Brain & Development 44 (2022) 595–604

BRAIN & DEVELOPMENT
Official Journal of the Japanese Society of Child Neurology

www.elsevier.com/locate/braindev

Original article

The Japanese version of the children's sleep habits questionnaire (CSHQ-J): A validation study and influencing factors

Ryuta Ishii [a], Hitoshi Obara [b], Shinichiro Nagamitsu [c], Michiko Matsuoka [d], Masao Suda [a], Koutaro Yuge [a,h], Takeshi Inoue [e], Ryoichi Sakuta [e], Yasunori Oka [f], Tatsuyuki Kakuma [b], Toyojiro Matsuishi [g,h], Yushiro Yamashita [a,h,*]

[a] *Department of Pediatrics and Child Health, Kurume University School of Medicine, Japan*
[b] *Biostatistics Center, Kurume University, Japan*
[c] *Department of Pediatrics, Fukuoka University Faculty of Medicine, Japan*
[d] *Department of Neuropsychiatry, Kurume University School of Medicine, Japan*
[e] *Child Development and Psychosomatic Medicine Center, Dokkyo Medical University Saitama Medical Center, Japan*
[f] *Sleep Disorder Center, Ehime Medical University, Japan*
[g] *Department of Pediatrics, St. Mary's Hospital, Japan*
[h] *Cognitive and Molecular Research Institute of Brain Diseases, Kurume University School of Medicine, Japan*

Received 12 October 2021; received in revised form 5 May 2022; accepted 12 June 2022

Abstract

Subject: This study aimed to validate the Japanese version of the Child's Sleep Habits Questionnaire (CSHQ-J) and identify which factors affect the CHSQ-J total score.

Methods: The participants were 3158 children (aged 4–12 years) and their parent/guardian, as community samples from large, medium-sized, and small cities. Each parent/guardian filled in the questionnaire set (CSHQ-J, Pittsburgh Sleep Quality Index, demographic data: family structure, sleep environment, participants' present illness, and economic information); we also collected 51 clinical samples from our facility to calculate the cutoff score. According to the age of the participants in the original CSHQ (4–10 years), validation was assessed statistically via exploratory and confirmatory factor analyses and internal consistency (verified by Cronbach's α). Multivariate analysis was conducted to identify factors affecting the CSHQ-J total score.

Results: We received responses from 2687 participants (response rate: 85%) and analyzed 1688 participants who were the age of the original CSHQ participants. The alpha coefficients of each subscale of the CSHQ-J ranged from 0.43 to 0.68. The cutoff score was 48 (sensitivity: 0.69, specificity: 0.79). The confirmatory and exploratory factor analyses did not converge. Multivariate analysis showed that the factors that significantly influenced the CSHQ-J total score were co-sleeping, supplemental sleep, and child's age. Present illness, especially adenoids, also significantly influenced CSHQ total score.

Conclusions: The CSHQ-J has adequate internal consistency and is useful for screening for pediatric sleep disorders. Supplemental sleep, habit of co-sleeping, and child's age should be considered when using the CSHQ-J as a screening tool for sleep problems in children.

Keywords: Pediatrics; Sleep; Validation study; Habits; Questionnaires; Multivariate analysis

* Corresponding author at: Department of Pediatrics and Child Health, Kurume University School of Medicine, 67 Asahi-machi, Kurume-shi, Fukuoka 830-0011, Japan.

E-mail address: yushiro@med.kurume-u.ac.jp (Y. Yamashita).

https://doi.org/10.1016/j.braindev.2022.06.003
0387-7604/

1. Introduction

Sleep disorders in children are not rare—at least 25% of children or toddlers experience sleep disorders [1-3]. The sleep duration of children is decreasing worldwide, and that of Japanese children is the shortest in the world [4-6]. Previous studies have reported that pediatric sleep disorders or sleep difficulty are related to obesity [7], mental ill health such as anxiety and depression, emotional and behavioral problems, and decreasing cognitive function and academic performance [8-10]. Ranum et al. reported an association between short sleep duration and increased risk of future emotional disorder symptoms in both boys and girls, and between reduced sleep duration and behavioral disorder symptoms in boys [11]. Vriend et al. reported that a change in sleep duration can have significant consequences for children's daytime functioning, such as academic performance [12]. Thus, the influence of pediatric sleep disorders and their early detection should be considered.

There are many internal and external factors that could influence children's sleep [13]. Internal factors include age, gender, present illness such as a developmental disorder, obstructive sleep apnea or sleep disorders themselves, and habits such as supplementary sleeping and exercising. Among children with neurodevelopmental disorders, >80% have sleep disorders. Specifically, children with autism spectrum disorder have difficulty falling asleep as well as staying asleep [14-16]. External factors include parental factors (parents' sleep quality and work timing [night-shift duty], co-sleeping) and environmental factors (using electronic devices, economic status). Parents' health-related bad habits or low health literacy can reduce their child's sleep time. Parents' low health literacy may lead to them putting a television in the bedroom, thus increasing the risk of sleep disturbance [17]. It is also known that children's sleep is affected by parental sleep and work timing, and bedroom lighting [18-22]. Sleep hygiene is associated with an earlier bedtime for adolescents, and night lights (i.e., video games, phone calls, internet) have been reported to lead to a late bedtime [23]. In fact, screens such as televisions and smartphones (and other smaller screens) reduce children's sleep time by 18 min and 20.6 min, respectively [24]. In summary, both internal and external factors have significant effects on children's sleep, and thus need to be considered during pediatric sleep assessment.

