

Study of the sleep patterns, sleep habits, and sleep problems in Japanese elementary school children using the CSHQ-J

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Objective: This study aimed to examine the sleep patterns, sleep habits, and sleep problems in Japanese elementary school children from the aspect of their developmental age.

Methods: The Japanese version of the Children's Sleep Habits Questionnaire (CSHQ-J) was distributed to the parents of 330 students of which 296 (154 boys and 142 girls) questionnaires were returned. The subjects were divided into 3 groups by grade (Low-grade [1st–2nd graders], Middle-grade [3rd–4th graders], and High-grade [5th–6th graders]).

Results: Bedtime was significantly later and sleep duration was significantly shorter in the older students. The total CSHQ-J score was significantly higher in the Low-grade group compared with that in the High-grade group. Regarding the sub-items of the CSHQ-J, the scores for "bedtime resistance" and "sleep anxiety" were significantly higher in the Low-grade group compared with those in the High-grade group.

Conclusions: That sleep duration was significantly shorter in the older students was attributable to their later bedtimes. Differences in the total and sub-item scores of the CSHQ-J were largely attributable to the autonomy of sleep.

Key words: CSHQ-J, elementary school children, sleep habits, bedtime, Japanese

Introduction

Sleep deficiency and sleep problems interfere with cognitive function and induce a variety of problematic daytime behaviors (hyperkinesia, attention deficit, and unstable emotions) in children.¹⁻⁷ Short sleep duration was shown to be an independent risk factor for obesity/overweight conditions.¹ Excessive sleepiness on rising and daytime sleepiness were associated with poorer grades in mathematics and English.² Cognitive functioning is also closely related to sleep duration. Reducing an individual's sleep to 5 hours a night is sufficient to impair both verbal creativity and abstract thinking.⁵ Hyperactivity and conduct problems at school in boys were both associated with parental reports of bedtime resistance. Hyperactivity was also associated with longer sleep duration on weekends. Conduct and

emotional problems in girls were associated with earlier bedtime on school days. Emotional problems in girls were also associated with longer sleep durations on school days and weekends.⁷ Children with more frequent injuries had significantly more sleep problems overall, particularly anxiety around bedtime, compared to children with low injury rates. Children with more parent-reported, injury-prone behaviors also had significantly greater levels of sleep disturbance.⁴

The problem of sleep shortage has been demonstrated by studies on sleep habits in Japanese youth. However, most previous studies have focused on adolescents in junior high school or higher-level schools,⁸⁻¹⁰ while few studies have reported sleep habits and sleep problems in elementary school children. We investigated the sleep habits and sleep problems in children who attended regular classes in a public elementary school. The

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objective of the present study was to describe the changes in sleep habits according to age in these subjects and to discuss these changes from a child-development aspect.

Methods

Subjects

The subjects were children who attended regular classes in a public elementary school in Chiba Prefecture (330 first- to sixth-graders) and their parents. The district they lived in was a general residential area in the suburbs of Tokyo. We obtained the approval of the school administrators to perform this survey of their pupils. The content and aim of the survey was explained orally and in a written document to the children, their parents, and the school teachers and administrators. The children whose parents gave informed consent were enrolled in the study. The first and second graders, third and fourth graders, and fifth and sixth graders were grouped into Low-grade, Middle-grade, and High-grade groups, respectively.

Survey procedure

The school principal distributed the document explaining the study as well as the documents for parents' informed consent and the questionnaire sheets to the teachers of all grades. The teachers distributed the documents and the questionnaires to the students' parents. All questionnaires were collected 1 week after distribution, with anonymity maintained. For ethical considerations, the document provided an explanation of the study objectives and an outline of the tests to be performed. The document also explained that there would be no negative consequences for declining to participate in the study, and that withdrawal from the study was possible at any time after informed consent was given. This survey was conducted in November 2009 and was approved by the ethical committee of Kohnodai Hospital, National Center for Global Health and Medicine.

