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Review

Short Sleep in Pupils in Japan: Current Status and Associated Factors

Jun Kohyama *

Department of Sleep Medicine, Tokyo Bay Urayasu Ichikawa Medical Center, Toudaijuma 3-4-32, Urayasu 279-0001, Chiba, Japan; E-Mail: j-kohyama@jadecom.or.jp

* **Correspondence:** Jun Kohyama; E-Mail: j-kohyama@jadecom.or.jp

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Abstract

***Background*:** Several recommendations on optimum sleep duration have been published for adolescents to secure a healthy life. This study aimed to compare the sleep duration of middle and high school pupils in Japan with the recommended values and determined the factors associated with the duration of sleep among them.

Methods: A total of 1766 completed questionnaires were obtained from grades 7 to 12 pupils in Japan. The questionnaire addressed the following points: sleeping, eating, defecation, physical activity, screen time, after-school activity, body mass index, and self-reported academic performance. On self-reported academic performance, they were asked to select their overall academic performance from the following four choices: very good, good, average, poor.

Results: The mean sleep duration of school nights did not reach the lowest recommended level in case of all grades. By means of multiple linear regression analysis, the regression equation for sleep duration of both school nights (adjusted $R^2 = 0.2046$, $F = 38.84$, $p < 0.001$) and non-school nights (adjusted $R^2 = 0.093$, $F = 16.15$, $p < 0.001$) were obtained. For both school and non-school nights, grade (standardized partial regression coefficient (β), -0.321

for school days and -0.176 for non-school days), after-school activity (β, -0.100 for school days and -0.142 for non-school days) and school day screen time (β, -0.097 for school days and -0.092 for non-school days) showed significant associations with sleep duration. Self-reported academic performance was not associated with the sleep duration of both school and non-school nights.

Conclusions: The mean sleep duration of school nights of grade 7 to 12 pupils in Japan was lower than the recommendations. Pupils may compensate for their sleep shortage during school nights by increasing sleep duration of non-school nights. Shortening after-school activity and school day screen time would be expected to increase their sleep duration.

Keywords

Sleep duration; after-school activity; screen time; insufficient sleep syndrome

1. Introduction

According to the recent data of the Organization for Economic Co-operation and Development [1], Japan is the most sleep-deprived nation in the world. In such a sleep-deprived society, the attitude toward sleep is a serious issue, especially among adolescents, who represent the next generation, because the consequences of sleep problems are presumed to affect various aspects of the life [2]. Insufficient sleep is associated with a wide range of negative outcomes such as obesity, cardiovascular disease, malignant neoplasms, cerebrovascular disease, diabetes, hypertension, accidents and injuries, and poor academic performance [3]. Indeed, a considerable number of pupils in Japan purportedly suffer from insufficient sleep syndrome defined by the international classification of sleep disorders version 3 [4].

The U.S. Centers for Disease Control and Prevention assessed the prevalence of short sleep duration according to the American Academy of Sleep Medicine recommendations (6-12 years old, 9-12 h and 13-18 years old, 8-10 h) on school nights [5] in American middle and high school students. They reported that the overall prevalence of short-sleeping pupils was 57.8% and 72.7% for middle and high school students, respectively [6]. According to the National sleep foundation [7], the lower recommendation of sleep duration is 9 h for 6-13 years, 8 h for 14-17 years, and 7 h for 18-25 years. The National Heart, Lung, and Blood Institute recommended that at least 10 h sleep is essential for school-aged children and adolescents to perform adequately [8]. It should be noted that there are large differences among recommendations on sleep duration. Indeed, there was a recent article objecting the set recommendations for sleep duration in children and teens [9]. The article claimed that the sleep ranges and age groupings are too wide and the indicators for determining sleep need and guidelines on the timing of day and night sleep periods should be provided. Despite these recommendations, the problem of insufficient sleep among adolescents remains unaddressed. Since grade 7 pupils includes 12-13-year-old children, grade 8 includes 13-

14-year-old, grade 9 includes 14-15-year-old, grade 10 includes 15-16-year-old, grade 11 includes 16-17-year-old, and grade 12 includes 17-18-year-old pupils, in general, the above-cited recommendations can be simplified as the lowest recommended sleep duration is 8 h for grade 7-11 and 7 h for grade 12, respectively. The current study aimed to compare the sleep duration of middle and high school pupils in Japan with the lowest recommended values [5, 7-8] and revealed the factors associated with their sleep duration.