There are many devices to assess children's sleep, as well as several scales to evaluate pediatric sleep characteristics, including polysomnography (PSG), actigraphy, sleep logs, and questionnaires. PSG and actigraphy are objective and useful in assessing the quality and quantity of sleep physiologically; however, these methods are highly specialized and expensive. In contrast, sleep logs and sleep questionnaires are inexpensive and simple subjective measures that can detect sleep duration and sleep problems equally as well as PSG and actigraphy [25]. The Child's Sleep Habit Questionnaire (CSHQ) is widely used and validated in many countries as a parent-reported sleep questionnaire for children [26-30]. The CSHQ is designed based on the general clinical symptoms described in the International Classification of Sleep Disorders (ICSD) and has appropriate internal consistency and a cutoff score of 41. However, this CSHQ cutoff score is controversial. A recent study reported that the Portuguese version of the CSHQ has a cutoff score of 48 [30]. Furthermore, few studies have examined the factors that affect the CSHQ total score. Few sleep questionnaires have been internationally standardized in Japan, and the CSHQ has not yet been validated.

The present study aimed to validate the Japanese version of the CSHQ (CSHQ-J), calculate the cutoff score, and identify the factors that affect the CSHQ-J total score.

2. Methods

2.1. Procedures and participants

We conducted a cross-sectional survey from January 2017 to December 2017 without performing any intervention. The participants' ages ranged from 4 to 12 years. We surveyed two different groups of participants—community samples and clinical samples—for the validation of the CSHQ-J. We sent the face sheet and two questionnaires (the CSHQ-J and the Japanese version of the Pittsburgh Sleep Quality Index (PSQI-J)) to the children and their parents/guardians. In both groups, we excluded subjects who had already been diagnosed with sleep disorders or received intervention. The translation and back-translation necessary for validation had already been carried out by Doi et al. with the author of the original article [31]. Before starting the present study, we received permission to use the translated questionnaire. This study conformed to the ethical standards of the Helsinki Declaration and was approved by the Medical Ethics Committee of the Kurume University School of Medicine (approval no. 16183).

The community samples were chosen via classification based on the population size—large (>0.5 million), medium-sized (>0.15 million), and small cities (<0.15 million) —to prevent deflection. We selected the nursery school, kindergarten, and elementary school from each area (four nursery schools, seven kindergartens, and four elementary schools), explained the aim of this study to their respective managers, and acquired consent for participation before starting the survey. We also explained the research outline to the children's parents using a document that described the study aim, guarantee of anonymity, and voluntary participation. Considering the daylight hours of the season, we surveyed the community samples for 1 month (February 1–28, 2017). The completed questionnaires were submitted by the children or their parents to their teachers during the investigation period and sent to the research manager from each facility. To analyze the test–retest reliability, the CSHQ-J was sent to other principals and parents (n = 30) who had agreed to participate voluntarily; their completed questionnaires were collected 2 weeks later for the second time.

The clinical samples comprised 51 outpatients treated at Kurume University Hospital over the course of 1 year (January 1–December 31, 2017); it was suspected during the pediatrician's examination or interview prior to treatment that all of these outpatients had sleep disorders. Considering the possible effects of intervention, changing environment, or disease, we excluded the following participants: 1) those who had moved house within the last 1 month; 2) those who were already on medication or intervention for sleep disorders; 3) those who had been diagnosed with depression or bipolar disorder. We did not exclude subjects with developmental disorders such as attention deficit hyperactivity disorder. We explained the methodology of the present study by letter or interview and obtained informed consent from all participants.

2.2. Measures and instruments

2.2.1. Face sheet

We enclosed a face sheet in an envelope to collect information on the participants' background characteristics. The collected data comprised children's information (gender, age, present illness, area), lifestyle (daily breakfast consumption, smart media use), sleep environment (whether they co-sleep, bed type and size, supplemental sleep while on holiday), economic status (parents' job specifications [night-shift duty], income), and family information (structure [e.g., single parent], history). The income data item followed the Japanese National Census Classification. We did not collect identifying information about the participants. We also excluded physical data such as body weight, height, and academic performance from the face sheet.

2.2.2. Japanese version of the Children's sleep habits questionnaire

The CSHQ is a parent/guardian-reported questionnaire for children aged between 4 and 10 years [26]. The total score is calculated as the sum of 33 questions. A cutoff score of 41 (sensitivity: 0.80, specificity: 0.72) is used to identify the probability of sleep problems. A parent or guardian chooses one of the three frequencies—"Usually" (5–7 nights/week), "Sometimes" (2–4 nights/week), and "Rarely" (0–1 nights/week)—to answer questions about their child's sleep in the previous week or during the most recent typical week if their child's sleep was disrupted in the previous week for a specific reason, such as a cold. The parent/guardian also reports, for each item, whether the behavior in question is a problem for them using the following response options: yes, no, not applicable. The CSHQ contains 56 items (questions) related to common sleep behaviors and yields both a total score and a score for each of the following eight subscales (Supplemental material 1): Bedtime Resistance (six items), Sleep-onset Delay (one item), Sleep Duration (three items), Sleep Anxiety (four items), Waking During the Night (three items), Parasomnia (seven items), Sleep-disordered Breathing (three items), and Daytime Sleepiness (eight items). Some items are reversed (1, 2, 3, 10, 11, and 26) so that a higher score is indicative of a more disturbed sleep. A high CSHQ total score suggests a high likelihood of sleep problems and sleep disturbance.

2.2.3. Pittsburgh sleep quality index

Buysse et al. [32] established the PSQI for adults, which is a self-reported measure of sleep quality and disturbances over the previous month. The PSQI comprises seven component scores (scored 0–3) that are added to yield one global score between 0 and 21, with higher scores indicating poor sleep quality. The PSQI comprises 19 items that evaluate the seven components of sleep quality—Subjective sleep quality, Sleep latency, Sleep duration, Habitual sleep efficiency, Sleep disturbances, Use of sleeping medication, and Daytime dysfunction. The cutoff score is 5.5. The PSQI-J was validated in 2000 and is used to screen for primary insomnia (sensitivity: 85.7%, specificity: 86.6%) [33].