Evaluation of children's sleep

The Children's Sleep Habits Questionnaire (CSHQ) was used in this study. The CSHQ is a self-report questionnaire for parents about the sleep habits and sleep disorders of their children aged from 4 to 12 years.¹¹ The CSHQ has been used in many studies on children's sleep.¹²⁻¹⁵ The CSHQ includes items relating to a number of key sleep domains that encompass the major clinical sleep complaints in this age group: bedtime behavior and sleep onset, sleep duration, anxiety around bedtime, abnormal behavior occurring during sleep and night

waking, sleep-disordered breathing, parasomnias, and morning waking/daytime sleepiness. In Japan, Doi et al. developed the Japanese version of the Children's Sleep Habits Questionnaire (CSHQ-J).¹⁶

The CSHQ-J consists of 52 questions regarding children's sleep habits and disorders in the past week. The parents were asked to rate each item according to a Likert scale and to write it in the answer form. Eight sub-items (bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, nocturnal awakening, parasomnia, sleep-disordered breathing, and daytime sleepiness) were graded. The total score of the CSHQ-J was calculated by summing the scores of 33 questions of the 8 sub-items. Higher scores indicated the presence of more problems in sleep habits and disorders.

Statistical analyses

Bedtime, sleep duration, wake time, and sub-item scores of the CSHQ-J were compared by Kruskal-Wallis and Dunn's post hoc tests. GraphPad Prism ver. 5.0 for Mac was used for all statistical analyses. $P < 0.05$ was considered to indicate statistical significance.

Results

The subjects were divided into 3 groups by grades (Low-grade, Middle-grade, and High-grade groups). The questionnaires were distributed to the parents of 330 students, and 296 (154 boys and 142 girls) returned the questionnaires, for a response rate of 89.7%. The mean age of the responders was 9.3 ± 1.7 years. There were 34 first graders (19/15), 55 second graders (22/33), 55 third graders (28/27), 47 fourth graders (22/25), 52 fifth graders (30/22), and 53 sixth graders (33/20) (boys/girls, respectively).

Table 1 shows the scores on the CSHQ-J sub-items and sleep patterns (sleep habits). Overall, the mean bedtime was 21:17 (SD \pm 43 minutes), wake time was 6:03 (SD \pm 21 minutes), and the mean sleep time was 518 minutes (SD \pm 40 minutes). Bedtime, wake time, sleep duration, and CSHQ-J results were compared (Table 1). The mean bedtime was 21:00 (SD \pm 43 minutes), 21:16 (SD \pm 33 minutes), and 21:31 (SD \pm 46 minutes) in the Low-grade, Middle-grade, and High-grade groups, respectively, and the mean bedtimes for each group became later as the grades advanced. The mean wake times were 6:03 (SD \pm 20 minutes), 6:01 (SD \pm 22 minutes), and 5:57 (SD \pm 20 minutes) in the Low-through High-grade groups, respectively, revealing no significant differences. The mean sleep durations were 539 minutes (SD \pm 35 minutes), 521 minutes (SD \pm 33

minutes), and 495 minutes (SD ± 38 minutes) in the Low- through High-grade groups, respectively, with the mean sleep duration in the High-age group being significantly shorter compared to the Middle- and Low-grade groups, while sleep duration in the Middle-grade group was also significantly shorter than that in the Low-grade group.

Table 2 shows the CSHQ-J subscores. The total score on the CSHQ-J was significantly higher in the Low-grade group vs. the High-grade group. With regard to the CSHQ-J sub-items, "bedtime resistance" and "sleep anxiety" were significantly higher in the Low-grade group compared with the High-grade group. Among the items comprising "bedtime resistance," "falls asleep in own bed," "falls asleep in other's bed," and "afraid of sleeping alone" were significantly higher in the Low-grade group vs. the High-grade group. With regard to "sleep anxiety," the rate of being "afraid of sleeping alone" was significantly higher in the Low-grade group compared with the High-grade group. Besides "bedtime resistance" and "sleep anxiety," the item "sleeps the same amount each day" comprising "sleep duration" was significantly higher in the Middle-grade group compared with the Low-grade group.

