Validation of the Sleep Disturbance Scale for Children (SDSC) in Infants and Toddlers from Mainland China

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Abstract

A Chinese version of the sleep disturbance scale for children (SDSC) has been validated for 5 to 16-year olds. However, the assessment tool of sleep disturbance in infants and young children from mainland China is relatively rare and limited, and clinicians cannot objectively, accurately, and comprehensively screen for early detection and intervene to treat them.

Background:To evaluate the reliability and validity of SDSC among infants (aged 6 months to 36 months) in mainland China, and to provide a reference for expanding the application of the SDSC for the Chinese infants (SDSC-I).

Methods: From April to November 2021, parents of infants from Fuzhou, Quanzhou, Longyan, Sanming and Nanping in Fujian Province completed the SDSC which is specifically for infants and toddlers. The reliability and validity of the scales were estimated by item analysis, standard Cronbach's alpha coefficient, exploratory factor analysis (EFA), confirmatory factorial analyses (CFA) and other measurement characteristics.

Results: 432 out of 469 samples were valid. Through item selections and exploratory factory analysis, the SDSC-I concluded 6 dimensions (Disorders of Initiating Sleep, Disorders of Maintaining Sleep, Sleep Hyperhidrosis, Sleep Breathing Disorders, Parasomnias, and Non-Restorative Sleep and Excessive Somnolence) including 23 items. Cronbach's α coefficient of the scale was 0.863, for the 6 dimensions were within 0.576–0.835. The values of parameters for content validity of the scale were: IR = 0.87, I-CVI > 0.78, Kappa value > 0.74, S-CVI/UA = 0.87, S-CVI/Ave = 0.98. Principal component analysis revealed that, the KMO value was 0.84, the factor loading of items ranged from 0.328–0.849, with 6 factors of eigenvalue > 1, which could explain 58.274% of the total variance. The results of the confirmatory factor analysis showed: χ^2/DF was 3.556, RMSEA was 0.077, CFI was 0.809, and SRMR was 0.070.

Conclusions: The SDSC-I has been proved to be reliable and valid, and it can assess the sleep problems of infants in a comprehensive and detailed manner. Therefore, the scale is useful for early screening and adetection of sleep disorders by clinicians, and is worthy of popularization and application.

Introduction

Healthy sleep in children plays an important role throughout their development, especially for physical growth, immune function, brain development, mental health, child temperament and personality maturation. Sleep problems is not only closely related to cognitive, emotional and behavioral developmental problems in childhood, but also is one of the important risk factors for chronic diseases such as hypertension, obesity, anxiety disorders and depression in adulthood [1–2]. These physiologic and psychological processes change over the life course, especially in the first 5 years[3]. Although sleep problems are common in childhood but easily overlooked. A meta-analysis showed that the prevalence of sleep problems for children in mainland China was 37.6% (95% CI: 34.3–40.9%), with 33.3% in infants, 38.9% in preschoolers, and 43.7% in school-age children [4]. Infancy and early childhood are critical

periods for the development of sleep and the formation of healthy sleep patterns and habits in children. Few pediatricians in mainland China have received formal training in sleep medicine during medical school or residency. The practitioners have been shown to inadequately address sleep issues during routine well-child health care and to underdiagnose sleep problems. As a result, pediatricians are not able to effectively and confidently screen patients for sleep problems and provide sleep-related counseling. Therefore, early screening for sleep problems in infants and toddlers can help to correctly identify the diagnosis and treatment of sleep disorders.

Since in 2011 Spruyt et al.[5] conducted a comprehensive review of the overall deficiencies of pediatric questionnaires in sleep, many existing tools have been further developed and evaluated by sleep researchers worldwide.There are 144 "tool"-studies (70 tools) published aiming at investigating sleep in primarily 6–18 years old per parental report[5]. In 1996, Bruni et al.[6] developed a 26 item Likert-type rating scale (Sleep Disturbance Scale for Children: SDSC) used and validated in an Italian population of 1304 children. The SDSC appears to be a useful tool for assessing the sleep disturbances of school-age children in both clinical and non-clinical populations. In 2013, they used it to assess the psychometric properties of the SDSC in an population of healthy preschool children (range 3–6 years) in Italian. This further verifies that the SDSC has a good reliability and validity for use in studies of sleep in young children[7]. In the same year, Huang et al.[8] translated the SDSC and tested its reliability and validity in 3525 children aged 5–16 years. The results showed that its psychometric properties are also satisfactory,and it could be used as an epidemiological screening tool for parent-reported sleep disorders in Chinese school-age children.In 2019, Lecuelle et al.[9] firstly validated the SDSC for French preschoolers (aged 6 months to 4 years). The convergent validity and internal reliability of a 22-item SDSC for young children (SDSC-Y) were acceptable.Subsequently, Romeo et al.[10] applied a 22-item version of the SDSC to a convenience sample of 193 Italian infants and toddlers (aged 6–36 months), and a 19 items questionnaire eventually formed was encouraged for the evaluation of sleep problems.