2.3. Statistical analysis

Analyses were carried out using JMP and Stata software, version 15. P values of <0.05 were considered significant. The returned questionnaires were checked for completeness and excluded from the analysis if any data for the CSHQ-J calculation were missing. Only data for participants aged 4–10 years were analyzed, in accordance with the participant age of the original CSHQ. The internal consistency of the 33 scoring items and subscales was assessed using Cronbach's α—values for Cronbach's α between 0.70 and 0.90 are generally considered adequate [34,35]. The cutoff score was determined as having the best diagnostic confidence using the Youden index for the receiver operator characteristic curve (ROC), with the sensitivity and specificity also calculated using the curve [36]. Regarding the prevalence of sleep disorders, reference was made to previous studies in Japan (23.5%) [2]. Spearman's coefficients were computed to determine the test–retest reliability by resurveying 30 volunteers 2 to 4 weeks after the initial survey. We characterized the community samples based on the face sheet information and calculated the mean CSHQ-J total score. The influences of participant characteristics on the CSHQ-J total score were examined by multivariate analysis with a multiple regression model. We also conducted uni- and multivariate analyses to identify factors that affected the CSHQ-J total score, from the face sheet data (children's information including lifestyle, family's information including economic status, and environmental information including co-sleeping) and the PSQI-J.

2.4. Exploratory and confirmatory factor analyses

A confirmatory factor analysis of the community samples was carried out based on the factor structure of the original CSHQ as a specified model. The comparative fit index (CFI), Tucker-Lewis index (TLI), and root mean square error of approximation (RMSEA) were used as measures of the fit of the model. A CFI and TLI > 0.95 and a RMSEA < 0.05 were considered to indicate a good fit. A moderate fit was indicated by a CFI and TLI > 0.90 and a RMSEA < 0.08. Because the original model did not fit well (neither index was converged), an exploratory factor analysis of the community samples was carried out. Furthermore, a confirmatory factor analysis of the same sample was also carried out on a model arrived at via exploratory factor analysis.

3. Results

3.1. Basic characteristics

Among 3158 participants (community samples), 2687 returned completed questionnaires (response rate: 85%). We excluded participants for whom some CSHQ-J items were not answered, and excluded participants aged 11 years or older to match the participant age specified in the original CSHQ. The final number of community samples was 1652. The community samples had a mean age of 93.9 ± 21.7 months and a negligible gender difference (49.7% were male). The mean CSHQ-J total score was 43.5 ± 6.0; as the age increased, the mean CSHQ-J total score decreased (47.5 at 4 years, 41.2 at 10 years). The mean CSHQ-J total score was higher among children with an illness than among those without an illness (Table 1).

The largest percentage of participants (46.8%) lived in a middle-sized city. With respect to lifestyle, 95.3% and 93.5% of participants ate breakfast daily and used smart media, respectively. With respect to sleep behavior, 57.9% slept on futons and 53.6% co-slept. The mean CSHQ-J total score was higher among those who had a co-sleeper (46.0) than those who did not (40.6). The economic status item was not answered by 38.6% of the parents; therefore, income was based on the average income in Japan ($44,000). Most children (86.2%) lived with their parents, while 13.8% had either one parent or neither—19.4% of the parents were night-shift workers and 23.4% were suspected to have sleep disorders (PSQI total score >5.5) (Table 2).

Table 1
Basic characterization of community and the mean CSHQ-J total score.

		Community Sample	
		N (%)	CSHQ-J Mean (SD)
Total		1652	43.5 (6.0)
Gender	Male	832 (49.7)	43.4 (6.0)
	Female	803 (49.3)	43.6 (6.1)
	No answer	17 (1.0)	
Age distribution			
4y.o		60 (3.6)	47.5 (7.8)
5y.o		275 (16.6)	45.5 (5.4)
6y.o		266 (16.1)	44.7 (6.6)
7y.o		254 (15.4)	43.2 (5.3)
8y.o		272 (16.5)	42.9 (5.9)
9y.o		259 (15.7)	42.4 (5.7)
10y.o		266 (16.1)	41.2 (5.3)
Present illness			
None		1369 (82.9)	43.2 (5.7)
Adenoid		16 (0.1)	47.6 (10.3)
Allergy		181 (11.0)	43.9 (6.7)
Asthma		98 (5.8)	45.5 (7.1)
Epilepsy		6 (0.4)	42.7 (5.8)
DD		29 (1.8)	46.6 (9.5)
Duplication		46 (2.8)	

SD: Standard Deviation. y.o: years old, DD: Developmental Disorder.

3.2. Internal consistency (Cronbach's α, test–retest reliability)

The internal consistency of the CSHQ-J total score was 0.76 in the community samples, which was higher than that of the CSHQ [26]. The Cronbach's α of each subscale in the community samples ranged between 0.42 (Subscale 5) and 0.68 (Subscale 8) (Table 3). The test–retest reliability correlation coefficient for the CSHQ-J total score was 0.73.

3.3. Cutoff score and clinical samples

Among the 51 clinical samples from our hospital, we selected 36 clinical samples that matched the participant age of the original CSHQ for the calculation of the cutoff score. The mean age of the clinical samples was 90.4 ± 20.2 months. However, the clinical samples had a high male ratio (72.2%). The mean CSHQ-J total score in the clinical samples (52.2 ± 8.9) was significantly higher than that in the community samples (43.5 ± 6.0). The CSHQ-J cutoff score with the highest sensitivity and specificity was 48 (sensitivity: 69.44%, specificity:

Table 2
Characterization of community sample and the mean CSHQ-J total score.