The item "wakes up in a negative mood" comprising "daytime sleepiness" was significantly higher in the Low- and Middle-grade groups compared with the High-grade group. The item "takes a long time to be alert" comprising "daytime sleepiness" was significantly higher in the Low-

grade group compared with the High-grade group. Sleep onset delay, sleep duration, night waking, parasomnia, and sleep-disordered breathing, all sub-items of the CSHQ-J, were not significantly different among the grade groups. Moreover, there were no significant differences between boys and girls in terms of CSHQ-J sub-item scores, the total score, wake time, bedtime, or sleep time.

Discussion

The CSHQ is a parent-report questionnaire used to identify both behaviorally based and medically based sleep problems in school-aged children. In addition, it can be utilized as an assessment tool for sleep patterns and sleep habits (wake time, bedtime, and sleep time). We discuss sleep patterns and habits in addition to sleep problems in our subject population.

Sleep pattern and sleep habits

According to the survey by the Japanese Society of School Health on sleep habits (wake time, bedtime, and sleep time),¹⁷ the mean bedtimes were approximately 21:50 in the third- and fourth-graders and 22:00 in the fifth- and sixth-graders in elementary schools in 2004. The mean bedtimes in these two age groups were approximately 20 minutes later than those observed in a previous survey conducted 23 years ago. The mean sleep time was 8 hours and 51 minutes in the third- and fourth-graders and about 8 hours in the fifth- and sixth-graders. These values

Table 1. Comparison of CSHQ-J sub-items and sleep patterns by grade groups among 296 elementary school children

CSHQ-J subscale	Total			Low			Middle			High			Dunn's multiple comparison test			
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	K-W	L vs. M	L vs. H	M vs. H
Bedtime	21:17	43	292	21:00	43	86	21:16	33	102	21:31	46	104	***	***	**	
Morning wake-up time	6:03	21	288	6:03	20	88	6:01	22	99	5:57	20	105				
Sleep duration	518	40	293	539	35	88	521	33	100	495	38	105	***	**	***	***
Bedtime resistance	9.2	2.7	274	10.4	1.1	83	9.4	2.6	94	8.6	2.4	97	***	*	***	
Sleep onset delay	1.1	0.4	296	1.1	0.4	89	1.2	0.4	102	1.1	0.4	105				
Sleep duration	4.0	1.4	277	3.9	1.3	85	4.2	1.5	94	4.1	1.4	98				
Sleep anxiety	5.7	1.9	281	6.1	1.9	85	5.8	2.1	97	5.3	1.8	99	**		**	
Night wakings	3.3	0.7	276	3.4	0.8	84	3.3	0.6	91	3.3	0.7	101				
Parasomnias	8.0	1.9	267	8.3	1.4	80	8.3	1.8	90	8.2	1.2	97				
Sleep disordered breathing	3.2	0.9	282	3.3	0.8	87	3.3	0.8	96	3.3	0.6	99				
Daytime sleepiness	8.8	2.2	260	9.4	1.8	82	9.3	2.0	87	8.8	1.9	91				
Total	40.0	6.5	231	41.5	5.1	71	40.3	6.2	76	39.1	4.9	84	**		**	

CSHQ-J, Children's Sleep Habits Questionnaire (Japanese); bedtime and wake-up time, mean ± SD (min); sleep duration, mean ± SD (min)

K-W, Kruskal-Wallis test; L, low; M, middle; H, high

Table 2. Comparison of CSHQ-J subscores by grade groups among 296 elementary school children