Research findings on factors affecting children's sleep are inconsistent, and there is no clear definition of sleep disorders in children, and the concepts of sleep disorders and sleep problems as proper nouns are vague [4, 8]. Studies on children's sleep in mainland China have also gradually increased in recent 20 years, but there are fewer relevant assessment tools, Most of the tools queried general sleep problems in childhood. Especially for early screening of younger children, a more objective and comprehensive assessment tool still is missing. The SDSC was a parent-report scale for screening sleep disturbances within the preceding 6 months, it has been validated used in sleep studies in different languages such as Australian [11], Persian [12], Indonesian [13], Flemish [14], Brazilian Portuguese [15], Portuguese[16], Finnish [17], Malay [18]and Turkish[19]. In 2017, the “Guideline for sleep hygiene among children aged 0 ~ 5 years” was published in mainland China [20], recommending the "Brief Infant Sleep Questionnaire (BISQ)[21]" and the " Children’s SleepHabits Questionnaire (CSHQ) [22]" as screening tests for children's sleep. Nevertheless, BISQ was mainly used to assess the children's sleep, such as sleep ecology, infant daytime, nighttime sleep patterns, bedtime, hours of nighttime and number of night wakings[23].

Therefore, this present study was primarily to assess the psychometric property of the SDSC in an chinese population of infants and toddlers (6 ~ 36 months), which assist pediatricians in early screening and diagnosis of sleep disturbances in young children at a community hospital.

Methods

Sampling

From April to November 2021, community hospitals in Fuzhou, Quanzhou, Longyan, Sanming and Nanping in Fujian Province were selected for sampling using convenience sampling method. Ethical approval was approved by the Fujian Medical University Union Hospital, Scientific Research Ethics Committee (approval date and decision number: 2021KY131).And informed consent was acquired from all parents of infants included in our study.

Participants

Parents of healthy infants and toddlers aged 6 months to 3 years were selected to exclude children with psycho-behavioral developmental abnormalities,rheumatoid-immune and oncological diseases, or who were using drugs anti-epileptic, antihistamine, benzodiazepines,etc. that could affect their sleep structure.Children with developmental, physical or mental disabilities or receiving medication such as antihistaminic drugs, antiepileptic drugs, glucocorticoids, melatonin) were excluded, as these factors may affect sleep architecture includind sleep cycles of REM and NREM sleep.

The SDSC-I based on the SDSC

The SDSC adapted in the present study was authorized by Oliviero Bruni. The translation and adaptation of the scale were performed independently by six senior experts, including a pediatric neurologists, a health care physicians, a pediatric psychiatrists, a pediatric psychiatrists, an English language specialist and a nurse. They were 3 males and 3 females; their ages ranged from 45 to 56 years with an average age of (50.3 ± 3.9) years. The entries were revised, screened, and evaluated for validation. All specialist independently provided the clarity score between one and four for each item to evaluate the content validity of the scale. Drawing on previous sleep questionnaires, particularly the recent validation of the Italian SDSC (a 19-item version) and French SDSC-Y (a 22-item version), we finally removed two items(sleepwalking and hypnagogic hallucinations). Meanwhile, the “hypnic jerks“ and “rhythmic movement disorder” were combined into one item. And a item (Needs parent in room to sleep) has been added, resulting a 23-items questionnaire. It investigates the occurrence of sleep disturbance during the preceding 6 months and each item is scored in a 5-point Likert-type scale. A sociodemographic data form was filled out by parents, it included the date of birth, gender, developmental history and medical history (i.e., past or present diseases, therapies, etc) of the children.

2.4 Statistical analysis

The normality of the data was examined by using the ShapiroeWilks test. The Manne-Whitney U test was used for two groups(children aged 6 ~ 23 months and children aged 24 ~ 36 months) as previous study[10]. Item analysis was used to test the appropriateness of the items. The subjects were ranked in descending order of their total scores. The first 27% (96th participant with a score of 48) and all participants with a score of ≥ 48 were classified as "high group". The next 27% (96th subject with a score of 37) and all subjects with a score ≤ 37 were classified as "low group". The content validity of the scale was evaluated using inter-rater reliability(IR), item-content validity index(I-CVI), scale-content validity index(S-CVI), universal agreement S-CVI(S-CVI/UA), average S-CVI(S-CVI/Ave) and Kappa value [24–26]. The reliability analysis of the scale were evaluated by the Cronbach alpha, inter-item correlation, and internal correlation consistency. The T-score table was prepared similar to that in the original study by converting the mean scores of the scale into T-scores using the following formula: T-score = 50+(value-mean)/standard deviation* 10. A child with T-score > 70 was considered to have a significant sleep disorder [14]. Confirmatory factorial analyses(CFA) was performed by a structural equation model. Comparative fit index (CFI) value > 0.80 were considered a moderate fit[27]. The root mean square error of approximation (RMSEA) value and standardized RMR (SRMR) < 0.08 acceptable [28]. The data analysis were performed using SPSS Version 21.0 and Mplus version 8.3 software. P < 0.05 was considered to be significantly for this statistical analysis.

Results

Participants

The average age of the 432 children was 2years 1months ± 7months ranging from 6 months~3 years. The mean age for 242(56.02%) boys was 2years with (standard deviation =6months), the mean age for 190(43.98%) girls was 2years with (standard deviation =7months) . The rates for 188 infants <24 months was 43.5%.

Reliability analysis

The Cronbach's alpha value for the 23 items scores was 0.838, indicating a good reliability of the scale. The Cronbach’s alpha value for all dimensions ranged from 0.576 to 0.835. Except for item 1 and 24, item-total correlations were greater than 0.3. After eliminating any of these two item, the alpha was unchanged(see Table 1).