Some part of the present analyzed data has been used in other publications [10, 11]. According to the former analysis [11], early non-school day wake time in addition to less sleepiness, lower body mass index (BMI), less breakfast skipping, less constipation, and short non-school day screen time were found to be associated with good self-reported academic performance. However, the previous study [10] did not investigate these factors in association with sleep duration.

This study was approved by the Committee for Medical Research Ethics of Tokyo Bay Urayasu Ichikawa Medical Centre (no. 199).

2. Methods

A questionnaire was delivered to each student by their school teachers between October 2016 and November 2018. A letter was also delivered assuring them that their responses would be treated anonymously and confidentially and that it is voluntary to participate. Written consent (signed by any of the parents) and completed questionnaires were collected by school teachers on any of the subsequent days and were subsequently delivered to the author. Of the 3117 questionnaires collected from 13 public schools (eight junior high schools and five high schools), 1766 students agreed to participate in the study and answered all the required questions.

The queries in the questionnaire are shown in Table 1. The responses on sleepiness, breakfast, and defecation were expressed as sleepiness score, breakfast score, and defecation score, respectively. On dinner regularity, the choice of 1 to 7 was categorised into regular dinner (dinner regularity score 1) and the last choice of 8 into irregular dinner (dinner regularity score 2). The hours of after-school activity per week were taken as the product of the frequency and duration of activities. The responses on physical activity, screen time, and self-reported academic performance (1, very good; 2, good; 3, average; 4, poor) were termed as physical activity score, screen time score, and self-reported academic performance score, respectively. This categorization on self-reported academic performance was carried out following by Wolfson and Carskadon [12].

Table 1 Questionnaire.

(1) Please mark your grade. Elementary school (grade 5, 6) Middle high school (grade 1, 2, 3) High school (grade 1, 2, 3)
(2) Please mark your gender. Gender (male, female)
(3) Please describe your height and weight. Height (cm) Weight (kg)

(4) Please mark your bedtime before school days. 1. before 8 PM, 2. 8PM–9PM, 3. 9PM–10PM, 4. 10PM–11PM, 5. 11PM–12AM, 6. 12AM–1AM, 7. 1AM–2AM, 8. 2AM–3AM, 9. after 3AM
(5) Please mark your bedtime before non-school days. 1. before 8 PM, 2. 8PM–9PM, 3. 9PM–10PM, 4. 10PM–11PM, 5. 11PM–12AM, 6. 12AM–1AM, 7. 1AM–2AM, 8. 2AM–3AM, 9. after 3 AM
(6) Please mark your wake time on school days. 1. before 5AM, 2. 5AM–6AM, 3. 6AM–7AM, 4. 7AM–8AM, 5. 8AM–9AM, 6. 9AM–10AM, 7. 10AM–11AM, 8. 11AM–12PM, 9. after 12PM
(7) Please mark your wake time on non-school days. 1. before 5AM, 2. 5AM–6AM, 3. 6AM–7AM, 4. 7AM–8AM, 5. 8AM–9AM, 6. 9AM–10AM, 7. 10AM–11AM, 8. 11AM–12PM, 9. after 12PM
(8) Please mark the frequency you feel sleepy during class. 1. Never 2. Sometimes 3. Often 4. Always
(9) Please mark the frequency of eating breakfast. 1. Always 2. Often 3. Sometimes 4. Never
(10) Please mark the frequency of defecation. 1. Every day, 2. Every other day, 3. Once every two to three days, 4. Twice a week or less
(11) Please mark the time you usually take dinner. 1. Around 6 PM, 2. Around 7 PM, 3. Around 8 PM, 4. Around 9 PM, 5. Around 10 PM, 6. Around 11 PM, 7, Later than 11 PM, 8. Not determined
(12) Do you participate in any kind of after-school activity? 1. Yes 2. No
(13) If yes, please mark the frequency of participating in an after-school activity. 1. Once a week, 2. Twice a week, 3. Three times a week, 4. Four times a week, 5. Five times a week, 6. Six times a week, 7. Every day.
(14) Please mark the average duration of a single after-school activity. 1. 1 h, 2. 2 h, 3. 3 h, 4. 4 h, 5. 5 h or more.
(15) How many days a week do you take a habitual exercise except for school lessons? 0. Zero-day per week, 1. One day per week, 2. Two days per week, 3. Three days per week, 4. Four days per week, 5. Five days per week, 6. Six days per week or 7. Seven days per week
(16) How long do you use various media devices (television, video, video game, digital versatile disc, computer, tablet, mobile (cell) phone, and smartphone) in a day? Please answer separately on school days and non-school days. On a school day. 1. < 2 h, 2. 2–4 h, 3. 4–6 h, 4. 6–8 h, 5. 8 h or more. On a non-school day. 1. < 2 h, 2. 2–4 h, 3. 4–6 h, 4. 6–8 h, 5. 8 h or more.
(17) Please mark one of the following choices where your overall academic performance mostly belongs to. 1. Very good, 2. Good, 3. Average, 4. Poor.