CSHQ-J subscale	Total			Low			Middle			High			Dunn's multiple comparison test		
	Mean	SD	N	1st–2nd graders		N	3rd–4th graders		N	5th–6th graders		K-W	L vs. M	L vs. H	M vs. H
				Mean	SD		Mean	SD		Mean	SD				
Bedtime resistance	9.2	2.7	274	10.4	1.1	83	9.4	2.6	94	8.6	2.4	97	***	*	***
Goes to bed at the same time	1.3	0.5	295	1.2	0.5	89	1.3	0.4	101	1.3	0.5	105			
Falls asleep in own bed	1.7	0.9	291	2.0	0.9	87	1.7	0.9	100	1.5	0.8	104	**		***
Falls asleep in other's bed	2.2	0.9	288	2.5	0.8	87	2.2	0.9	101	2.1	0.9	100	**		**
Needs a parent in room to sleep	1.6	0.8	288	1.9	0.9	88	1.6	0.8	99	1.3	0.7	101			
Struggles at bed time	1.1	0.3	286	1.0	0.2	86	1.1	0.3	98	1.0	0.2	102			
Afraid of sleeping alone	1.6	0.8	291	1.8	0.9	87	1.6	0.8	101	1.4	0.7	103	**		**
Sleep onset delay	1.1	0.4	296	1.1	0.4	89	1.2	0.4	102	1.1	0.4	105			
Falls asleep in 20 minutes	1.1	0.4	296	1.1	0.4	89	1.2	0.4	102	1.1	0.4	105			
Sleep duration	4.0	1.4	277	3.9	1.3	85	4.2	1.5	94	4.1	1.4	98			
Sleeps too little	1.4	0.6	287	1.3	0.5	88	1.4	0.6	97	1.4	0.6	102			
Sleeps the right amount	1.5	0.7	284	1.4	0.7	86	1.4	0.7	97	1.5	0.7	101			
Sleeps the same amount daily	1.2	0.6	293	1.1	0.4	88	1.3	0.6	100	1.3	0.6	105	*	*	
Sleep anxiety	5.7	1.9	281	6.1	1.9	85	5.8	2.1	97	5.3	1.8	99	**		**
Needs a parent in room to sleep	1.6	0.8	288	1.9	0.9	88	1.6	0.8	99	1.3	0.7	101			
Afraid of sleeping in the dark	1.4	0.8	291	1.4	0.7	88	1.5	0.8	100	1.4	0.7	103			
Afraid of sleeping alone	1.6	0.8	291	1.8	0.9	87	1.6	0.8	101	1.4	0.7	103	**		**
Trouble sleeping away	1.2	0.4	285	1.1	0.4	86	1.1	0.4	98	1.2	0.5	101			
Night wakings	3.3	0.7	276	3.4	0.8	84	3.3	0.6	91	3.3	0.7	101			
Moves to another's bed at night	1.2	0.5	287	1.3	0.6	88	1.2	0.4	97	1.1	0.4	102			
Wakes once during the night	1.1	0.4	284	1.2	0.4	87	1.1	0.4	96	1.1	0.4	101			
Awakes more than once	1.0	0.2	279	1.0	0.1	84	1.0	0.2	94	1.0	0.2	101			
Parasomnias	8.0	1.9	267	8.3	1.4	80	8.3	1.8	90	8.2	1.2	97			
Wets the bed at night	1.1	0.3	286	1.1	0.4	87	1.1	0.3	97	1.0	0.2	102			
Talks during sleep	1.4	0.6	287	1.4	0.5	85	1.4	0.5	99	1.5	0.6	103			
Restless and moves a lot	1.5	0.7	285	1.5	0.7	88	1.5	0.7	94	1.5	0.6	103			
Sleepwalks	1.0	0.2	279	1.0	0.2	84	1.0	0.2	96	1.0	0.1	99			
Grinds teeth during sleep	1.2	0.5	284	1.2	0.5	87	1.2	0.5	98	1.2	0.5	99			
Awakens screaming or sweating	1.0	0.2	288	1.0	0.1	88	1.0	0.2	98	1.0	0.1	102			
Alarmed by nightmares	1.0	0.2	286	1.0	0.2	86	1.1	0.3	98	1.0	0.0	102			
Sleep-disordered breathing	3.2	0.9	282	3.3	0.8	87	3.3	0.8	96	3.3	0.6	99			
Snores loudly	1.2	0.5	286	1.2	1.2	98	1.2	0.5	98	1.2	0.4	100			
Stops breathing periodically	1.1	0.2	287	1.1	1.0	98	1.0	0.2	98	1.1	0.2	101			
Snorts and gasps	1.0	0.2	285	1.0	1.0	96	1.0	0.2	96	1.0	0.2	102			
Daytime sleepiness	8.8	2.2	260	9.4	1.8	82	9.3	2.0	87	8.8	1.9	91			
Wakes by himself or herself	2.2	0.8	290	2.3	2.1	99	2.1	0.8	99	2.1	0.8	103			
Wakes up in a bad mood	1.2	0.4	288	1.3	1.3	97	1.3	0.5	97	1.1	0.3	103	***		***
Others wake the child	1.2	0.4	289	1.2	1.3	98	1.3	0.4	98	1.3	0.4	102			
Has a hard time getting out of bed	1.2	0.4	285	1.3	1.2	95	1.2	0.4	95	1.2	0.4	102			
Takes a long time to become alert	1.2	0.4	278	1.3	1.3	96	1.3	0.5	96	1.2	0.4	96	*		*
Seems tired	1.2	0.4	281	1.1	0.4	96	1.3	0.4	96	1.2	0.4	101			
Watching TV	0.4	0.7	283	0.3	0.3	98	0.3	0.7	98	0.4	0.7	98			
Riding in car	0.4	0.7	286	0.5	0.5	99	0.5	0.8	99	0.4	0.7	100			
Total	40.0	6.5	231	41.5	5.1	71	40.3	6.2	76	39.1	4.9	84	**	**	