Table 1 Item-total correlation analysis and Exploratory Factor Analysis of the SDSC-I

	Item-total correl	Alpha if deleted	Variance Explained(%)	Factor loading
Factor 1: Disorders of initiating sleep (DIS)			11.747	
D1.Sleep duration	0.155	0.839		0.463
D2.Sleep latency	0.423	0.830		0.328
D3.Going to bed reluctantly	0.511	0.826		0.679
D4.Difficulty to fall asleep	0.610	0.821		0.721
D5.Needs parent in room to sleep	0.351	0.835		0.849
D6.Anxiety when falling asleep alone	0.412	0.835		0.817
Factor 2: Disorders of Maintaining Sleep (DMS)			11.129	
M7.Night awakenings more than twice	0.431	0.830		0.586
M8.Difficulty to fall asleep after waking	0.518	0.827		0.660
M9.Noctural hyperkinesia	0.473	0.829		0.419
Factor 3: Sleep Hyperhidrosis (SHY)			10.994	
H10.Falling asleep sweating	0.473	0.828		0.837
H11.Night sweating	0.497	0.827		0.824
Factor 4: Sleep Breathing Disorders (SBD)			9.061	
B12. Breathing problems	0.344	0.834		0.765
B13.Sleep apnoea	0.229	0.837		0.806
B14.Snoring	0.418	0.831		0.603
Factor 5: Parasomnias (PARA)			8.112	
P15.Startles or jerks while falling asleep	0.456	0.830		0.668
P16. Sleep terrors or Nightmares	0.551	0.826		0.735
P17.Sleeptalking	0.368	0.833		0.545
P18.The child grinds teeth during sleep	0.257	0.836		0.421
Factor 6: Non-Restorative Sleep and Excessive Somnolence (NRSES)			7.232	
N19.Unusually difficult to wake up in the morning	0.282	0.836		0.638
N20.Feeling tired with non-restorative sleep	0.445	0.831		0.787

N21.Sleep paralysis	0.387	0.833	0.773
N22.Daytime somnolence	0.381	0.833	0.664
N23.Sleep attacks	0.276	0.845	0.543

A Shapiroe-Wilks test of the total scale and subscale scores demonstrated a non-normal distribution.The correlation analysis was performed by nonparametric Spearman Rho.The correlation between subscale(DIS, DMS, SHY, SBD, PARA and NRSES) of the SDSC-I were <0.40, except a correlation between DIS and DMS was 0.525. Between the total score and subscales, a strong correlation was observed ranging from 0.501(SBD) to 0.820(DIS).

Construct validity

This scale was suitable for EFA using geomin rotation,with KMO value=0.82 and Bartlett's test of sphericity of χ 2 value=3088.36(P<0.001). Based on the eigenvalues, a six-factor solution explained 58.27% of the total variance.The factor loads of all the items varied between 0.328(item2) and 0.849(item5). The 23-item scale, the factor loadings and the 6 factors are depicted in Table 1. In the model described in CFA, χ2/DF=3.556, CFI =0.809, SRMR=0.070, and the RMESA=0.077 values were determined. The factor loading of the 23 items was from 0.22 to 0.87(see Figure 1). The factor structure of the chinese SDSC in infants was consistent with previous studies and appeared to be compatible.

Content validity

The inter-rater reliability of the SDSC-I was 0.87, I-CVI being >0.78, Kappa values >0.74, S-CVI/UA being 0.87, S-CVI/Ave being 0.98, all met the requirements, and the scale content validity was ideal presented in Table 2.

Table 2 Content validity analysis of each item for Chinese version of SDSC-I

Item	Expert Rating (score)						I-CVI	Kappa
	A	B	C	D	E	F		
D1	4	3	4	4	4	4	1.00	1.00
D2	4	4	4	4	4	4	1.00	1.00
D3	3	3	4	3	3	4	1.00	1.00
D4	4	4	3	3	3	4	1.00	1.00
D5	3	3	4	2	4	4	0.83	0.81
D6	3	2	4	3	4	3	0.83	0.81
M7	4	3	4	3	4	3	1.00	1.00
M8	4	4	4	3	4	3	1.00	1.00
M9	4	4	4	4	4	3	1.00	1.00
H10	4	4	4	4	3	3	1.00	1.00
H11	4	4	4	3	3	4	1.00	1.00
B12	3	3	4	4	3	3	1.00	1.00
B13	3	3	4	4	4	3	1.00	1.00
B14	4	4	4	3	4	3	1.00	1.00
P15	4	4	4	2	4	4	0.83	0.81
P16	4	4	4	3	4	4	1.00	1.00
P17	4	4	4	3	4	4	1.00	1.00
P18	4	3	4	4	3	4	1.00	1.00
N19	4	4	4	3	4	4	1.00	1.00
N20	4	4	4	3	4	4	1.00	1.00
N21	3	3	4	3	4	3	1.00	1.00
N22	4	4	4	3	3	4	1.00	1.00
N23	4	4	4	3	4	4	1.00	1.00

Item Analysis

According to the total score, the critical ratio method was used to divide 27% into the high group (n = 132, ≥48 points, numbered 2) and the low group (n = 129, ≤37 points, numbered 1), and t-tests were conducted to examine the differences between the two groups on each entry score. The results showed

statistically significant differences between the high and low subgroups ($P < 0.05$, see Table 3), indicating a strong differentiation in each dimension.