In order to calculate sleep duration, we needed representative time for each category of bed and wake times. Representative times for each bedtime category (1. < 8PM, 2. 8PM–9PM, 3. 9PM–10PM, 4. 10PM–11PM, 5. 11PM–12AM, 6. 12AM–1AM, 7. 1AM–2AM, 8. 2AM–3AM, 9. > 3AM) were determined as follows: 7:30PM, 8:30PM, 9:30PM, 10:30PM, 11:30PM, 12:30AM, 1:30AM, 2:30AM, and 3:30AM. As for the wake time category (1. < 5AM, 2. 5AM–6AM, 3. 6AM–7AM, 4. 7AM–8AM, 5. 8AM–9AM, 6. 9AM–10AM, 7. 10AM–11AM, 8. 11AM–12PM, 9. > 12PM), representative times were as follows: 4:30AM, 5:30AM, 6:30AM, 7:30AM, 8:30AM, 9:30AM, 10:30AM, 11:30AM, and 12:30PM. The sleep duration on school nights was calculated as the difference between the bedtime before school days and wake time on school days of these representative times. The sleep duration of non-school nights was calculated as the difference between bedtime before non-school days and wake time on non-school days of these representative times. In order to calculate screen time from the screen time scores, representative times for each screen time category (1. less than 2 h, 2. 2-4 h, 3. 4-6 h, 4. 6-8 h, and 5. 8 h or more) were determined as follows: 1 h, 3 h, 5 h, 7 h, and 9 h.

Since BMI has been reported to be altered markedly during school-aged children and adolescents in Japan [13], an analysis of variance (ANOVA) was conducted to determine the differences among BMI of twelve categories divided by gender and grade (male and female categories of grade 7 to 12). Student's t-test was used to assess the gender difference among the factors investigated. The factors associated with sleep duration on school nights and non-school nights were assessed by multiple regression analysis using grade, gender, BMI, breakfast score, dinner regularity score, physical activity score, defecation score, sleepiness score, screen time scores on both school days and non-school days, after-school activity hours per week, and self-reported academic performance score as explanatory variables.

A p-value of < 0.05 was considered statistically significant. These analyses were conducted by a Bell Curve in Excel.

3. Results

The pupils in each of the twelve categories, segregated by gender and grade of the current subjects, are shown in Table 2 with the factors that had no relation with school days (nights) and non-school days (nights). The ANOVA of the BMI among these twelve categories revealed a significant difference ($F = 9.67$ ($df = 1754$)). Then, BMI values were standardized by gender and grade in the subsequent analysis.