CSHQ-J, Children's Sleep Habits Questionnaire (Japanese); bedtime and wake-up time, mean \pm SD (min); sleep duration, mean \pm SD (min)

K-W, Kruskal-Wallis test; L, low; M, middle; H, high

were 10–15 minutes shorter in both age groups compared to a survey conducted 23 years ago.

Ishihara et al. calculated the mean bedtime and wake time on weekdays in elementary school children based on the NHK national time use survey and examined the changes over time. Their report showed that mean bedtime was about 21:00 in 1960 and about 22:00 in 2005, which suggests that sleep time had become approximately 30 minutes shorter.¹⁸ In the present study, the mean sleep duration was 518 minutes (SD \pm 40 minutes), and the mean bedtime was 21:17 (SD \pm 43 minutes) among all of the elementary school pupils, while the mean sleep duration was 495 minutes (SD \pm 38 minutes) and the mean bedtime was 21:31 (SD \pm 46 minutes) in the High-age group of fifth and sixth graders, which suggests that sleep duration had become even shorter than that reported in the NHK survey from 1960. It was found that sleep time in children has become shorter in other countries as well,¹⁹ suggesting a global trend.

It is known that age, ethnicity, culture, gender, and socioeconomic backgrounds influence the sleep habits of children.^{14,20-25} Other reports revealed that sleep time became shorter and bedtimes became later in older students in elementary schools.^{19,25,26} In these cases, it was found that older children reported more morning sleepiness and it was suggested that sleep time was shorter than that which is physiologically required in older students.

Sleep time in children is remarkably shorter in Japan compared to other countries. The National Sleep Foundation recommends 9–11 hours of sleep in children aged 5–12 years.²⁷ The same foundation's report in 2003 indicated that the average sleep time in first- to fifth-graders in elementary school was 9.5 hours. A report from Italy showed that the total sleep time in children aged 8–10 years was 9–10 hours.²⁶ A survey on sleep time in children aged 5–13 years in Saudi Arabia, Switzerland, and Hong Kong²⁴ revealed that sleep duration was 8.5 hours to about 9 hours in older elementary school students in these 3 countries. When the data in these reports were compared with ours from the present study, it is evident that sleep time is far shorter in Japanese elementary school students.

The short sleep time observed in the older elementary school students in this study was attributable to the late bedtime since there was little difference in wake time between the children in this study and that in other groups. In relation to the cause of sleep time attenuation, Ishihara et al. stated that "children's sleep habits gradually turned into a late-night pattern over tens of years and shortening and irregular patterns of sleep time appeared." The

emergence of late-night patterns of activity may be caused by the widespread prevalence of media images represented by TV and late-night patterns of life habits in adults.¹⁸

As life habits have changed remarkably, especially in Japan, children's sleep duration seems to have been sacrificed. As a result, sleep duration among children has been shortened. It has been suggested that sleep shortage influences cognitive function, academic performance, and obesity,¹⁻⁴ and it will be necessary to further review life habits and sleep habits in children in Japan.