		Community Sample	
		N (%)	CSHQ-J Mean (SD)
Environment			
Area	Urban	447 (27.1)	42.8 (6.0)
Middle city		773 (46.8)	43.7 (5.8)
Rural		432 (26.2)	43.9 (6.3)
Lifestyle			
Taking a breakfast	Everyday	1574 (95.3)	43.4 (6.0)
Not everyday		74 (4.5)	45.8 (5.9)
Smart-media use	Yes	1545 (93.5)	43.6 (6.1)
No		91 (5.5)	42.1 (4.9)
Sleep Environment			
Kinds of bed	Bed	683 (41.3)	43.1 (5.9)
Futon		957 (57.9)	43.7 (6.1)
Cosleeper	Yes	885 (53.6)	46.0 (6.1)
No		767 (46.4)	40.6 (4.4)
Supplemental sleep Yes		683 (41.3)	44.8 (6.4)
	No	965 (58.4)	42.6 (5.5)
Economic status			
Income	No answer	637 (38.6)	
Below 30 thousand dollars		120 (7.3)	43.7 (5.5)
30–50 thousand dollars		259 (15.7)	44.1 (5.9)
50–75 thousand dollars		284 (17.2)	43.2 (6.6)
75–100 thousand dollars		202 (12.2)	43.7 (5.0)
Above 100 thousand dollars		150 (9.1)	43.1 (6.2)
Family			
Family structure			
	Live with both parents	1424 (86.2)	43.5 (6.0)
	Single-parent or neither	228 (13.8)	43.3 (6.2)
Night shift worker	Yes	321 (19.4)	44.4 (6.9)
	No	1331 (80.6)	43.3 (6.2)
PSQI score of parent			
	Above 5.5	387 (23.4)	45.0 (6.2)
	Below 5.5	927 (56.1)	42.8 (5.7)

Table 3
Comparison of internal consistencies in community samples. (CSHQ-J & American's CSHQ).

	Internal Consistency (N)	
	Japan	American[26]
Total Score	0.76 (1652)	0.68 (NA)
Subscales		
1.BedtimeResistance	0.65 (1652)	0.70 (441)
2.Sleep Onset Delay	NA	NA
3.Sleep Duration	0.66 (1652)	0.69 (459)
4.Sleep Anxiety	0.56 (1652)	0.63 (432)
5.Night Wakings	0.42 (1652)	0.54 (437)
6.Parasomnias	0.51 (1652)	0.36 (425)
7.Sleep Disordered Breathing	0.60 (1652)	0.51 (439)
8.Daytime Sleepiness	0.68 (1652)	0.65 (437)

NA: not applicable.

78.93%, area under curve (AUC): 0.795), which was higher than the cutoff score of the original CSHQ (Fig. 1). Using this CSHQ-J cutoff score of 48, the estimated prevalence of sleep problems in the community sample of Japanese children was 21.1%.

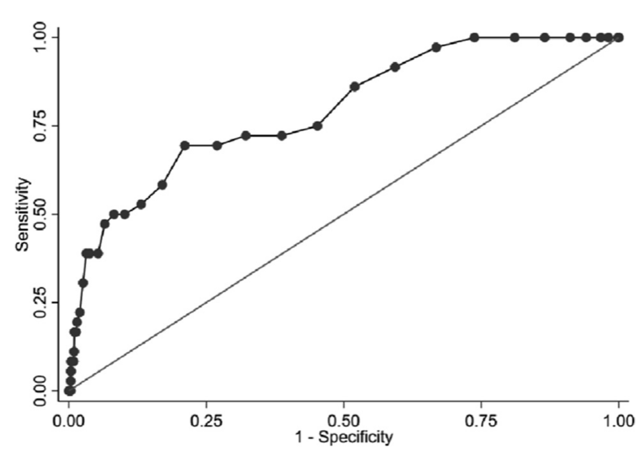

Fig. 1. The receiver operator characteristic curve (ROC) for cut-off score. The CSHQ-J cutoff score (48) is sensitivity: 69.44%, specificity: 78.93%, area under curve (AUC):0.795.

3.4. Factor analysis

We tried to confirm the model fit using the previous index, which the CSHQ study suggested as the 8-factor model [26]. However, it did not fit well in each index and RMSEA because the original model did not converge. Thus, we conducted exploratory and confirmatory factor analyses, which also did not converge.

3.5. Uni- and multivariate analyses

In the univariate analysis, age (months), area, present illness (asthma, adenoid, developmental disorder), daily breakfast consumption, sleep environment (bed type and size, supplemental sleep, co-sleeper), parent/s job (night-shift duty), and parents with a high PSQI score had significant differences, which contributed to the mean CSHQ-J total score. In the multivariate analysis, the factors with significant differences were age, present illness (asthma, adenoid), bed type, daily breakfast consumption, supplemental sleep, co-sleeper, and the PSQI total score. In these results, the presence of a co-sleeper contributed the most to the CSHQ-J total score, followed in order by supplemental sleep, age, and PSQI (Table 4).

4. Discussion

In this study, we validated the CSHQ-J and investigated the factors influencing the CSHQ-J total score. The reliability of the CSHQ-J was confirmed by an appropriate internal consistency and high correlation coefficient of test–retest reliability. Furthermore, we identified 48 as an appropriate cutoff score to screen for pediatric sleep disorders in Japan. Our factor analysis did not converge well with the original 8-factor structure, and our exploratory factor analysis result also did not converge. Multivariate analysis revealed that the factors that strongly influenced the CSHQ-J total score were age, co-sleeping, present illness, and PSQI score.

