

Link between social jet lag caused by “weekend catch-up sleep”, sleep debt, subjective symptoms, and lifestyle habits

Terumi Kogawa¹⁾ and Mitsuko Iwabuchi²⁾

1) Aomori University of Health and Welfare

2) Iwate Medical University

ABSTRACT

[Objective] In recent years, an increasing number of children have been complaining of physical problems as a consequence of spending after-school time at home on television, games. However, the way children spend their time after school, their sleep habits, and their physical symptoms have not yet been clarified. In the present study, we aimed to determine health education measures that could help maintain good sleeping habits and improve physical and mental health by examining the association between sleep status and subjective symptoms in middle school students.

[Methods] A survey was conducted using a self-administered questionnaire, which was filled out by the middle school students themselves, with seeking their parents for help as necessary. The study subjects consisted of 1,013 students who agreed to participate in the study and had no missing values. We analyzed the relationship between how middle school students spend time after school until the next day, sleep debt, social jet lag (SJL), and subjective symptoms.

[Results] There was a difference between boys and girls in the time spent after school, with boys spending more time playing games and girls spending more time doing homework. Many girls had sleep debt and SJL. Subjective symptoms were associated with sleep debt in both boys and girls. Gaming and homework influenced SJL in both boys and girls. Sleep debt was associated with subjective symptoms even after adjusting for the time spent after school until the next day.

[Conclusions] The different ways in which time was spent at home after school suggested an association with sleeping habits. It also suggested a relationship between sleep and subjective symptoms. Therefore, as health education for middle school students, it is necessary to convey that the way of spending time after school until the next day, including sleep habits, is related to subjective symptoms.

《Key Words》 *sleep debt, social jet lag, physical and mental symptoms, gaming, homework*
.....

Background and Aims

Sleep is a habit and natural act necessary for survival. It is intricately involved in ensuring the appropriate functioning of the nervous, immune, and endocrine systems. Sleep is vital for the maintenance and promotion of health. Above all, it is particularly important for the growth and development of the brain during puberty; in fact, problems

with learning motivation, academic ability, and truancy by lack of sleep¹⁻⁴⁾ are known to be associated with obesity⁵⁻⁷⁾. Although sleep is important in adolescents, sleep duration reportedly reduces with an increase in age^{8,9)}. Children who sleep later at night on a regular basis resolve the lack of sleep on weekends. Consequently, the phenomenon of “weekend catch-up sleep” has recently been receiving increasing attention¹⁰⁻¹²⁾.

The phenomenon of weekend catch-up sleep occurs as a result of the differences in bedtimes between weekdays and weekend^{13,14)}. Bedtime shift is the difference between weekend and school day bedtimes. Wake-up time shift is the difference between weekend and school day wake-up times.

Corresponding author Terumi Kogawa
(E-mail: t_kogawa@auhw.ac.jp)
Aomori University of Health and Welfare
58-1 Mase, Hamadate, Aomori, Japan
Tel: 017-765-2053 Fax: 017-765-2053
(Received January 12, 2022; Accepted May 2, 2022)

Sleeping until late on weekend to eliminate weekday sleep deprivation causes sleep time shifts, resulting in social jet lag (SJL). Following a short sleep time on weekdays, if the wake-up time is delayed on weekends in the absence of any social restrictions, the phase of the circadian rhythm causes a time difference from the sleep time zone on weekdays. SJL is a condition in which a malfunction in sleep occurs due to phase mismatch between social clock and the biological clock¹⁵⁾.

Although no studies have assessed these problems in children as a direct cause of lifestyle-related diseases, a few studies have examined the association of the phenomenon of weekend catch-up sleep with the physical symptoms and psychological state of children^{10,16)}. Furthermore, we have the problem of sleep debt to contend with. Sleep debt is a condition that occurs when one does not get sufficient sleep for days and the debt adds up from days to weeks^{17,18)}. While weekend catch-up sleep eliminates sleep debt and lowers the risk for hypertension¹⁹⁾, many studies^{16,20~22)} have pointed out the negative effects of weekend catch-up sleep and sleep debt. In contrast, the lifestyle behaviors of children are significantly associated with psychosomatic symptoms, suggesting that inappropriate lifestyle behaviors are likely to increase physical and psychological health risks¹¹⁾. The association between lifestyle and sleeping habits in children also needs to be assessed, and health education should consider all the habits involved in daily living. In the present study, we aimed to determine health education measures that could help maintain good sleeping habits and improve physical and mental health by examining the association between sleep status and subjective symptoms in middle school students.