Sleep problems

CSHQ scores are influenced by sleep environment in association with age and geographical location. Compared with older pupils and students, a report revealed that all CSHQ sub-item scores were higher in preschool children, except for "sleep-disordered breathing."¹⁵ The results of the present study showed that the total CSHQ score, the "bedtime resistance" score, and the "sleep anxiety" score were significantly higher in the Low-age group compared to the scores in other age groups. Among the items comprising "bedtime resistance," there were significant differences in the following factors among the age groups: "falls asleep in own bed," "falls asleep in other's bed," and "afraid of sleeping alone."

Each of these items is related to the autonomy of sleep. During the process of normal child development, nighttime fears of imaginary stimuli (e.g., ghosts and monsters) are recognized in early childhood. This may be related to the development of cognitive function. Separation anxiety from parents is also relatively common in early childhood. It has been said that imaginary fears and separation anxiety may also influence the autonomy of sleep in children.²⁸

Surveys on sleep in preschool children have mostly focused on nocturnal awakening and sleep-onset insomnia,^{15,18-31} with these symptoms decreasing with age. The prevalence of bedtime resistance was described to increase in the first 5 years of life from 14% during infancy to 50% at 5 years of age.³² That study showed that problems in sleep autonomy persisted until early elementary school. In puberty, the problem of "bedtime resistance" shifted to "sleep onset insomnia and sleep onset delay." Older children are more likely to experience sleep onset difficulties or delays rather than resistance in going to bed.³³ The results of the present study also showed that there was a tendency for improvement in "bedtime resistance" with age, which was consistent with

previous studies. On the other hand, there was no difference in the score for "sleep onset delay," a sub-item of the CSHQ-J, among the three groups. This survey was targeted to elementary school children. Therefore, "sleep onset delay" might be a problem in older youths compared to elementary school children.

Other than items comprising "bedtime resistance" and "sleep anxiety," both "sleep same amount each day" (comprising "sleep duration" and "wakes up in negative mood") and "takes a long time to be alert" (comprising "daytime sleepiness") were significantly different between the age groups. Scores for the items "wakes up in negative mood" and "takes a long time to be alert" were significantly higher in the younger children. These results suggested that problems in waking were present in younger children, but they were gradually resolved in older children at the elementary school level.

The score for "sleep same amount each day" was significantly higher in the older children. In surveys on sleep in elementary school children, daytime sleepiness was more prevalent in older children,^{25,33} and it has been indicated that older children sleep a shorter length of time than that which is physiologically required. Our results also revealed that sleep time was shorter in older children versus younger children and that it had been gradually shortened compared with that in previous reports, which suggested that older children have a shorter sleep time than what is typically required.

Conclusions

Results of this study suggest that sleep time became shorter and bedtime later in older students in elementary schools. The total CSHQ-J scores were significantly higher in the Low-grade group compared with the High-grade group. The rates of "bedtime resistance" and "sleep anxiety" were also significantly different between the Low-grade and High-grade groups. These scores are related with the development of sleep autonomy.

Limitations

The present survey was carried out in one district in Chiba Prefecture, and therefore, did not represent all elementary school children in Japan. However, the subjects were children who attended regular classes in a public school, and they were not thought to represent a unique population but were more representative of the general, national population of elementary school children.

The rate of nocturnal awakening, parasomnia, and sleep-disordered breathing, which were sub-items of the

CSHQ-J, showed no differences among the 3 groups. These sleep problems show an onset peak before going to school.^{28,31,34,35} This study focused only on elementary school children. Therefore, if preschool children are included, there may be a difference in the evaluation of these sub-items among age groups.

The CSHQ is a questionnaire filled out by parents to determine their child's sleep habits, behavior, and possible difficulties. Therefore, unless parents are aware of these and/or any problems in their child's sleep, the results of the CSHQ may not be reliable. As a future challenge, it will be necessary to objectively evaluate sleep habits, behavior, and variability with actigraphy and polysomnography. Because this study was not a follow-up study, further investigations are warranted to determine how sleep problems change with age in a longitudinal fashion using more accurate measurements of sleep.

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