We carried out a confirmatory factor analysis of the CSHQ-J using the original factor structure, but the result did not converge with the structure; similarly, in studies performed in other countries, the confirmatory factor analysis did not fit well with the original factor structure [27-30]. Owens et al. designed the CSHQ based on common clinical symptoms given in the ICSD, and elected to group items together conceptually according to presenting symptom constellations rather than to rely on a statistical procedure to derive empirically related subscales [26]. Therefore, some studies report that the CSHQ might be a more suitable screening tool for a clinical group, and that there are cultural differences in how sleep behaviors and patterns are understood or in the very nature of such behaviors/patterns [29]. This may be the reason that the confirmatory factor analysis did not fit well with the original factor structure, and that the exploratory factor analysis also did not converge. Recent studies have reported that Cronbach's α values were compared appropriately in the CSHQ study, and most were suboptimal [27,30]. For example, the Cronbach's α value in each country ranged between 0.68 and 0.81 [27]. Thus, the Cronbach's α value of the CSHQ-J (0.76) was also suboptimal with adequate internal consistency.

The CSHQ has a cutoff score of 41 for screening a child's sleep disorder, and a high CSHQ score indicates more sleep problems. Schlarb et al. reported that a high percentage (46%) of children had a CSHQ score higher than the original cutoff, and suggested that this high percentage could be an indicator of the need for a different cutoff score for children in Germany [28]. Our community sample had a higher mean CSHQ-J total score (43.5) than the original cutoff (41). In addition, 66.8% of community samples had a CSHQ-J total score higher than the original cutoff (data not shown). Therefore, we set the Japanese cutoff score at 48 (sensitivity: 69.44%, specificity: 78.93%, AUC: 0.795), which is higher than the original CSHQ cutoff but the same as the Portuguese CSHQ cutoff reported in a study of 148 Portuguese children aged 2–10 years [30]. Using our CSHQ-J cutoff score of 48, the prevalence of sleep problems in the community sample of Japanese children (21.1%) was similar to that of the reference (23.5%) [2]. There are several reasons for this high CSHQ-J cutoff score. There is a high prevalence of co-sleeping in Asia; only 4% of children in Asia fall asleep on their own in their own bed, compared with 57% in Western countries [37]. In Japan, co-sleeping is a traditional practice and is more likely to be common among younger Japanese children—at least 70% of infants reportedly sleep with their parents [38,39]. Our dataset also shows a high prevalence of co-sleeping (Supplemental material 2). Furthermore, the CSHQ includes items about co-sleeping: "Child needs parent in the room to fall asleep" and "Child falls asleep in parent's bed or sibling's bed", which may have influenced the high cutoff score of the CSHQ-J. For these reasons, the Japanese cutoff score of 48 may be suitable for screening sleep disorders in Japanese children.

It is important to identify the factors that cause pediatric sleep disturbances. Our multivariate analysis found several factors that affected the CSHQ-J total score, including co-sleeping. Previous studies have reported that co-sleeping between children and parents influences the child's sleep practice and sleep quality or emotion. Co-sleeping is reportedly associated with children finding it difficult to go back to sleep when they wake during the night [40]. Furthermore, co-sleeping with the mother negatively affects the child's sleep quality by increasing partner-influenced arousal [41]. However, increasing sensory contact through co-sleeping and proximity

Table 4
Univariate and multivariate analysis of variables expected to contribute to CSHQ-J total score.

Variables (Ref)		Univariate analysis R.C	S.E	P-value	95% C.I	Multivariate analysis R.C	S.E	P-value	95% C.I
Children's own information									
Gender	(male)	−0.26	0.30	0.387	−0.84 ~ 0.33				
Month Age		−0.07	0.01	p < 0.001	0.3 ~ 1.89	−0.04	0.01	p < 0.001	−0.06 ~ -0.03 *
Present illness									
Epilepsy		−0.83	2.46	0.737	−5.65 ~ 4.00				
Allergy		0.45	0.47	0.343	−0.48 ~ 1.38				
Asthma		2.97	0.62	p < 0.001	1.75 ~ 4.19	1.66	0.61	p < 0.001	0.47 ~ 2.85 *
Adenoid		4.11	1.51	p < 0.001	1.16 ~ 7.07	5.41	1.6	p < 0.001	2.27 ~ 8.55 *
DD		3.15	1.12	p < 0.001	0.95 ~ 5.36	0.68	1.15	0.552	−1.57 ~ 2.94
Environment									
Area									
Urban		Ref					Ref		
Middle city		0.93	0.36	p < 0.001	0.23 ~ 1.63	−0.06	0.37	0.862	−0.78 ~ 0.66
Rural		1.1	0. 4	p < 0.001	0.3 ~ 1.89	0.04	0.42	0.931	−0.78 ~ 0.85
Lifestyle									
Breakfast (not everyday)		2.45	0.71	p < 0.001	1.05 ~ 3.85	1.51	0.72	0.037	0.09 ~ 2.92 *
Smart-media Use (No)		−1.46	0.65	0.024	−2.73 ~ 0.19	−1.5	0.67	0.025	−2.82 ~ -0.19 *
Sleep environment									
Kind of bed (bed)		−0.59	0.30	0.052	−1.18 ~ -0.01	−0.63	0.31	0.043	−1.23 ~ -0.02 *
Bed size	Single	Ref					Ref		
Semi-double		1.65	0.49	p < 0.001	0.69 ~ 2.62	0.56	0.52	0.282	−0.46 ~ 1.59
Double		2.34	0.35	p < 0.001	1.65 ~ 3.03	0.68	0.38	0.077	0.07 ~ 1.43
More		3.09	0.56	p < 0.001	1.99 ~ 4.19	1.34	0.61	0.029	0.14 ~ 2.54 *
Cosleeper	(No)	−4.48	0.28	p < 0.001	−5.03 ~ -3.93	−3.06	0.35	p < 0.001	−3.75 ~ -2.38 *
Supplemental sleep (No)		−2.16	0.3	p < 0.001	−2.74 ~ -1.58	−2	0.3	p < 0.001	−2.59 ~ -1.41 *
Economic status									
Income	No answer	Ref							
	<3.0 million yen	0.28	0.61	0.648	−0.91 ~ 1.46				
	3.0–5.0million yen	0.75	0.45	0.100	−0.14 ~ 1.63				
	5.0–7.5million yen	−0.22	0.44	0.611	−1.08 ~ 0.64				
	7.5-10million yen	0.33	0.49	0.509	−0.64 ~ 1.3				
	>10 million yen	−0.33	0.55	0.553	−1.41 ~ 0.76				
Family									
Single-parent	(Yes)	−0.26	0.43	0.548	−1.10 ~ 0.58				
Nightshift worker	(No)	−1.16	0.37	p < 0.001	−1.89 ~ −0.42	−0.63	0.37	0.086	−1.36 ~ 0.09
PSQI total score		0.39	0.07	p < 0.001	0.26 ~ 0.52	0.3	0.06	p < 0.001	0.18 ~ 0.42 *