Methods

Study design

This was a cross-sectional study, conducted in Town A (population: approximately 20,000), located in the northern part of Honshu, the main island of Japan. Since 2006, after the merger of towns and villages, Town A has been conducting lifestyle-related disease prevention medical examinations at four middle schools in the town. This study requested a lifestyle-related survey at the above time of the medical examination.

Survey method

The participants of the study were 1,047 students who were enrolled in the third year of middle school between 2008 and 2012. The survey

used a self-administered questionnaire, which was filled out by the middle school students themselves, with seeking their parents for help as necessary. The study subjects consisted of 1,013 students who agreed to participate in the study and had no missing values.

Survey items

Sleep duration was calculated based on the difference between bedtimes and wake-up times on weekdays and weekends. Weekend catch-up sleep was calculated as SJL based on the difference between weekday and weekend sleep duration¹⁵⁾. In addition, sleep debt was calculated as the difference between bedtimes on weekends and weekdays²³⁾. Subjective symptoms of unknown causes are usually classified as general malaises experienced by adolescents¹²⁾. The main symptoms in children include headache, abdominal pain, poor early rising, fatigue, and so on, and children with two or more symptoms have been reported to range about 20~30%²⁴⁾. With reference to these, the questionnaire of subjective symptoms was assessed by each item (fatigue, difficulty concentrating, and irritability; shoulder stiffness, headache, and abdominal pain; and sleepiness during class, difficulty waking up, and trends in insomnia). These symptoms were assessed over the previous month on a four-point scale (0: never; 1: rarely [about 1~3 days a month]; 2: occasionally [about 1~3 days a week]; 3: always [more than 4 days a week]).

In addition, participants were asked how they spent their time after school until the next day when they went to school (hereafter, after school), including information on extracurricular activities, television and other media use, gaming, homework, dinner, and breakfast. During the survey period, SNS was not yet common; therefore, other media included watching DVDs and using personal computers. Information on breakfast skipping was also gathered, as breakfast is related to sleep, and school students who miss breakfast are reported to be sleep deprived²⁵⁾.

Statistical analyses

Data from 1,013 participants having no missing values were analyzed. The time spent in different activities was estimated in minutes. Mann-Whitney U test was initially used for comparisons between boys and girls. Correlations between subjective symptoms and how time was spent after school were assessed using Spearman's correlation coefficient. Correlations between the time spent after

school and SJL were assessed using the partial regression coefficient. The relationships between the time spent after school and SJL and sleep debt were evaluated using multiple regression analysis. Further, a polytomous logistic regression analysis was conducted after adjusting for degree of obesity, breakfast, dinner, extracurricular activities, television or any other media use, gaming, and homework. The contexts for each symptom level and sleep debt and SJL were compared that with reference to 0 levels. All statistical tests were two-sided. Statistical analysis was performed using SPSS software, version 25.0, for Windows (SPSS Japan, Tokyo, Japan).

Ethical considerations

Participants were provided with written and verbal explanations concerning the purpose of the study, their right to withdraw their participation, assurance of their anonymity, and publication of the results. Written and verbal explanation was provided to their parents/guardians too, on the school visit day. The participants and their parents/guardians provided written informed consent to participate in the study. This study was approved by the ethics committee of the Hirosaki University Graduate School of Medicine (No. 2008-170).

Results

Participant characteristics

The participants comprised 528 boys and 485 girls (Table 1). The time spent after school in various activities differed between the sexes. Girls spent

significantly less time playing games than boys ($p < .001$), but they spent significantly more time on breakfast ($p = .028$) and homework ($p < .001$). Moreover, boys' weekday sleep duration was significantly longer than that of girls ($p < .001$); however, weekend sleep duration, sleep debt, and SJL were significantly greater among girls ($p < .001$).

Table 2 presents the relationship between each symptom level, how time was spent after school, and sleep debt and SJL among boys and girls. No correlations were found between any of the symptoms and time spent after school having dinner or participating in extracurricular activities or obesity for boys, or between the symptoms and television or any other media use for girls. Gaming was more often associated with symptoms among boys than among girls. Sleep debt was correlated with symptoms (fatigue, irritability, abdominal pain, difficulty waking up, and trends in insomnia) in both boys and girls.

Effect of time spent after school on sleep debt and social jet lag

Table 3 shows the effects of time spent after school on sleep debt and SJL. For boys, the factors affecting SJL were gaming and homework, with a positive relationship with gaming time and negative relationship with homework. Likewise, the factors affecting SJL for girls were gaming and homework, with a negative association with breakfast time. No factors affecting sleep debt were found in both boys and girls.