Table 3 Item analysis for Chinese version of SDSC-I

Item	high group	low group	*t*	*P*
D1	1.61±0.627	1.27±0.48	4.85	<0.001
D2	3.3±1.089	1.95±0.774	11.56	<0.001
D3	2.99±1.169	1.47±0.638	13.14	<0.001
D4	3.12±1.153	1.35±0.525	16.04	<0.001
D5	4.76±0.594	3.28±1.576	9.98	<0.001
D6	4.36±1.12	2.1±1.468	13.93	<0.001
M7	2.8±1.298	1.45±0.637	10.73	<0.001
M8	2.05±1.036	1.09±0.28	10.35	<0.001
M9	4.26±0.879	2.26±1.241	14.95	<0.001
H10	3.03±1.278	1.29±0.575	14.27	<0.001
H11	2.67±1.275	1.19±0.452	12.56	<0.001
B12	1.39±0.749	1.00±0.00	6.04	<0.001
B13	1.15±0.502	1.00±0.00	3.47	0.001
B14	1.97±1.018	1.2±0.422	7.99	<0.001
P15	1.99±1.008	1.21±0.408	8.26	<0.001
P16	2.38±0.937	1.3±0.494	11.65	<0.001
P17	1.86±0.909	1.23±0.459	7.02	<0.001
P18	1.48±0.776	1.1±0.327	5.23	<0.001
N19	1.85±1.129	1.16±0.556	6.25	<0.001
N20	1.7±0.863	1.04±0.231	8.56	<0.001
N21	1.52±0.842	1.02±0.151	6.60	<0.001
N22	1.68±0.859	1.09±0.317	7.38	<0.001
N23	1.55±0.775	1.21±0.51	4.24	<0.001

Scale score distribution

The minimum scores of the scale was 23, and for the subscales of DIS, DMS, SHY, SBD, PARA, and NRSES was 6, 3, 2, 3, 4, and 5, respectively.And the maximum scores of the total scale and subscales were 78, 27, 15, 10, 11, 15, and 20, respectively.And correspondingly, The percentages of the lowest scores were: 0.20%, 0.70%, 6.5%, 37.5%, 58.3%, 22.2%, 48.8%, and the percentages of the highest scores were: 0. 20%, 0. 70%, 0.20%, 3.5%, 0.20%, 0.70%, 0.20%, all of which were low. All the total scores demonstrated left-tailed distribution (Wilk's W=0.973, *P*=0.000)(see Figure 2). Differences in total score by age and gender were not found.

Other measurements

As previously done in the similar studies [10], most of the infants (62.0%) slept >9 h per night and that none slept <5 h. 59.7% of the young children fell asleep 30min after going to bed. The highest prevalence of frequencies of parent-reported sleeping disturbances symptoms was item5 (77.3%) , and the lowest was item1(0.2%) and item13(0.2%)(see Table 4). The analysis of the respondents' compliance and the completion time of the scale showed that most of the parents could fill out the questionnaire issued in this study and complete it within 10-15 min, and the return rate of the questionnaire was over 90%.

Table 4 Frequencies (%) of parent-reported sleeping disturbances in infants.

Item	Never	Occasionally 1~2x/month	Sometimes 1~2x/week	Often 3~5x/week	Always
D1	62.000	33.100	4.600	0.200	0.000
D2	13.900	45.800	23.400	8.800	8.100
D3	32.200	37.300	16.900	8.600	5.100
D4	33.600	37.300	15.300	9.300	4.600
D5	6.900	8.800	6.900	14.800	62.500
D6	23.400	14.800	8.300	12.700	40.700
M7	37.300	38.900	9.700	9.700	4.400
M8	64.100	25.000	7.900	2.300	0.700
M9	11.100	22.200	12.300	30.600	23.800
H10	42.400	26.900	13.900	9.000	7.900
H11	50.200	27.800	10.600	7.400	3.900
B12	88.200	7.600	2.800	0.900	0.500
B13	95.600	3.000	1.200	0.200	0.000
B14	62.000	28.000	6.700	2.300	0.900
P15	55.800	35.600	4.900	3.000	0.700
P16	40.500	44.400	10.600	4.200	0.200
P17	58.100	32.900	6.900	2.100	0.000
P18	78.900	16.400	3.500	1.200	0.000
N19	73.600	14.400	7.200	3.000	1.900
N20	78.200	15.700	4.600	1.400	0.000
N21	85.200	10.900	3.000	0.500	0.500
N22	75.900	18.800	4.200	0.900	0.200
N23	74.100	19.200	5.600	1.200	0.000

Discussion

The main objective of the present was to assess sleep disturbance in infants and toddlers using the SDSC in chineslanguage. The validity and reliability was investigated by a modified version of the SDSC

(SDSC-I). The 23-item SDSC-I consists of six factors (DIS, DMS, SHY, SBD, PARA, and NRSES) was highly reliable and compatible.

In the present study, the SDSC firstly was applied for infants and toddlers within 3 years old in mainland China. Sleep problems are prevalent in chinese preschool and school-age children. Common sleep problems included difficulty falling asleep, enuresis, night waking, teeth grinding, sleep breathing disorder, night terrors, open mouth breathing, sleep talking, nightmares, night sweats, and daytime sleepiness[29]. Children's sleep is affected by significant socio-cultural differences. The existing sleep assessment tools for children are mainly applicable to preschool or school-age children, and most of them are limited to the assessment of a specific sleep problem, which cannot truly and comprehensively reflect the sleep problems of infants in China[30]. The clinical evidence demonstrated that pediatric sleep disturbances overlap with each other[10]. The SDSC not only evaluates sleep duration and sleep behavior habits, but also assesses sleep disorder-related problems, which is more beneficial for early screening of sleep disorders in clinical practice. The SDSC is currently used in China only to evaluate school-age children aged 5–16 years[8], but it has been used abroad to assess preschool-age children[9–10]. The first SDSC reliability test conducted by Huang et al.[8] on children in mainland China revealed good internal consistency of the scale (Cronbach's α = 0.81). Our study showed that the SDSC-I scale has acceptable and stable internal consistency with a Cronbach's α coefficient of 0.847, slightly higher than the results of previous research from chinese scholar[8], and similar to the French population and Italian population[9–10]. The internal consistency of all the dimensions was largely consistent across the infants and school-age children in china[8]. This study indicate that the SDSC-I therefore has a good reliability for evaluating sleep disturbance in chinese infants.

