily smokers 11 cigarettes and more per day		
	Unweighted	Weighted*	Unweighted	Weighted*	Unweighted	Weighted*	Unweighted	Weighted*	p Value†
Number	3158 (100.0%)		987 (100.0%)		258 (100.0%)		245 (100.0%)		
Purchases cigarettes mainly from vending machines	304 (9.6%)	9.6%	160 (16.2%)	16.2%	63 (24.4%)	24.4%	81 (33.1%)	33.1%	<0.01
Has used an age verification card before	424 (13.4%)	13.4%	205 (20.8%)	20.8%	92 (35.7%)	35.7%	127 (51.8%)	51.8%	<0.01
Method of obtaining verification card									
Took it from family without permission	66 (2.1%)	2.0%	34 (3.4%)	3.3%	8 (3.1%)	3.0%	24 (9.8%)	9.5%	<0.01
Borrowed it from family	103 (3.3%)	3.2%	48 (4.9%)	4.8%	21 (8.1%)	7.9%	34 (13.9%)	13.6%	<0.01
Borrowed it from somebody other than family	212 (6.7%)	6.8%	90 (9.1%)	9.2%	50 (19.4%)	19.6%	72 (29.4%)	29.7%	<0.01
Applied by herself	22 (0.7%)	0.7%	9 (0.9%)	0.9%	1 (0.4%)	0.4%	12 (4.9%)	4.9%	<0.01

*The distributions of the sample were adjusted to reflect the distribution of all high schools in Japan using post-clustering weights.
†Analyses were trend tests adjusted by grade.

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verification card, together with smoking levels for both genders, was similar. Although overall numbers of female smokers were lower than males, the percentage of females who had used a card before was equal to or slightly higher than males. The most common source of obtaining cards was from somebody other than the family. For the highest level of smokers, around 5% of both males and females applied for the card themselves. There were statistically significant differences for all research questions, and the amount smoked for both genders by trend-test ($p<0.01$).

DISCUSSION

We clarified that age verification cards were being used by minors to purchase tobacco from vending machines. The percentages of those using an age verification card increased with the amount smoked for both genders. The most common source of getting the card was from somebody other than family, followed by from family. Surprisingly, around 5% of both gender groups belonging to the highest level of smoking applied for the card themselves.

A previous paper reported that an effective method of preventing minors from smoking was to restrict sales at retailers.[3] Based on such studies, the FCTC included the restriction of sales of cigarettes through vending machines as one of its regulations. Our results show that age verification cards cannot completely prevent minors from accessing tobacco products.

The percentage of those who had used an age verification card became higher with the increased amount smoked for both genders. An age verification card is only supposed to be issued upon confirming that the holder is of legal age. However, high school students were using these cards to purchase cigarettes through vending machines. We also found the popular source for purchasing cigarettes for teenage smokers was still tobacco vending machines. Despite it being forbidden to borrow or lend age verification cards, we think teenagers may be lending cards to one another because the most common source of cards for teenagers was from someone outside of their family. That being said, since the second most common source of cards was family, we relate this misuse on poor management within families. Although the cards were introduced with the aim of preventing minors from purchasing cigarettes from vending machines, it has not fully served its purpose yet. Surprisingly, 5% of students in both genders who were categorised in the highest level of smoking applied for the cards themselves. High school students may submit false statements to receive their cards, and although the cards are supposedly issued upon confirmation that the holders are adults with photo and official identification, the institute that issues the cards may not be verifying this information properly. We could not find details on how high school students received cards that they applied for by themselves. These cards may have been sent to the students owing to clerical error.

There are some limitations in this study. First, we could not assess changes in smoking behaviours among high school students after the introduction of this new card system. Second, our study is a cross-sectional one that does not prove any causal association between smoking behaviour and the use of an age verification card. Finally, our results may be underestimating the actual numbers since we were asking high school students about their smoking behaviours, despite youth tobacco smoking being forbidden by law.

What this paper adds

- **FCTC includes the restriction to sales of cigarettes by tobacco vending machines. Age verification cards to restrict sales through tobacco vending machines were introduced nationally in Japan and Germany. This study shows that age verification cards cannot fully prevent minors from accessing tobacco products.**

In conclusion, our study showed that high school students who smoke use age verification cards to purchase cigarettes through vending machines. Age verification cards cannot entirely prevent minors from accessing tobacco products. We think there needs to be a total ban on tobacco vending machines, and not an age verification system, to prevent tobacco product sales to minors.

Acknowledgements We are grateful to Takeo Tanihata, Junichiro Mori, Masumi Minowa and Kenji Suzuki for advising this study design and management of the study, and Mr Michita Nagatsuka for assembling and management of the data, and to Mr William McMichael for English editing of the manuscript.

Funding This study was supported by a Research Grant for Cardiovascular Disease from the Ministry of Health, Labor and Welfare.

Competing interests None.

Ethics approval This study was conducted with the approval of the Nihon University (No 19-5-0, approved 18 September, 2007).

Provenance and peer review Not commissioned; externally peer reviewed.

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【背景】

タバコ枠組み条約（FCTC）により、2008年7月にTaspoが全国的に導入され、未成年者の自動販売機（自販機）によるタバコ購入が制限された。

【目的】

Taspo導入後の未成年喫煙者の自販機によるタバコ購入やTaspo利用の実態を全国調査を通して明らかにする。