Table 1. Gender differences in how time was spent after school

	Boys		Girls		p-value
	N = 528		N = 485		
	M	SD	M	SD	
Breakfast	12.7	5.7	13.5	5.5	.028
Dinner	22.4	8.8	23.0	8.8	.258
Extracurricular activities	137.1	30.4	134.5	39.8	.489
Television or any other media use	132.7	73.5	127.4	69.7	.242
Gaming	89.6	58.4	48.9	57.5	<.001
Homework	80.4	40.1	99.8	42.0	<.001
Weekday sleep duration (min.)	453.7	44.7	443.6	40.6	<.001
Weekend sleep duration (min.)	508.8	71.1	528.1	72.8	<.001
Sleep debt	55.2	74.8	84.6	77.3	<.001
Social jetlag	0.765	0.69	0.960	0.73	<.001

after school: the time between going home after school and the one going to school on the following day

M: mean, SD: standard deviation

The unit of each item was one minute.

p-values were obtained using a Mann-Whitney-U test.

Table 2. Correlation between symptoms and how time was spent after school

	Breakfast	Dinner	Extracurricular activities	Television or any other media use	Gaming	Home work	Degree of obesity	Sleep debt	SJL
Boys									
Fatigue	-.088*	.016	.048	-.040	.028	.016	-.024	.112**	.114**
Difficulty concentrating	-.065	-.007	.022	.093*	.135**	-.079	.001	.077	.078
Irritability	-.064	.046	-.024	.089*	.129**	-.129**	.021	.091*	.083
Shoulder stiffness	-.109*	-.038	-.036	-.030	.003	.031	.059	.094*	.093*
Headache	.009	-.013	.022	-.005	.036	-.050	.01	.009	.008
Abdominal pain	-.080	-.054	.017	.037	.103*	-.005	-.037	.115**	.041
Sleepiness during class	-.082	-.024	.034	.069	.079	-.105*	.038	.025	.064
Difficulty waking up	-.030	.068	-.064	.042	.136**	-.031	-.078	.147*	.134**
Trends in insomnia	.021	.052	-.002	.004	.030	-.018	.049	.093*	.111*
Girls									
Fatigue	-.028	-.035	.055	.039	.025	.032	.03	.120**	-.081
Difficulty concentrating	-.028	-.050	-.004	.071	.100*	-.077	-.02	-.001	-.034
Irritability	-.007	-.043	.035	.070	.025	-.005	.07	.140**	.101*
Shoulder stiffness	-.020	.098*	-.046	-.011	-.003	-.046	.06	.052	.085
Headache	-.063	.027	-.010	-.038	.055	-.027	.142**	.040	.040
Abdominal pain	-.009	.059	-.022	-.045	.045	-.010	-.02	.148**	.111**
Sleepiness during class	-.079	-.042	.018	.046	.051	-.099*	.034	.048	.048
Difficulty waking up	-.093*	.088	.091*	-.002	.107*	-.037	.024	.173**	.140**
Trends in insomnia	-.039	.039	-.025	.014	.117*	.006	.058	.116**	.075

after school: the time between going home after school and the one going to school on the following day

Spearman's correlation coefficient

*: $p < 0.05$, **: $p < 0.01$

Context of each symptom level and sleep debt and social jet lag

The relationships between each symptom level and sleep debt and SJL, after adjusting for how time was spent after school, are presented in Tables 4 and 5. For boys, fatigue, difficulty concentrating, irritability, shoulder stiffness, abdominal pain, and difficulty waking up were the symptoms associated with sleep debt after adjusting their time spent after school. SJL was associated with fatigue, difficulty in concentration, shoulder stiffness, and difficulty waking up (Table 4). In girls, sleep debt and SJL were both associated with fatigue, abdominal pain, and difficulty waking up (Table 5).

Discussion

This study examined the association between sleeping habits and subjective symptoms among middle school students, and indicated that the time spent after school doing different activities differed by gender. Although one previous study did not find any gender-related differences in terms of bed-times and wake-up times on weekdays²⁶⁾, other studies have reported that girls wake up earlier on weekdays but later on weekends^{27,28)}. In a previous study, girls were found to be significantly more morning oriented than boys²⁹⁾. In another study,

girls also showed longer sleep times on weekends and were more likely to have SJL³⁰⁾. Our study showed that girls have more sleep debt and SJL conditions than boys. Although one report alerts to sleep debt in children³¹⁾, the majority of studies^{17,18)} do not report gender differences for children's and adolescents' sleep debt.