Ref: Reference, R.C: Regression Coefficient, S.E: Standard Error, 95% C.I: Confidence Interval", DD: Developmental Disorder. *: Significant difference on multivariate analysis.

between the child and parent can have emotional benefits such as reducing the child's night-related fear [42]. In short, there is a debate between the advantages and disadvantages of co-sleeping.

Children's physical and neurodevelopmental illnesses also contributed to a high CSHQ-J total score in our study. The CSHQ includes items about sleep-disordered breathing. Children with uncontrolled asthma reportedly have high CSHQ scores [43], and adenotonsillectomy reportedly reduces children's sleep disturbance by alleviating their respiratory problems [44]. In the multivariate analyses, present illness, especially adenoids, also significantly influenced CSHQ total score. These reports may support our finding of an association between children's present illness and the CSHQ-J total score. However, in contrast with our findings, Matsuoka et al. reported that children with developmental disorders have significantly higher CSHQ total scores and poor sleep quality (higher parasomnia and sleep breathing subscale scores) than children with typical development [45]. Further research is needed to explain this difference between studies.

Our findings also showed that having a parent with a low sleep quality (high PSQI score) was significantly associated with a higher CSHQ-J total score. However, it is unclear whether parents' sleep quality causes children's sleep disturbance, as the correlation between parents' and children's sleep is controversial. Some studies report that parents' sleep is qualitatively influenced by their children's sleep [42], while others report that parents' sleep behaviors (bedroom sharing and bedtime latency) negatively influence children's sleep behaviors [46]. Considering these associations, children with a high CSHQ-J total score should be assessed regarding present illness (asthma, adenoids), parental sleep quality, and co-sleeping.

Our study has some limitations. First, there is the possibility of a bias in our survey. We surveyed 3158 community samples and analyzed the data of 2124. The response rate was 85% (2687 samples), and 20.9% of the responses were excluded (563 samples) as these lacked some of the data needed to calculate the CSHQ-J score. This might have caused selection bias. Second, we surveyed children aged between 4 and 12 years and their parents, which is different from the distribution of the CSHQ study by Owens et al. [26]. Therefore, we also excluded participants 11 years or older (472 samples) to match the participant age of the original CSHQ. In our findings, the child's age significantly affected the CSHQ-J total score, possibly because of the influence of the Japanese co-sleeping habit. Moreover, few reports have investigated the cutoff score based on each child's age. Considering these reasons, we may need to select the CSHQ-J cutoff score by age. Finally, it is often reported that smart media or smartphone usage affects children's sleep—Yoshimura et al. reported that the short viewing distance when one is recumbent has a positive correlation with a poor sleep state, low sleep efficiency, and long sleep latency [47]. However, in our study, smart media usage was not significantly associated with the CSHQ-J total score. In addition, we did not evaluate the relationship between children's smart media usage time and the CSHQ-J total score. Therefore, further research is required.

In conclusion, the CSHQ-J is a reliable and valid screening instrument for pediatric sleep disorders and has a higher cutoff score (48) than the CSHQ (41). According to our analysis, the CSHQ-J total score is strongly influenced by several factors such as habit of co-sleeping, child's age, and present illness. Thus, these factors should be considered when treating children with sleep disorders.

Acknowledgement

We thank Dr. Jun Koyama for supervising of sleep disorder classification, and all other investigators who made this study possible. Finally, we also thank all participants who volunteered to take part in this study. This was not an industry-supported study. The authors were funded by a public grant (Grants-in-aid for Scientific Research < KAKENHI> #18K13250, 16K01806, Japan Agency for Medical Research and Development (BIRTHDAY)). Thus, the authors have no financial conflicts of interest to declare.

Conflict of interest disclosures

The authors declare no competing interests.

Author contributions

Ryuta Ishii: First author.

Hitoshi Obara: Contributed data analysis and interpretation.

Shinichiro Nagamitsu: Contributed conception of the study, research design creation, data collection, data analysis, data interpretation.

Michiko Matsuoka: Contributed research design and data collection.

Masao Suda: Contributed data collection.

Koutaro Yuge: Contributed data collection.

Takeshi Inoue: Contributed data collection.

Ryoichi Sakuta: Contributed data collection.

Yasunori Oka: Contributed research design creation.

Tatsuyuki Kakuma: Contributed data analysis and interpretation, data analysis and interpretation.

Toyojiro Matsuishi: Contributed conception of the study, research design creation.

Yushiro Yamashita: Contributed conception of the study, research design creation, data collection, data analysis, data interpretation.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.braindev.2022.06.003.

References

[1] Ophoff D, Slaats MA, Boudewyns A, Glazemakers I, Van Hoorenbeeck K, Verhulst SL. Sleep disorders during childhood: a practical review. Eur J Pediatr 2018;177:641–8. https://doi.org/10.1007/s00431-018-3116-z.