This study demonstrated that a strong correlation was found between each dimension of the SDSC-I scale and the total score, with all the correlations more than 0.5. It indicated that the factors (DIS, DMS, SHY, SBD, PARA, and NRSES) were consistent with the clinical concept, as previously reported [9–10]. Except for item 1, the correlation coefficient values were all greater than 0.5 between each item and the corresponding dimension. Therefore, our study showed that the dimension in which the entry was located was reasonable, and suggested that the scale had a good construct validity. According to the exploratory factor analysis, six factors with eigenvalues greater than 1 were extracted, which was basically consistent with the findings of Italian and French scholars [9–10]. And all six areas of sleep disorders based on clinical concepts and previous studies were helpful for clinicians to identify areas that require more in-depth investigation[10]. The factor loadings of all the item ranged from 0.328 to 0.849, which was similar to the results (from 0.26 to 0.91) in previous French study population and slightly lower than the results (from 0.50 to 0.87) in the Italian population. Six-factor model in the present study matched the theoretical constructs of the six dimensions designed by the SDSC-I, indicating that the scale has a good structural validity.

The current international classification of sleep disorders is based on the "The Third Edition of the International Classification of Sleep Disorders (ICSD-3)" in 2014, identifying seven categories[31]: ▯insomnia disorders; ▯sleep related breathing disorders; ▯central disorders of hypersomnolence;

circadian rhythm sleep-wake disorders; parasomnias; sleep related movement disorders; other sleep disorders.Insomnia in children is usually reported by parents or other caregivers and is mainly characterized by going to bed reluctantly, frequent awakenings during the night and difficulty to fall asleep alone. In addition to nocturnal symptoms, daytime symptoms of functional impairment such as fatigue, irritability, hyperactivity and impulsivity, and daytime sleepiness may also result from night sleep difficulties[32]. The 23-items version of the SDSC in our study is also a revised version of the original SDSC as Lecuelle et al.[9] And Romeo et al.[10]. In the SDSC-I, we therefore removed three items regarding sleepwalking and hypnagogic hallucinations. However, bruxism was retained due to results of a research on sleep problems in children in Mainland China[4, 29–30]. Bruxism is reported to be poorly prevalent in French and Italian infants and toddlers. Nevertheless, it is common among infants and young children in mainland China[29]. Furthermore, rhythmic movement disorder and hypnic jerks are frequently misinterpreted by parents in French population as the child being agitated, or turning several times in bed when unable to fall asleep[9]. On the contrary, parents in mainland China, as well as researchers of sleep problems, are more concerned about: whether children wake up frequently, restless sleep, leg movements, bruxism, hyperhidrosis, snoring, night awakening, apnea, choking or asping, mouth breathing, sleep talking, nightmare, enuresis, trouble falling asleep, or other problems during sleep[4]. For instance, chinese parents of young children pay particularly close attention to bruxism at this age years, and they often associate bruxism with ascariasis or other diseases. Therefore, bruxism are retained after consulting parents and specialists. Although national and cultural differences lead to some slight inconformity in the application of the SDSC, the scale is also illustrated good applicability.

Compared with a previous study of Romeo et al.[10], 58.5% of infants in our group slept 9 ~ 11 h, higher than the Italian population (46.6%). A sleep latency < 30 min to fall asleep was demonstrated for 59.7% of the chinese infants vs. 54.5% of the Italian. The incidence of bedtime resistance and difficulty falling asleep among chinese infants was lower than that in Italian infants (13.6% vs 20.9% and 13.2% vs 16.6%, respectively). Chinese infants and toddlers are awake more infrequently during the night (13.6% vs 20.9%) and present nocturnal hyperkinesia (13.2% vs 16.6%). Snoring was found similarly in chinese and Italian population (5.7% vs 4.8%). As for parasomnias, a prevalence of 3.1% of sleep talking was reported in our research (vs. 3.5% in the Italian research), and frequent twitching or jerking of legs was reported in 54.4% among chinese infants, significantly higher than Italian (24.0%). This may be related to the fact that Chinese parents prefer to sleep in the same bed with their children. As studies have shown Chinese children need to be held or patted to sleep by their parents[33]. Sweating while falling asleep and during sleep was reported respectively for 16.9% (vs. 7.7%) and for 11.3% (vs. 8.4%). It may be related to high parental concern about night sweating or excessive warmth in children in mainland China. Interestingly, parents of chinese infants often associate excessive sweating with vitamin D deficiency or physical weakness (a symptom of Traditional Chinese medicine). The percentage of T-score greater than 70 was higher than in the Italian population (4.6% vs. 3.6%) and similar to that of chinese school-age children in the previous study (4.1%).Our study showed that 10.9% of infants and toddlers were within the critical range of 61–70 points,12% in the Italian study were within that critical value. The influencing factors

relevant to sleep disorders or sleep problems in children vary widely from study to study and may be closely related to sociocultural, climatic environment, individual or family factors[29].