Other studies^{21,22)}, have indicated that boys who engage in prolonged weekend catch-up sleep to compensate for weekday sleep deprivation may spend less time viewing television. Moreover, delayed sleep timing during adolescence is partly driven by environmental factors that can displace sleep, such as viewing television, or any other media use^{32,33)}. In the present study, weekend catch-up sleep was related to difficulty waking up among boys and girls, and gaming appears to be a significantly related background factor. Hence, it is necessary to be careful about game time, which can lead to sleep debt and weekend catch-up sleep. In contrast, as homework had a negative association with SJL for both boys and girls, it was considered that doing homework at a fixed time, including on weekends, was a favorable way to reduce SJL. Excessive study time on weekends has been reported to cause depression³⁴⁾; however, setting aside regular and moderate homework time might help improve the health of middle school students.

Table 3. Relationships between time spent after school and SJL, and, sleep debt

	SJL	B	SE	β	t-value	p	VIF
Boys							
Breakfast		-0.007	0.006	-0.059	-1.264	0.207	1.021
Dinner		0.001	0.004	0.018	0.389	0.697	1.078
Extracurricular activities		0.001	0.001	0.060	1.375	0.170	1.066
Television or any other media use		-0.001	0	-0.065	-1.455	0.146	1.178
Gaming		2.00E-03	0.001	0.136	3.071	0.002	1.196
Home work		-0.002	0.001	-0.129	-2.942	0.003	1.039
Girls							
Breakfast		-0.015	0.007	-0.113	-2.303	0.022	1.191
Dinner		0.008	0.004	0.092	1.892	0.059	1.182
Extracurricular activities		-0.001	0.001	-0.044	-0.981	0.327	1.016
Television or any other media use		7.21E-05	0	0.007	0.151	0.880	1.027
Gaming		0.001	0.001	0.090	1.966	0.050	1.038
Home work		-0.002	0.001	-0.096	-2.086	0.038	1.061
Sleep debt							
Boys							
Breakfast		-0.061	0.622	-0.005	-0.097	0.922	1.196
Dinner		0.282	0.401	0.033	0.703	0.483	1.178
Extracurricular activities		-0.130	0.101	-0.057	-1.286	0.199	1.021
Television or any other media use		-0.070	0.046	-0.068	-1.510	0.132	1.078
Gaming		-0.027	0.058	-0.021	-0.475	0.635	1.066
Home work		0.072	0.083	0.038	0.861	0.390	1.039
Girls							
Breakfast		-1.07	0.702	-0.076	-1.525	0.128	1.191
Dinner		0.734	0.436	0.083	1.68	0.094	1.182
Extracurricular activities		0.030	0.087	0.016	0.342	0.732	1.016
Television or any other media use		0.019	0.051	0.017	0.373	0.710	1.027
Gaming		-0.009	0.062	-0.007	-0.143	0.887	1.038
Home work		0.026	0.086	0.014	0.301	0.763	1.061

after school: the time between going home after school and the one going to school on the following day

SJL and sleep debt were evaluated multiple regression analysis

B: Partial regression coefficient, SE: Standard error, VIF: Variance Inflation Factor

Although there are no studies on sleep debt and physical symptoms in children, sleep debt has been reported to exacerbate colitis inflammation and delay recovery in adults³⁵⁾, and thereby being supposed to be similar in girls too. A girl's functional abdominal pain or irritable bowel syndrome is associated with vagal activity, which is closely associated with sleep³⁶⁾. It is necessary to pay attention to the symptoms peculiar to girls from childhood. Based on the above earlier studies and the results of this study. It is therefore necessary to convey how to spend the time after school as the content of health education that helps maintain good sleep habits and improves physical and mental health of middle school students.

A limitation of this study was that, as a cross-

sectional study, we could not directly state that inappropriate sleeping habits worsened the experienced symptoms. Additionally, the study area was limited to a town, it is necessary to be careful to generalize our findings. Nonetheless, we also focused on other information, such as subjective symptoms associated with sleeping habits after school. we focused on other information related to sleeping habits after school. Further studies are needed to assess and validate these findings in greater detail.