The sleep parameters including mean sleep duration and screen time of both school nights (not "nights" but "days" for screen time) and non-school nights (not "nights" but "days" for screen time) in each grade are shown in Table 3 with the standard deviation. The mean sleep duration of school nights of grade 7 to 12 pupils of both genders did not reach the lowest recommended values (8 h for grade 7 to 11, and 7 h for grade 12) [5, 7-8]. Even in the non-school nights, the mean sleep duration of grade 10 and 11 male pupils did not reach these figures [5, 7-8]. In contrast with the school nights, the mean sleep duration of non-school nights was increased in all twelve

categories (from 50.4 min (grade 7 male) to 112.2 min (grade 12 female)).

The distribution of sleep duration categories (less than 6 h, 6-7 h, 7-8 h, 8-9 h, 9-10 h, 10 h or more) of school nights and non-school nights in each grade is shown in Figure 1 with the data for both genders together. Among the sleep duration categories of school nights, the highest rate was 8-9 h in grade 7 and 8 pupils, 7-8 h in grade 9, 6-7, and 7-8 h in grade 10, 7-8 h in grade 11, and 6-7 h in grade 12 pupils. On the other hand, for the non-school nights, the highest rate was 9-10 h in grade 7, 8, and 9 pupils, 8-9 h in grade 10 and 11, and 9-10 h in grade 12 pupils, respectively. Except for the non-school nights of grade 12 pupils, the highest sleep duration category moved toward the shorter categories with the grade progression. The percentage of pupils with school night sleep duration of fewer than 6 h was 1.8% in grade 7, 2.3% in grade 7, 9.3% in grade 9, 13.5% in grade 10, 12.4% in grade 11, and 13.2% in grade 12. These values were decreased to 0.9%, 1.9%, 2.5%, 5.7%, 2.0%, and 3.8% in non-school nights, respectively. The actual number of these short sleep pupils was 136 for school nights while 14 for non-school nights. The average rate of pupils with sleep duration of 10 h or more for school nights was 0.7%, and the same became 19.0% for non-school nights. The actual number of these long-sleep pupils was 48 in school nights and 350 in non-school nights, respectively.

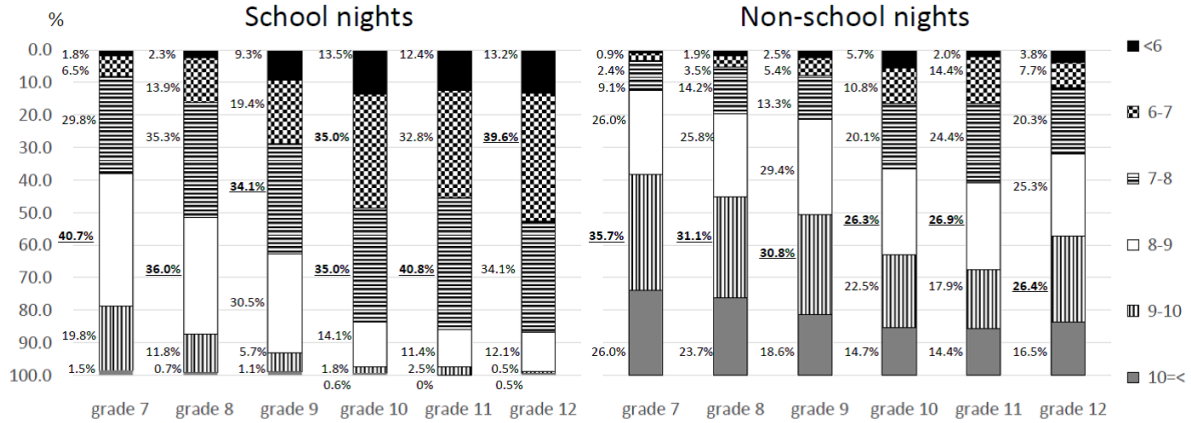

Figure 1 Distribution of sleep duration categories (less than 6 h, 6-7 h, 7-8 h, 8-9 h, 9-10 h, 10 h or more) of school nights (left) and non-school nights (right) by the grade group. Except for non-school nights of grade 12 pupils, the highest sleep duration category (the percentage is underlined) moved toward shorter category with the grade progression. Please see further explanations in the text.