Several limitations of our study were need to be acknowledged: a) The sensitivity and specificity of the scale could not be calculated in our study because of lacking a patient group with sleep disorders. Due to methodological issues, the rates of sleep disorders determined in this study cannot be used as epidemiological data[19]; b)The parents may be lack of awareness and attention to sleep problems because of social, familial, cultural and environmental factors. Therefore, data collected from parental reports had a potential recall bias[8]; c) Our study also has some statistical validation limitations such as lack of test-retest fidelity,comparison of different age groups andmulti-group modeling CFA[9]. The potential sleep-related problems could be evaluate by pediatricians easily adminstrating, scoring and interpretating the SDSC-I, which would be conducive to address the prevention of sleep disorders[8].

Conclusions

The SDSC-I has been proved to be as good as versions reliable and valid in other languages, and it can assess the sleep problems of infants in a comprehensive and detailed manner. Therefore, the scale is useful for early screening and adetection of sleep disorders by clinicians, and is worthy of popularization and application. This study is one first step to apply the SDSC to Chinese infants, and further research is performed to provide a more in-depth assessment of sleep disorders like polisomnography or actigraphy.

Abbreviations

SDSC
sleep disturbance scale for children
SDSC-I
SDSC for the Chinese infants
EFA
exploratory factor analysis
CFA
confirmatory factorial analyses
SDSC-Y
a French version of the SDSC adapted for preschool (6 month-to-4-year-old) Children
BISQ
Brief Infant Sleep Questionnaire
CSHQ
Children’s SleepHabits Questionnaire
IR
inter-rater reliability
I- **CVI**
II- item-content validity inde

S- **CVI**
T- universal agreement
CFI
Comparative fit index
RMSEA
root mean square error of approximation
SRMR
standardized RMR
DIS
Disorders of initiating sleep
DMS
Disorders of Maintaining Sleep
SHY
Sleep Hyperhidrosis
SBD
Sleep Breathing Disorders
PARA
Parasomnias
NRSES
Non-Restorative Sleep and Excessive Somnolence
ICSD-3
The Third Edition of the International Classification of Sleep Disorders

Declarations

Ethics approval and consent to participate

Ethical approval was approved by the Fujian Medical University Union Hospital, Scientific Research Ethics Committee (approval date and decision number: 2021KY131).All the methods were performed in accordance with the Declaration of Helsinki.And informed consent was acquired from all parents of infants included in the present study.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors’contributions

XR C and XX L participated in the design of the study and data collection.

XX L and XR C performed the statistical analysis. XX L,XRC, YH C,YH Y,Ping X and S C conceived of the study and participated in its design as well as coordination and helped to write and revise the manuscript. All authors read and approved the final manuscript.

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References

1. Yang Shichang,Xu Yahui,Yang Weiwei. Research status of sleep disorders in children[J]. Chinese Journal of Applied Clinical Pediatrics,2018(5). DOI:10.3760/cma.j.issn.2095-428X.2018.05.018.
2. Carter JC, Wrede JE. Overview of Sleep and Sleep Disorders in Infancy and Childhood. Pediatr Ann. 2017 Apr 1;46(4):e133-e138. doi: 10.3928/19382359-20170316-02.

3. 3.Bathory E, Tomopoulos S. Sleep Regulation, Physiology and Development, Sleep Duration and Patterns, and Sleep Hygiene in Infants, Toddlers, and Preschool-Age Children. Curr Probl Pediatr Adolesc Health Care. 2017 Feb;47(2):29-42. doi: 10.1016/j.cppeds.2016.12.001.
4. Chen X, Ke ZL, Chen Y, Lin X. The prevalence of sleep problems among children in mainland China: a meta-analysis and systemic-analysis. Sleep Med. 2021 Jul;83:248-255. doi: 10.1016/j.sleep.2021.04.014.
5. Sen T, Spruyt K. Pediatric Sleep Tools: An Updated Literature Review. Front Psychiatry. 2020 Apr 23;11:317. doi: 10.3389/fpsyt.2020.00317.
6. Bruni O, Ottaviano S, Guidetti V, Romoli M, Innocenzi M, Cortesi F, Giannotti F. The Sleep Disturbance Scale for Children (SDSC). Construction and validation of an instrument to evaluate sleep disturbances in childhood and adolescence. J Sleep Res. 1996 Dec;5(4):251-61. doi: 10.1111/j.1365-2869.1996.00251.x.
7. Romeo DM, Bruni O, Brogna C, Ferri R, Galluccio C, De Clemente V, et al. Application of the 442 Sleep Disturbance Scale for Children (SDSC) in preschool age. Eur J Paediatr Neurol 443 2013;17:374–82. doi:10.1016/j.ejpn.2012.12.009.
8. Huang, M-M., Qian, Z., Wang, J., Vaughn, M.G., Lee, Y.L., Dong, G-H., Validation of the Sleep Disturbance Scale for Children and prevalence of parent-reported sleep disorder symptoms in Chinese children, Sleep Medicine (2014), doi: http://dx.doi.org/10.1016/j.sleep.2014.03.023
9. Lecuelle F, Gustin MP, Leslie W, Mindell JA, Franco P, Putois B. French validation of the sleep disturbance scale for children (SDSC) in young children (aged 6 months to 4 years). Sleep Med. 2020 Mar;67:56-65. doi: 10.1016/j.sleep.2019.09.014.
10. Romeo DM, Cordaro G, Macchione E, Venezia I, Brogna C, Mercuri E, Bruni O. Application of the Sleep Disturbance Scale for Children (SDSC) in infants and toddlers (6-36 months). Sleep Med. 2021 May;81:62-68. doi: 10.1016/j.sleep.2021.02.001.
11. Marriner AM, Pestell C, Bayliss DM, McCann M, Bucks RS. Confirmatory factor analysis of the Sleep Disturbance Scale for Children (SDSC) in a clinical sample of children and adolescents. J Sleep Res 2017;26:587–94. doi:10.1111/jsr.12526
12. Saffari M, Gholamrezaei A, Saneian H, et al. Linguistic validation of the sleep disturbance scale for children (SDSC) in Iranian children with Persian language. Sleep Med 2014;15:998e1001. https://doi.org/10.1016/j.sleep.2014.03.021.
13. Herwanto H, Lestari H, Warouw SM, et al. Sleep disturbance scale for children as a diagnostic tool for sleep disorders in adolescents. Paediatr Indones 2018;58:133e7. https://doi.org/10.14238/pi58.3.2018.133-7.
14. Spruyt K, Cluydts R, Verleye GB. Pediatric sleep disorders: exploratory modulation of their 434 relationships. Sleep 2004;27:495–501. doi:10.1093/sleep/27.3.495
15. Sousa VD, Rojjanasrirat W. Translation, adaptation and validation of instruments or scales for use in cross-cultural health care research: a clear and user-friendly guideline. J Eval Clin Pract 2011;17:268e74. https://doi.org/10.1111/j.1365-2753.2010.01434.x.