Conclusions

In the present study, we observed a relationship between sleep habits and certain physical and mental symptoms in Japanese middle school students. The different ways in which time was spent

Table 4. Context of each symptom level and sleep debt and, SJL (boys)

Symptom	Level	n	(%)	Sleep debt			SJL		
				<i>exp</i>	<i>p</i>	95% CI	<i>exp</i>	<i>p</i>	95% CI
Fatigue									
	0	355	(67.2)	1			1		
	1	126	(23.9)	1.000	0.908	0.997-1.003	1.325	0.089	0.958-1.832
	2	37	(7.0)	1.001	0.725	0.997-1.004	1.136	0.481	0.796-1.622
	3	10	(1.9)	1.004	0.049	1.000-1.008	1.974	0.003	1.269-3.070
Difficulty concentrating									
	0	281	(53.2)	1			1		
	1	160	(30.3)	1.001	0.309	0.999-1.004	1.158	0.325	0.864-1.551
	2	69	(13.1)	0.997	0.165	0.993-1.001	0.860	0.483	0.565-1.310
	3	18	(3.4)	1.008	0.003	1.003-1.014	2.145	0.014	1.170-3.933
Irritability									
	0	317	(60.0)	1			1		
	1	133	(25.3)	1.001	0.577	0.998-1.004	1.137	0.408	0.838-1.544
	2	54	(10.2)	1.005	0.003	1.002-1.009	1.410	0.099	0.938-2.120
	3	24	(4.5)	0.995	0.110	0.988-1.001	1.013	0.965	0.557-1.844
Shoulder stiffness									
	0	407	(77.1)	1			1		
	1	67	(12.7)	1.002	0.285	0.998-1.005	0.933	0.739	0.620-1.404
	2	34	(6.4)	1.005	0.030	1.000-1.009	1.527	0.080	0.951-2.453
	3	20	(3.8)	0.999	0.741	0.992-1.005	1.782	0.050	1.001-3.175
Headache									
	0	405	(76.7)	1			1		
	1	102	(19.3)	1.000	0.973	0.997-1.003	1.028	0.864	0.746-1.417
	2	17	(3.2)	0.999	0.679	0.992-1.005	0.672	0.324	0.305-1.48
	3	4	(0.8)	1.003	0.664	0.999-1.016	0.529	0.617	0.044-6.419
Abdominal pain									
	0	370	(70.1)	1			1		
	1	137	(25.9)	1.001	0.283	0.999-1.004	1.081	0.598	0.81 -1.443
	2	17	(3.2)	1.006	0.033	1.000-1.012	1.278	0.473	0.654-2.499
	3	4	(0.8)	1.010	0.060	1.000-1.021	0.766	0.765	0.133-4.412
Sleepiness during class									
	0	229	(41.5)	1			1		
	1	174	(33.0)	1.000	0.890	0.997-1.003	1.203	0.232	0.888-1.628
	2	94	(17.8)	1.000	0.819	0.997-1.004	1.054	0.778	0.729-1.524
	3	41	(7.7)	1.002	0.282	0.998-1.007	1.285	0.299	0.801-2.064
Difficulty waking up									
	0	262	(49.6)	1			1		
	1	118	(22.4)	1.001	0.539	0.998-1.004	0.878	0.464	0.62 -1.244
	2	83	(15.7)	1.002	0.224	0.999-1.006	1.239	0.255	0.857-1.792
	3	65	(12.3)	1.007	0.001	1.003-1.010	1.710	0.006	1.169-2.5
Trends in insomnia									
	0	433	(82.0)	1			1		
	1	64	(12.1)	1.001	0.397	0.998-1.005	1.217	0.319	0.827-1.791
	2	18	(3.4)	1.001	0.735	0.995-1.007	1.734	0.070	0.957-3.141
	3	13	(2.5)	1.004	0.181	0.998-1.011	1.853	0.093	0.903-3.804

Exp: exposure, *p*: *p* value, 95% CI: 95% confidence interval

A polytomous logistic regression analysis was conducted after adjusting for degree of obesity, breakfast, dinner, extracurricular activities, television or any other media use, gaming, and homework.

Compared with the 0 level group

Table 5. Context of each symptom level and sleep debt and, SJL (girls)