On the basis of the multiple linear regression analysis, significantly predictable regression equation were developed for sleep duration of both school nights (adjusted $R^2 = 0.2046$, $F = 38.84$ ($df = 1753$), $p < 0.001$) and non-school nights (adjusted $R^2 = 0.093$, $F = 16.15$ ($df = 1753$), $p < 0.001$). The regression coefficients for school nights and non-school nights are shown in Table 4. The common factors associated with short sleep duration in both school nights and non-school nights were a higher grade and the increase of both after-school activity and school day screen time. Self-reported academic performance was not a significant factor associated with sleep duration.

Table 2 The mean values with standard deviation of the scores of the factors investigated.

Grade	Gender	Number	BMI	Breakfast score	Defecation score	Sleepiness score	After-school activity per week (hour)	Dinner regularity score	Physical activity score	Self-reported academic performance score
7	Male	172	18.97, 3.38	1.19, 0.57	1.61, 0.88	1.81, 0.69	3.73, 4.24	1.41, 0.49	4.70*, 2.58	2.41, 0.76
	Female	167	18.74, 2.59	1.16, 0.48	1.76, 0.87	1.93, 0.67	3.07, 3.83	1.37, 0.48	4.02, 2.92	2.45, 0.69
8	Male	225	19.10, 2.73	1.23, 0.57	1.54**, 0.82	2.06, 0.83	3.96, 4.43	1.38, 0.49	5.36**, 2.37	2.71, 0.84
	Female	206	19.33, 2.33	1.23, 0.56	1.86, 1.00	2.08, 0.67	4.37, 4.54	1.36, 0.48	3.56, 3.03	2.75, 0.82
9	Male	144	20.12, 2.98	1.25. 0.60	1.52**, 0.82	2.04, 0.84	7.55**, 8.58	1.51, 0.50	2.78**, 2.92	2.67, 0.89
	Female	135	19.90, 2.23	1.33, 0.71	2.04, 1.05	2.07, 0.66	5.01, 6.48	1.39, 0.49	1.18, 2.28	2.56, 0.83
10	Male	192	20.24, 2.58	1.26, 0.67	1.38**, 0.64	2.44, 0.87	7.09*, 10.03	1.24*, 0.43	4.48**, 2.90	2.66, 0.83
	Female	142	20.08, 2.11	1.30, 0.68	1.85, 1.00	2.51, 0.82	10.16, 11.23	1.35, 0.48	2.38, 2.93	2.61, 0.74
11	Male	100	20.50, 2.66	1.42, 0.83	1.20**, 0.53	2.52, 0.81	10.15, 10.45	1.32*, 0.47	4.01**, 3.11	2.62, 0.91
	Female	101	20.20, 2.01	1.34, 0.68	1.85, 0.97	2.73, 0.79	11.95, 9.80	1.48, 0.50	1.94, 2.72	2.67, 0.74
12	Male	93	21.01**, 2.44	1.52, 0.88	1.30**, 0.66	2.35, 0.88	7.32, 7.97	1.22*, 0.41	2.37**, 2.63	2.66**, 0.85
	Female	89	20.00, 2.46	1.34, 0.67	1.90, 1.09	2.58, 0.88	9.98, 10.07	1.36, 0.48	1.10, 2.23	2.29, 0.83

Asterisks at the right side of some figures for males represent significant gender differences (*$p < 0.05$; **$p < 0.01$).

Table 3 The mean values with standard deviation of sleep-related parameters and screen time of both school nights and non-school nights.