16. Ferreira VR, Carvalho LBC, Ruotolo F, de Morais JF, Prado LBF, Prado GF. Sleep disturbance scale for children: translation, cultural adaptation, and validation. Sleep Med 2009;10:457–63.doi:10.1016/j.sleep.2008.03.018.
17. Simola P, Niskakangas M, Liukkonen K, et al. Sleep problems and daytime tiredness in Finnish preschool-aged children-a community survey. Child Care Health Dev 2010;36:805e11. https://doi.org/10.1111/j.1365-2214.2010.01112.x.
18. Ong LC, Yang WW, Wong SW, et al. Sleep habits and disturbances in Malaysian children with epilepsy. J Paediatr Child Health 2010;46:80e4. https://doi.org/10.1111/j.1440-1754.2009.01642.x.
19. Ağca S, Görker I, Turan FN, Öztürk L. Validity and reliability of the Turkish version of Sleep Disturbance Scale for Children. Sleep Med. 2021 Aug;84:56-62. doi: 10.1016/j.sleep.2021.05.016.
20. Guideline for sleep hygiene among children aged 0□5 years:WS/T 579-2017[S]. 2017.
21. Sadeh A. A brief screening questionnaire for infant sleep problems: validation and findings for an Internet sample. Pediatrics 2004;113:e570-7. doi:10.1542/peds.113.6.e
22. Owens JA, Spirito A, McGuinn M. The Children's SleepHabits Questionnaire (CSHQ): psychometric properties of a survey instrument for school-aged children. Sleep 2000;23:1043e51
23. Mindell JA, Gould RA, Tikotzy L, Leichman ES, Walters RM. Norm-referenced scoring system for the Brief Infant Sleep Questionnaire - Revised (BISQ-R). Sleep Med. 2019 Nov;63:106-114. doi: 10.1016/j.sleep.2019.05.010.
24. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine (Phila Pa 1976). 2000 Dec 15;25(24):3186-91. doi: 10.1097/00007632-200012150-00014.
25. LYNN M R.Determination and quantification of content validity□J□.Nurs Res□1986□35 □6□□382.
26. POLIT D F□BECK C T.The content validity index□are you sure you know what's being reported? Critique and recommendations□J□.ResNurs Health□2006□29□5□□489-497.
27. Hair J, Anderson R, Babin B, et al. Multivariate data analysis: a global perspective, vol. 7. Upper Saddle River, NJ: Pearson; 2010.
28. Brown TA. Confirmatory factor analysis for applied research. New York:Guilford Press; 2006.
29. Chen Yang yang, Zhou Nan. Research progress on sleep problems in Preschool children in China[J].Chinese Journal of School Health,2020,41(9):1433-1437. DOI:10.16835/j.cnki.1000-9817.2020.09.044.
30. Feng Weiwei, Pan Xiaoping, Wang Huishan, et al.Development and evaluation of the Chinese Infants Sleep Assessment Scales[J].Chinese Journal of Child Health Care,2021,29(5):468-472. DOI:10.11852/zgetbjzz2020-1376.
31. Sateia MJ. International classification of sleep disorders-third edition: highlights and modifications. Chest. 2014 Nov;146(5):1387-1394. doi: 10.1378/chest.14-0970.
32. American Academy of Sleep Medicine□International Classification of Sleep Disorders□3rd ed □M].Darien,IL:American Academy of Sleep Medicine,2014□

33. Feng Weiwei, Zhang Yue, Wang Huishan, et al.Development and evaluation of the Chinese Toddler Sleep Assessment Scale[J].Chinese Journal of Child Health Care,2021,29(12):1295-1299. DOI:10.11852/zgetbjzz2021-0272.