Symptom	Level	n	(%)	Sleep debt			SJL		
				<i>exp</i>	<i>p</i>	95% CI	<i>exp</i>	<i>p</i>	95% CI
Fatigue									
	0	307	(63.3)	1			1		
	1	107	(22.0)	1.003	0.058	1.000-1.006	1.144	0.416	0.828-1.581
	2	61	(12.6)	1.002	0.249	0.999-1.005	1.123	0.510	0.795-1.588
	3	10	(2.1)	1.006	0.003	1.002-1.010	1.542	0.046	1.007-2.360
Difficulty concentrating									
	0	259	(53.4)	1			1		
	1	163	(33.6)	1.000	0.837	0.997-1.002	0.927	0.596	0.702-1.225
	2	53	(10.9)	1.000	0.876	0.997-1.004	1.19	0.388	0.802-1.768
	3	10	(2.1)	0.997	0.524	0.988-1.006	0.953	0.912	0.403-2.249
Irritability									
	0	238	(49.1)	1			1		
	1	149	(30.7)	1.002	0.106	1.000-1.005	1.26	0.121	0.941-1.688
	2	74	(15.3)	1.004	0.013	1.001-1.008	1.433	0.054	0.994-2.066
	3	24	(4.9)	1.005	0.064	1.000-1.010	1.512	0.138	0.876-2.611
Shoulder stiffness									
	0	305	(62.9)	1			1		
	1	78	(16.1)	1.002	0.279	0.999-1.005	1.261	0.185	0.895-1.776
	2	54	(11.1)	1.001	0.639	0.997-1.005	1.148	0.505	0.765-1.721
	3	48	(9.9)	1.001	0.765	0.997-1.005	1.338	0.168	0.885-2.023
Headache									
	0	331	(68.2)	1			1		
	1	109	(22.5)	1.000	0.930	0.997-1.003	0.951	0.748	0.699-1.294
	2	35	(7.2)	0.999	0.595	0.994-1.003	1.282	0.284	0.814-2.020
	3	10	(2.1)	1.005	0.195	0.998-1.012	1.325	0.487	0.600-2.925
Abdominal pain									
	0	318	(65.6)	1			1		
	1	117	(24.1)	1.000	0.792	0.998-1.003	1.045	0.772	0.774-1.412
	2	39	(8.0)	1.005	0.018	1.001-1.009	1.411	0.133	0.900-2.213
	3	11	(2.3)	1.010	0.004	1.003-1.017	2.373	0.022	1.135-4.960
Sleepiness during class									
	0	179	(36.9)	1			1		
	1	163	(33.7)	1.002	0.183	0.999-1.005	1.165	0.323	0.861-1.575
	2	105	(21.6)	1.001	0.618	0.998-1.004	1.063	0.729	0.753-1.501
	3	38	(7.8)	1.003	0.151	0.999-1.008	1.495	0.093	0.935-2.390
Difficulty waking up									
	0	222	(45.8)	1			1		
	1	98	(20.2)	1.002	0.239	0.999-1.005	1.181	0.343	0.837-1.667
	2	76	(15.7)	1.001	0.509	0.998-1.005	1.208	0.319	0.833-1.752
	3	89	(18.3)	1.005	0.001	1.002-1.009	1.594	0.008	1.130-2.247
Trends in insomnia									
	0	362	(74.6)	1			1		
	1	83	(17.1)	1.002	0.296	0.999-1.005	1.367	0.062	0.984-1.898
	2	28	(5.8)	1.003	0.169	0.999-1.008	1.328	0.271	0.801-2.202
	3	12	(2.5)	1.002	0.564	0.995-1.009	0.834	0.681	0.35 -1.984

Exp: exposure, *p*: *p* value, 95% CI: 95% confidence interval

A polytomous logistic regression analysis was conducted after adjusting for degree of obesity, breakfast, dinner, extracurricular activities, television or any other media use, gaming, and homework.

Compared with the 0 level group

after school suggested an association with sleeping habits. It also suggested a relationship between sleep and subjective symptoms. Thus, maintaining good sleeping habits during adolescence is essential for improving mental and physical health. The content of health education should cover not only sleeping habits but also homework and gaming tendencies.

Acknowledgments

This work was supported by JSPS KAKENHI Grant Numbers JP18592406, JP 21592845.

Conflict of Interest Statement

The authors declare that they have no conflict of interest.