			School-				Non-school-			
			Nights	Days			Nights	Days		
Grade	Gender	Number	Sleep duration (hour)	Awake time; mean (time), standard deviation (hour)	Bed time; mean (time), standard deviation (hour)	Screen time (hour)	Sleep duration (hour)	Awake time; mean (time), standard deviation (hour)	Bed time; mean (time), standard deviation (hour)	Screen time (hour)
Grade 7	Male	172	7.90**, 1.01	6:21 0.68	22:27**, 0.98	2.13, 1.44	8.74, 1.29	7:33* 1.43	22:49, 1.09	3.80*, 2.05
	Female	167	7.60, 0.88	6:20 0.65	22:44, 0.80	1.92, 1.42	8.93, 1.22	7:54 1.31	22:58, 1.09	3.32, 2.07
Grade 8	Male	225	7.63**, 0.97	6:26 0.75	22:49**, 0.98	2.37, 1.66	8.58, 1.46	7:40** 1.54	23:05**, 1.30	4.02, 2.32
	Female	206	7.21, 1.00	6:22 0.71	23:10, 1.05	2.18, 1.59	8.63, 1.29	8:03 1.48	23:25, 1.14	3.62, 2.10
Grade 9	Male	144	7.00, 1.28	6:44 0.66	23:44, 1.33	2.33, 1.84	8.33, 1.56	8:25 1.65	0:05, 1.49	3.83, 2.52
	Female	135	7.07, 1.09	6:41 0.58	23:37, 1.07	2.22, 1.86	8.53, 1.19	8:29 1.36	23:58, 1.26	3.53 2.25
Grade 10	Male	192	6.61, 1.08	6:15 0.79	23:38, 1.02	2.57**, 1.47	7.95, 1.65	7:52 1.67	23:55, 1.20	3.93**, 2.19
	Female	142	6.46, 1.04	6:12 0.70	23:44, 0.91	3.20, 1.71	8.02, 1.52	8:03 1.56	0:01, 1.06	4.63, 2.21
Grade 11	Male	100	6.53, 0.93	6:25 0.88	23:52, 0.95	3.07, 2.00	7.84, 1.52	7:53 1.94	0.02, 1.12	3.98**, 2.32
	Female	101	6.62, 1.02	6:17 0.73	23:40, 0.95	3.60, 2.03	8.06, 1.45	8:01 1.52	23:58,1.16	4.90, 2.30
Grade 12	Male	93	6.49, 0.94	6:26 0.84	23:56, 1.11	3.33, 2.16	8.06, 1.61	8:26 1.84	0:22, 1.31	4.48, 2.39
	Female	89	6.44, 1.08	6:25 0.75	23:58, 1.05	3.17, 2.28	8.31, 1.37	8:37 1.47	0:18, 1.11	4.50, 2.34

Asterisks at the right side of some figures for the males represent significant gender differences (*$p < 0.05$; **$p < 0.01$).

Table 4 The regression coefficients for sleep duration for school nights and non-school nights.

	Factors	Partial regression coefficient (95% confidence interval)	Standardized partial regression coefficient (β)	F-value	p-value
School nights	Grade	-0.229 (-0.264–-0.194)	-0.321	166.317	<0.001
	Sleepiness score	-0.155 (-0.218–-0.092)	-0.112	23.264	<0.001
	Hours of after-school activity per week	-0.014 (-0.021–-0.008)	-0.100	17.367	<0.001
	Screen time score during school days	-0.123 (-0.207–-0.039)	-0.097	8.164	<0.01
Non-school nights	Physical activity score	-0.082 (-0.106–-0.059)	-0.171	46.764	<0.001
	Grade	-0.160 (-0.208–-0.113)	-0.176	43.868	<0.001
	Hours of after-school activity per week	-0.026 (-0.035–-0.017)	-0.142	30.351	<0.001
	Screen time score during non-school days	0.121 (0.032–0.210)	0.094	7.162	<0.01
	Screen time score during school days	-0.149 (-0.264–-0.034)	-0.092	6.495	0.011
	Defecation score	-0.079 (-0.154–-0.004)	-0.049	4.221	0.040
	Standardized body mass index	0.069 (-0.135–-0.003)	-0.047	4.181	0.041

4. Discussion

The current study revealed that the mean sleep duration of school nights in grade 7 to 12 pupils did not reach any of the lowest recommended levels [5, 7-8]. Even in non-school nights, the mean sleep duration of grade 10 and 11 male pupils was below the recommended level [5, 7-8]. The number of pupils with a short-sleep duration of fewer than six hours decreased remarkably from 136 in school nights to 14 in non-school nights, while the number of pupils with a long-sleep duration of 10 h or more increased markedly from 48 in school nights to 350 in the non-school night. According to the multiple linear regression analysis, grade progression was associated with short-sleep duration for both school nights and non-school nights. In addition, the increase in after-school activity and school day screen time was associated with the short-sleep duration of both school nights and non-school nights.