[2] Kaneita Y, Ohida T, Osaki Y, Tanihata T, Minowa M, Suzuki K, et al. Insomnia among Japanese adolescents: a nationwide representative survey. Sleep 2006;29:1543–50. https://doi.org/10.1093/sleep/29.12.1543.

[3] Maski K, Owens JA. Insomnia, parasomnias, and narcolepsy in children: clinical features, diagnosis, and management. Lancet Neurol 2016;15:1170–81. https://doi.org/10.1016/S1474-4422(16)30204-6.

[4] Iglowstein I, Jenni OG, Molinari L, Largo RH. Sleep duration from infancy to adolescence: reference values and generational trends. Pediatrics 2003;111:302–7. https://doi.org/10.1542/peds.111.2.302.

[5] Matricciani L, Olds T, Petkov J. In search of lost sleep: secular trends in the sleep time of school-aged children and adolescents. Sleep Med Rev 2012;16:203–11. https://doi.org/10.1016/j.smrv.2011.03.005.

[6] Mindell JA, Sadeh A, Wiegand B, How TH, Goh DY. Cross-cultural differences in infant and toddler sleep. Sleep Med 2010;11:274–80. https://doi.org/10.1016/j.sleep.2009.04.012.

[7] Ogilvie RP, Patel SR. The epidemiology of sleep and obesity. Sleep Health 2017;3:383–8. https://doi.org/10.1016/j.sleh.2017.07.013.

[8] Iwadare Y, Kamei Y, Usami M, Ushijima H, Tanaka T, Watanabe K, et al. Behavioral symptoms and sleep problems in children with anxiety disorder. Pediatr Int 2015;57:690–3. https://doi.org/10.1111/ped.12620.

[9] Kaneita Y, Ohida T, Uchiyama M, Takemura S, Kawahara K, Yokoyama E, et al. The relationship between depression and sleep disturbances: a Japanese nationwide general population survey. J Clin Psychiatry 2006;67:196–203. https://doi.org/10.4088/jcp.v67n0204.

[10] Wolfson AR, Carskadon MA. Sleep schedules and daytime functioning in adolescents. Child Dev 1998;69:875–87.

[11] Ranum BM, Wichstrom L, Pallesen S, Falch-Madsen J, Halse M, Steinsbekk S. Association between objectively measured sleep duration and symptoms of psychiatric disorders in middle childhood. JAMA Netw Open. 2019; 2 (12): e1918281.

[12] Vriend JL, Davidson FD, Corkum PV, Rusak B, Chambers CT, McLaughlin EN. Manipulating sleep duration alters emotional functioning and cognitive performance in children. J Pediatr Psychol 2013;38:1058–69. https://doi.org/10.1093/jpepsy/jst033.

[13] Borbely AA, Daan S, Wirz-Justice A, Deboer T. The two-process model of sleep regulation: a reappraisal. J Sleep Res 2016;25:131–43. https://doi.org/10.1111/jsr.12371.

[14] Kotagal S, Broomall E. Sleep in children with autism spectrum disorder. Pediatr Neurol 2012;47:242–51. https://doi.org/10.1016/j.pediatrneurol.2012.05.007.

[15] Blackmer AB, Feinstein JA. Management of sleep disorders in children with neurodevelopmental disorders: a review. Pharmacotherapy 2016;36:84–98. https://doi.org/10.1002/phar.1686.

[16] Souders MC, Mason TBA, Valladares O, Bucan M, Levy SE, Mandell DS, et al. Sleep behaviors and sleep quality in children with autism spectrum disorders. Sleep 2009;32:1566–78. https://doi.org/10.1093/sleep/32.12.1566.

[17] Bathory E, Tomopoulos S, Rothman R, Sanders L, Perrin EM, Mendelsohn A, et al. Infant sleep and parent health literacy. Acad Pediatr 2016;16:550–7. https://doi.org/10.1016/j.acap.2016.03.004.

[18] Hale L, Parente V, Phillips GK. Social determinants of children's sleep. In: Wolfson AR, Montgomery-Downs HE, editors. The Oxford handbook of infant, child, and adolescent sleep and behavior. New York: Oxford; 2013. p. 99–112.

[19] Mindell JA, Williamson AA. Benefits of a bedtime routine in young children: sleep, development, and beyond. Sleep Med Rev 2018;40:93–108. https://doi.org/10.1016/j.smrv.2017.10.007.

[20] Dolezal BA, Neufeld EV, Boland DM, Martin JL, Cooper CB. Interrelationship between sleep and exercise: a systematic review. Adv Prev Med 2017;2017:1364387. https://doi.org/10.1155/2017/1364387.

[21] Peters EM, Lusher JM, Banbury S, Chandler C. Relationships between breast-feeding, co-sleeping, and somatic complaints in early childhood. Infant Ment Health J 2016;37:574–83. https://doi.org/10.1002/imhj.21583.

[22] McHale SM, Lawson KM, Davis KD, Casper L, Kelly EL, Buxton O. Effects of a workplace intervention on sleep in employees' children. J Adolesc Health 2015;56:672–7. https://doi.org/10.1016/j.jadohealth.2015.02.014.

[23] Bartel KA, Gradisar M, Williamson P. Protective and risk factors for adolescent sleep: a meta-analytic review. Sleep Med Rev 2015;21:72–85. https://doi.org/10.1016/j.smrv.2014.08.002.

[24] Falbe J, Davison KK, Franckle RL, Ganter C, Gortmaker SL, Smith L, et al. Sleep duration, restfulness, and screens in the sleep environment. Pediatrics 2015;135:e367–75. https://doi.org/10.1542/peds.2014-2306.

[25] Kushida CA, Chang A, Gadkary C, Guilleminault C, Carrillo O, Dement WC. Comparison of actigraphic, polysomnographic, and subjective assessment of sleep parameters in sleep-disordered patients. Sleep Med 2001;2:389–96. https://doi.org/10.1016/s1389-9457(00)00098-8.