References

- 1) Gruber R., Laviolette R., Deluca P., et al.: Short sleep duration is associated with poor performance on IQ measures in healthy school-age children. *Sleep Medicine*. 2010; 11(3): 289–294.
- 2) O'Brien LM.: The neurocognitive effects of sleep disruption in children and adolescents. *Child Adolesc Psychiatr Clin N Am*. 2009; 18(4): 813–823.
- 3) Beebe DW., Rose D., Amin R.: Attention, learning, and arousal of experimentally sleep-restricted adolescents in a simulated classroom. *J Adolesc Health*. 2010; 47(5): 523–525.
- 4) Hochadel J., Frölich J., Wiater A., et al.: Prevalence of sleep problems and relationship between sleep problems and school refusal behavior in school-aged children in children's and parents' ratings. *Psychopathology*. 2014; 47(2): 119–126.
- 5) Bonuck K., Chervin RD., Howe LD.: Sleep-disordered breathing, sleep duration, and childhood overweight: a longitudinal cohort study. *J Pediatr*. 2015; 166(3): 632–639.
- 6) Spruyt K., Gozal D.: The underlying interactome of childhood obesity: the potential role of sleep. *Childhood Obesity*. 2012; 8(1): 38–42.
- 7) Gozal D., Kheirandish-Gozal L.: Childhood obesity and sleep: relatives, partners, or both?—A critical perspective on the evidence. *Ann N Y Acad Sci*. 2012; 1264(1): 135–141.
- 8) Matricciani L., Olds T., Petkov J.: In search of lost sleep: secular trends in the sleep time of school-aged children and adolescents. *Sleep Medicine Reviews*. 2012; 16(3): 203–211.
- 9) Eaton DK., McKnight-Eily LR., Lowry R., et al.: Prevalence of insufficient, borderline, and optimal hours of sleep among high school students—United States, 2007. *J Adolesc Health*. 2010; 46(4): 399–401.
- 10) Clinkinbeard SS., Simi P., Evans MK., et al.: Sleep and delinquency: does the amount of sleep matter? *Journal of Youth and Adolescence*. 2011; 40(7): 916–930.
- 11) Isshiki Y., Morimoto K.: Lifestyles and psychosomatic symptoms among elementary school students and junior high school students. *Environmental Health and Preventive Medicine*. 2004; 9(3): 95–102.
- 12) Sweeting H., West P.: Health at age 11: reports from schoolchildren and their parents. *Arch Dis in Child*. 1998; 78(5): 427–434.
- 13) Giannotti F., Cortesi F., Sebastiani T., et al.: Circadian preference, sleep and daytime behaviour in adolescence. *J Sleep Res*. 2002; 11(3): 191–199.
- 14) Laberge L., Petit D., Simard C., et al.: Development of sleep patterns in early adolescence. *J Sleep Res*. 2001; 10(1): 59–67.
- 15) Wittmann M., Dinich J., Mellow M., et al.: Social jetlag: misalignment of biological and social time. *Chronobiol Int*. 2006; 23(1–2): 497–509.
- 16) Hall MH., Lee L., Matthews KA.: Sleep duration during the school week is associated with C-reactive protein risk groups in healthy adolescents. *Sleep Medicine*. 2015; 16(1): 73–78.
- 17) William C. Dement (2001) "Reducing America's Sleep Debt" (<https://sleepreviewmag.com/sleep-disorders/breathing-disorders/obstructive-sleep-apnea/news-story-4-2/>, 2021/12/15)
- 18) Cabeza de Baca T., Chayama KL., Redline S., et al.: Sleep debt: the impact of weekday sleep deprivation on cardiovascular health in older women. *Sleep*. 2019; 42(10): zsz149.
- 19) Hwangbo Y., Kim WJ., Chu MK., et al.: Association between weekend catch-up sleep duration and hypertension in Korean adults. *Sleep Medicine*. 2013; 14(6): 549–554.
- 20) Killick R., Hoyos CM., Melehan KL., et al.: Metabolic and hormonal effects of "catch-up" sleep in men with chronic, repetitive, lifestyle-driven sleep restriction. *Clin Endocrinol*. 2015; 83(4): 498–507.
- 21) Kim CW., Choi MK., Im HJ., et al.: Weekend catch-up sleep is associated with decreased risk of being overweight among fifth-grade students with short sleep duration. *J Sleep Res*. 2012; 21(5): 546–551.
- 22) Tambalis KD., Panagiotakos DB., Psarra G., et al.: Insufficient sleep duration is associated with dietary habits, screen time, and obesity in children. *Journal of Clinical Sleep Medicine*. 2018; 14(10): 1689–1696.
- 23) Jankowski KS.: Social jet lag: sleep-corrected formula. *Chronobiol Int*. 2017; 34(4): 531–535.
- 24) Sawamura R., Tanaka H., Terashima S., et al.: Difference between children's self-recognition and their parents' recognition of Child's physical and mental symptoms and life events. *JPn J Psychosom Med*. 1998; 38: 221–228.
- 25) Agostini A., Lushington K., Kohler M., et al.: Asso-