This study confirmed the serious status of insufficient sleep among middle and high school pupils in Japan. Since the mean sleep duration was increased more than 50 min from school nights to non-school nights, it can be assumed that pupils try to compensate for their sleep shortage by increasing sleep duration during non-school nights. The issues of sleep shortage have been acknowledged for more than 20 years [12]; however, the problem could not be sufficiently addressed. Although several trials have been conducted [14, 15], it could be said that no fundamental change has occurred in the sleep situation of middle and high school pupils for these 20 years.

In order to help these sleep-deprived pupils for insufficient sleep, we should know the factors associated with short sleep duration. As far as the present study is concerned, in addition to grade progression, increases in after-school activity and school day screen time were found to be significant factors associated with short sleep duration of both school nights and non-school nights. Shortening after-school activity and school day screen time would be expected to increase their sleep duration; however, these questions remain to be solved.

In Japan, to improve their academic performance, 41.3% of middle-high school pupils and 27.2% of high school pupils engage in private cram schools [16]. Some pupils also attend piano lessons, swimming club, etc. In addition, 11.3% of high school students get engaged in some kind of part-time jobs [17]. It should be noted that after-school activity in the current study did not consider these activities specifically and might include all these extracurricular activities.

An association between screen media use and decreased sleep duration has been widely acknowledged [18-20]. Carter et al. [18] reported a strong and consistent association between bedtime media device use and inadequate sleep quantity. The association between media use and adolescents' poor sleep efficiency has also been well documented [20]. However, few studies considered the screen time of school days and non-school days separately. In the present study, a long school day screen time was associated with a short-sleep duration during school nights. However, the present study also demonstrated a significant association between long school day screen time and short-sleep duration of non-school nights. Furthermore, sleep duration of non-

school nights and non-school day screen time revealed a positive significant association. The reason for these latter two associations remains to be elucidated.

The association between academic performance and a short-sleep duration is widely acknowledged [12, 21-26]; however, in the current study, we could not find such association. It should be noted that the necessary sleep duration varies from person to person and from night to night [27], and individual variabilities in the need for sleep are influenced by genetic, behavioral, medical, and environmental factors [5]. The present result may be affected by these individual variabilities in sleep duration. In addition, contrary to the widely accepted notion [12, 21-26], sleep duration was recently reported to be a weaker predictor of academic performance in contrast to sleepiness [28]. Further studies are required to clarify the association between sleep duration and academic performance.

This study depended on the responses given for the questionnaire answers, thus the lack of objective data is the major limitation. Additionally, this study lacked age information. This was because some pupils in Japan tend to be sleep-deprived during entrance examinations, and examinations are essentially grade-related issues rather than age-related ones. Then, the current study focused on the grade and ignored the age data from a social viewpoint. However, it should not be forgotten that age is one of the important biological factors. Moreover, this study did not assess the socioeconomic status. Low socioeconomic status might be closely associated with biological sleep problems during development, probably due to nutritional, hygienic, and educational problems. Indeed, children from a low socioeconomic status [29-31] show higher rates of sleep problems, such as short sleep duration, although the opposite results have also been reported [32]. An association between socioeconomic status and sleep habits remains to be elucidated.

In summary, we can say that (i) The mean sleep duration of school nights of grade 7 to 12 pupils did not reach the lower level of recommendations. (ii) Pupils are assumed to compensate for their sleep shortage during school nights by increasing sleep duration during non-school nights. (iii) Shortening after-school activity and school day screen time would be expected to increase their sleep duration. (iv) The association between sleep duration and academic performance remains to be delineated.

Author Contributions

The author did all the research work of this study.

Competing Interests

The author has declared that no competing interests exist.

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