[26] Owens JA, Spirito A, McGuinn M. The Children's Sleep Habits Questionnaire (CSHQ): psychometric properties of a survey instrument for school-aged children. Sleep 2000;23:1043–51.

[27] Silva FG, Silva CR, Braga LB, Neto AS. Portuguese Children's Sleep Habits Questionnaire – validation and cross-cultural comparison. J Pediatr (Rio J) 2014;90:78–84. https://doi.org/10.1016/j.jped.2013.06.009.

[28] Schlarb AA, Schwerdtle B, Hautzinger M. Validation and psychometric properties of the German version of the Children's Sleep Habits Questionnaire (CSHQ-DE)Normierung und psychometrische Eigenschaften der deutschen Version des Children's Sleep Habits Questionnaire (CSHQ-DE). Somnologie 2010;14:260–6.

[29] Waumans RC, Terwee CB, Van den Berg G, Knol DL, Van Litsenburg RR, Gemke RJBJ. Sleep and sleep disturbance in children: reliability and validity of the Dutch version of the Child Sleep Habits Questionnaire. Sleep 2010;33:841–5. https://doi.org/10.1093/sleep/33.6.841.

[30] Parreira AF, Martins A, Ribeiro F, Silva FG. Clinical validation of the Portuguese version of the Children's Sleep Habits Questionnaire (CSHQ-PT) in children with sleep disorder and ADHD. Acta Med Port 2019;32:195–201. https://doi.org/10.20344/amp.10906.

[31] Doi Y, Oka Y, Horiuchi F, Okawa M, Uchiyama M. Development of the Japanese version of the Children's Sleep Habits Questionnaire (CSHQ-J). Japanese Journal of. Sleep Med 2007;2:83–8 in Japanese.

[32] Buysse DJ, Reynolds 3rd CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res 1989;28:193–213.

[33] Doi Y, Minowa M, Uchiyama M, Okawa M, Kim K, Shibui K, et al. Psychometric assessment of subjective sleep quality using the Japanese version of the Pittsburgh Sleep Quality Index (PSQI-J) in psychiatric disordered and control subjects. Psychiatry Res 2000;97:165–72.

[34] Nunnally JC, Bernstein IH. Psychometric theory. 3rd ed. New York: McGraw-Hill; 1994.

[35] Streiner DL, Norman GR. Health measurement scales. A practical guide to their development and use. New York: Oxford University Press; 2003.

[36] Fletcher RH, Fletcher SW, Wagner EH. Clinical epidemiology: the essentials. 2nd ed. Baltimore, MD: Williams and Wilkins; 1988.

[37] Mindell JA, Sadeh A, Kohyama J, How TH. Parental behaviors and sleep outcomes in infants and toddlers: a cross-cultural comparison. Sleep Med 2010;11:393–9. https://doi.org/10.1016/j.sleep.2009.11.011.

[38] Latz S, Wolf AW, Lozoff B. Cosleeping in context: sleep practices and problems in young children in Japan and the United States. Arch Pediatr Adolesc Med 1999;153:339–46. https://doi.org/10.1001/archpedi.153.4.339.

[39] Shimizu M, Park H, Greenfield PM. Infant sleeping arrangements and cultural values among contemporary Japanese mothers. Front Psychol 2014;5:718. https://doi.org/10.3389/fpsyg.2014.00718.

[40] Mindell JA, Meltzer LJ, Carskadon MA, Chervin RD. Developmental aspects of sleep hygiene: findings from the 2004 National Sleep Foundation Sleep in America Poll. Sleep Med 2009;10:771–9. https://doi.org/10.1016/j.sleep.2008.07.016.

[41] Mosko S, Richard C, McKenna J. Infant arousals during mother-infant bed sharing: implications for infant sleep and sudden infant

death syndrome research. Pediatrics 1997;100:841–9. https://doi.org/10.1542/peds.100.5.841.

[42] Meltzer LJ, Mindell JA. Relationship between child sleep disturbances and maternal sleep, mood, and parenting stress: a pilot study. J Fam Psychol 2007;21:67–73. https://doi.org/10.1037/0893-3200.21.1.67.

[43] Urrutia-Pereira M, Sole D, Chong Neto HJ, Acosta V, Cepeda AM, Álvarez-Castelló M, et al. Sleep disorders in Latin-American children with asthma and/or allergic rhinitis and normal controls. Allergol Immunopathol (Madr) 2017;45:145–51. https://doi.org/10.1016/j.aller.2016.05.005.

[44] Türkoğlu S, Tahsin Somuk B, Sapmaz E, Bilgiç A. Effect of adenotonsillectomy on sleep problems, attention deficit hyperactivity disorder symptoms, and quality of life of children with adenotonsillar hypertrophy and sleep-disordered breathing. Int J Psychiatry Med 2019;54:231–41. https://doi.org/10.1177/0091217419829988.

[45] Matsuoka M, Nagamitsu S, Iwasaki M, et al. High incidence of sleep problems in children with developmental disorders: results of a questionnaire survey in a Japanese elementary school. Brain Dev 2014;36:35–44. https://doi.org/10.1016/j.braindev.2012.12.004.

[46] Iwata S, Iwata O, Matsuishi T. Sleep patterns of Japanese preschool children and their parents: implications for co-sleeping. Acta Paediatr 2013;102:e257–62. https://doi.org/10.1111/apa.12203.

[47] Yoshimura M, Kitazawa M, Maeda Y, Mimura M, Tsubota K, Kishimoto T. Smartphone viewing distance and sleep: an experimental study utilizing motion capture technology. Nat Sci Sleep 2017;9:59–65. https://doi.org/10.2147/NSS.S123319.