- ciations between self-reported sleep measures and dietary behaviours in a large sample of Australian school students (n=28,010). *J Sleep Res.* 2018; 27: e12682.
- 26) Randler C., Bilger S.: Associations among sleep, chronotype, parental monitoring, and pubertal development among German adolescents. *J Psychol.* 2009; 143(5): 509-520.
 - 27) Díaz-Morales JF., de León MC., Sorroche MG.: Validity of the morningness-eveningness scale for children among Spanish adolescents. *Chronobiol Int.* 2007; 24(3): 435-447.
 - 28) Yang CK., Kim JK., Patel SR., et al.: Age-related changes in sleep/wake patterns among Korean teenagers. *Pediatrics.* 2005; 115(1) Supplement: 250-256.
 - 29) Randler C.: Gender differences in morningness-eveningness assessed by self-report questionnaires: A meta-analysis. *Personality and Individual Differences.* 2007; 43(7): 1667-1675.
 - 30) Collado Mateo MJC., Díaz-Morales JF., Escribano Barreno C., et al.: Morningness-eveningness and sleep habits among adolescents: age and gender differences. *Psicothema.* 2012; 24(3): 410-415.
 - 31) Williamson AA., Meltzer LJ., Fiks AG.: A stimulus package to address the pediatric sleep debt crisis in the United States. *JAMA Pediatrics.* 2020; 174(2): 115-116.
 - 32) Van den Bulck J.: Television viewing, computer game playing, and Internet use and self-reported time to bed and time out of bed in secondary-school children. *Sleep.* 2004; 27(1): 101-104.
 - 33) Gradisar M., Wolfson AR., Harvey AG., et al.: The sleep and technology use of Americans: findings from the National Sleep Foundation's 2011 Sleep in America poll. *Journal of Clinical Sleep Medicine.* 2013; 9(12): 1291-1299.
 - 34) Yeo SC., Tan J., Lo JC., et al.: Associations of time spent on homework or studying with nocturnal sleep behavior and depression symptoms in adolescents from Singapore. *Sleep Health.* 2020; 6(6): 758-766.
 - 35) Ranjbaran Z., Keefer L., Stepanski E., et al.: The relevance of sleep abnormalities to chronic inflammatory conditions. *Inflamm Res.* 2007; 56: 51-57.
 - 36) Monica J., Margaret H., Danita C., et al.: Autonomic nervous system function in young children with functional abdominal pain or irritable bowel syndrome. *The Journal of Pain.* 2012; 13(5): 477-484.

「週末の寝だめ」によって引き起こされる社会的時差ぼけと睡眠負債、自覚症状と生活習慣との関連

古川照美¹⁾, 岩渕光子²⁾

1) 青森県立保健大学

2) 岩手医科大学

.....(2022年1月12日受付：2022年5月2日受理).....

抄 録

【目的】 近年、放課後の時間をテレビ、ゲームなどに費やした結果として、身体的な問題を訴える子供たちが増えている。しかし、放課後の過ごし方や睡眠習慣、身体的症状について明らかになっているとは言い難い。本研究では中学生の睡眠状態と自覚症状との関連を検討することにより、良好な睡眠習慣と心身の健康の維持、向上のための健康教育対策に示唆を得ることを目的とした。

【方法】 調査は、中学生本人が必要に応じて保護者に協力を求めながら記入する自記式質問紙で行った。本研究への参加に同意し、欠損値のない1,013人を最終的な解析対象とした。中学生の放課後から翌日までの過ごし方、睡眠負債、社会的時差ぼけ (SJL)、自覚症状との関係を分析した。

【結果】 放課後の過ごし方は男子と女子で差があり、男子はゲームに、女子は宿題に多くの時間を費やしていた。多くの女子が睡眠負債と SJL を持っていた。自覚症状は、男子と女子の両方で睡眠負債と関連していた。ゲームと宿題は、男子と女子の両方で SJL に影響を与えていた。睡眠負債は、放課後から翌日までの過ごし方の時間を調整した後も自覚症状と関連していた。

【結論】 放課後から翌日の過ごし方の違いと、睡眠習慣との関連が示唆された。また、睡眠と自覚症状との関連も示唆された。したがって、中学生に対する健康教育として、睡眠習慣を含む、放課後から翌日までの過ごし方が自覚症状と関連していることを伝える必要がある。

Aomori J. Health Welfare, 4(1); 22-31: 2022

Key words: 睡眠負債, 社会的時差ぼけ, 自覚症状, ゲーム, 宿題

連絡先

古川照美 (E-mail: t_kogawa@auhw.ac.jp)

青森県立保健大学

青森市大字浜館字間瀬58-1

Tel: 017-765-2053 Fax: 017-765-2053

Originally published in Aomori Journal of Health and Welfare (https://auhw.repo.nii.ac.jp/?action=repository_opensearch&index_id=279) This is an open access article distributed under the terms of the Creative Commons Attribution License (<https://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in Aomori Journal of Health and Welfare, is properly cited. The complete bibliographic information, a link to the original publication on https://auhw.repo.nii.ac.jp/?action=repository_opensearch&index_id=279, as well as this copyright and license must be included.