Figures

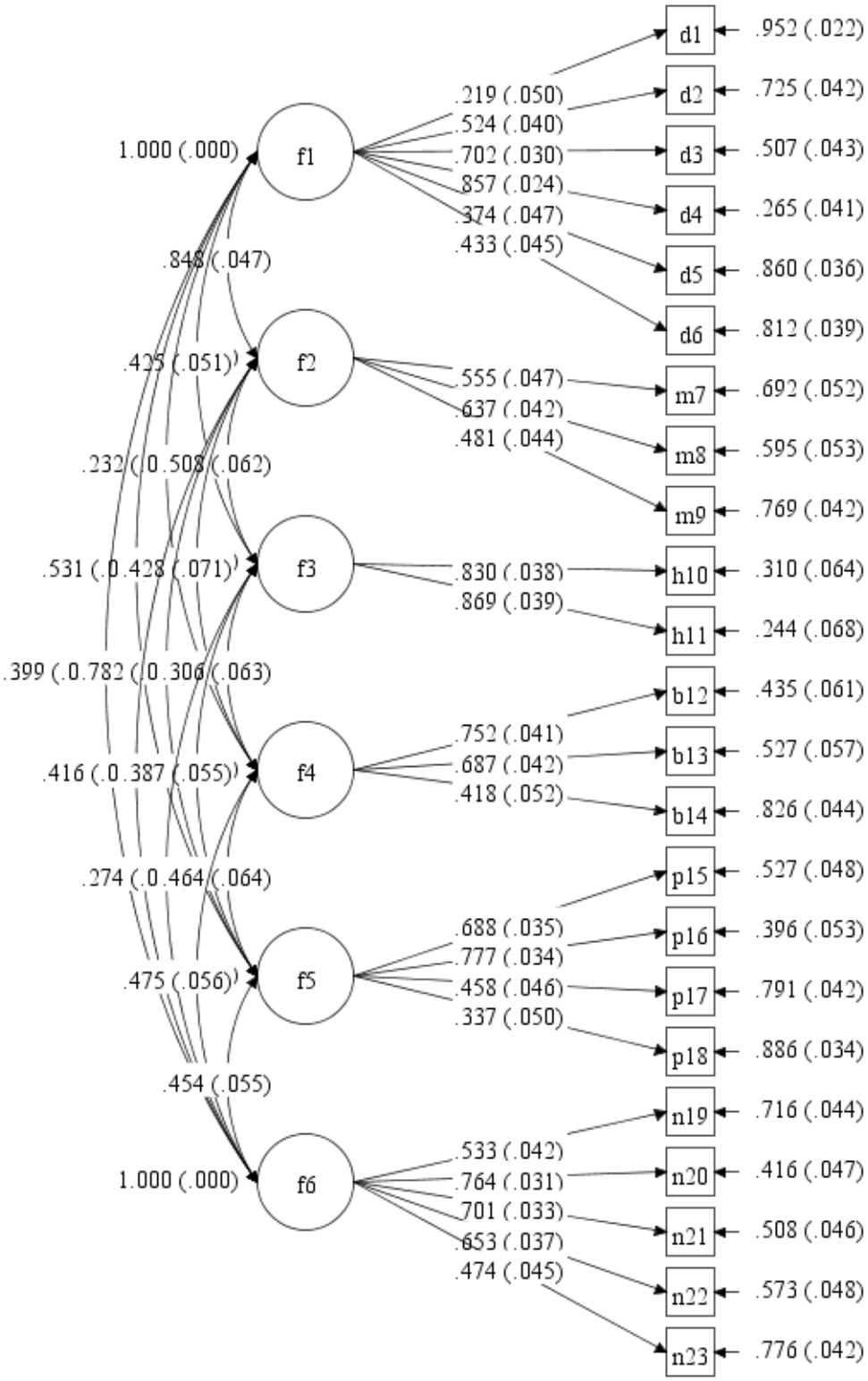

Figure 1

Model path analysis diagram.

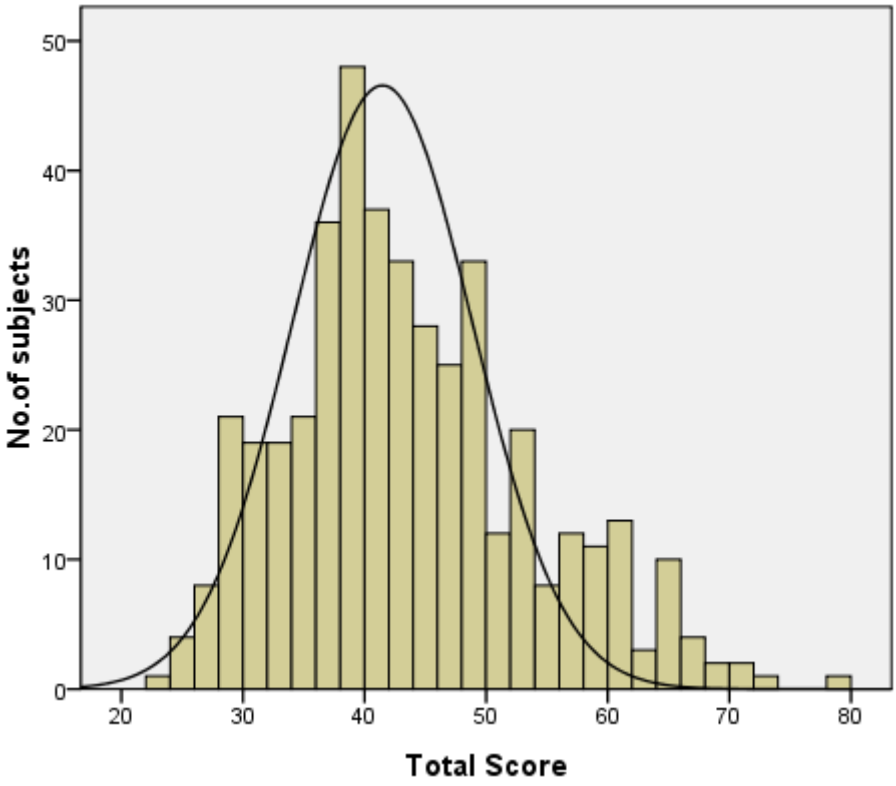

Figure 2

Distribution of the SDSC-I total score.