



Original Article

Translation and cross-cultural validation of the French version of the Sleep-Related Breathing Disorder scale of the Pediatric Sleep Questionnaire



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ABSTRACT

Background: Sleep-disordered breathing (SDB), including obstructive sleep apnea syndrome, is often underestimated because it requires a burdensome test (ie, polysomnography) to ensure diagnosis. To improve polysomnography referral, it is of utmost importance to validate efficient alternative screening tools. This study aimed to provide a translation and a cross-cultural validation of the Pediatric Sleep Questionnaire (PSQ) into French to obtain an easy-to-use and reliable screening tool. The psychometric properties of the French version were also determined.

Methods: The process of cross-cultural adaptation was carried out following these steps: forward-backward translation, evaluation by an expert committee, and pretesting of the pre-final version. Reliability of the French-PSQ version was assessed by Cronbach's alpha coefficients and Spearman's correlation on a convenient sample of 201 children (aged between 2 and 17 years). Construct validity was determined by factor analysis of principal components.

Results: Internal consistency was within an adequate range for all subscales: 0.711 for snoring, 0.559 for sleepiness, 0.682 for behavioral problems, and 0.776 for the whole questionnaire. Spearman's correlation analysis comparing questionnaires administered two weeks apart showed good correlation coefficients for all subscales (snoring: 0.642, sleepiness: 0.846, behavioral problems: 0.780, and entire SRBD scale: 0.835). Factor analysis performed to assess the structure of the French-SRBD scale confirmed the same four factors described in the original questionnaire ("breathing," "behavior," "sleepiness," and "other").

Conclusion: The French version of the PSQ has been successfully cross-culturally adapted and showed good psychometric properties, suggesting that it is useful as a tool to screen sleep-disordered breathing in French-speaking children.

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1. Introduction

Obstructive sleep apnea (OSA) is characterized by repetitive episodes of prolonged partial upper airway obstruction and/or intermittent complete obstruction that disrupts normal ventilation during sleep [1]. The reported prevalence of pediatric OSA ranges

from 1% to 4%, although it is very likely underestimated because of a high proportion of undiagnosed cases [2]. Untreated sleep-disordered breathing (SDB) can have serious effects in young patients, leading to growth failure [3,4], neurocognitive deficits with learning delays [5,6], and behavioral disorders (inattention and hyperactivity) [7,8]. A large number of both daytime and nighttime clinical signs and symptoms are used to evaluate the possibility of sleep disorders in children, of which the most common etiology is adenotonsillar hypertrophy. The reference standard for the diagnosis and assessment of SDB is nighttime polysomnography (PSG) recording [9,10]. Most of the time, PSG requires an overnight stay at a sleep laboratory to monitor the electrical activity of the brain, movements of facial muscles and eyes, and respiratory activity. However, PSG is time-consuming, expensive, or not always available. Questionnaires have been developed to assess sleep disorders in children. According to the literature, these questionnaires are useful, easy-to-use, reliable, and inexpensive. Moreover, they are adapted to screen children for OSA in clinical and epidemiological studies. Additionally, they often represent the only means to collect data about past medical history and current elements that can range from simple isolated snoring to obstructive sleep apnea. The questionnaire survey may allow for a pre-selective sorting of candidates for polysomnography.

According to the European Respiratory Society Task Force on SDB diagnosis and management, if PSG is not available, it is possible to use validated questionnaires such as the Pediatric Sleep Questionnaire (PSQ) or the Sleep Clinical Record [11]. The PSQ, and in particular the Sleep-Related Breathing Disorder (SRBD) scale developed by Chervin and colleagues, correctly classify 86% of cases. This questionnaire takes into account diurnal and nocturnal symptoms, along with neurobehavioral complications of OSA [12,13]. Authors agree that the validated PSQ has a diagnostic accuracy sufficient to be used as a screening tool for SDB [10,14,15]. Translated into Spanish [16], Turkish [17], Malaysian [18], Chinese [19] and Portuguese [20], this widely used questionnaire has not yet been translated into and validated in French.

This study aimed to validate the translated and culturally adapted version of the PSQ-SRBD scale on a cohort of French children.

2. Methods

2.1. The instrument/questionnaire

The original version of the PSQ or the SRBD scale is a questionnaire that can be auto-administered to parents of children aged 2–18 years. It consists of 22 closed-response questions based on the prominent symptom-complexes of sleep disorders including snoring, daytime sleepiness, and inattentive or hyperactive behavior. Three subscales of the SRBD questionnaire have also been validated: “snoring” (items 1 to 4), “sleepiness” (items 10 to 13) and “behavior” (items 17 to 22). The SRBD scale showed a sensitivity of 81% and a specificity of 87% to detect children with OSA [12].

Possible answers include “yes,” “no” or “don’t know,” which are weighted as 1, 0, or missing, respectively. The overall score is obtained by calculating the mean of the scores of all items excluding the missing items. The optimal threshold value has been set at 0.33 (cutoff value: 33% of 22 questions answered positively). Thus, a score greater than 0.33 is considered positive and suggests the presence of pediatric SDB [12].

2.2. Study population

In this cross-sectional study, the sample was selected by convenience and included parents of children aged 2–17 years

admitted to the Odontology Center of the Rothschild Hospital (Assistance Publique – Hôpitaux de Paris) for dental care in pediatric dentistry (general population without particular risk factors) from April 2015 to October 2016. Only children whose parents perfectly understand French were eligible for inclusion. Children with craniofacial malformation, neuromuscular diseases, and chronic respiratory pathology, including asthma, were excluded. To calculate the sample size, we applied the rule of two to 20 subjects per item ratio recommended by Kline [21]. Terwee et al., also recommended a sample size greater than 100 to be adequate [22]. Therefore, we chose to select ten subjects per item, which involved the recruitment of 220 children to test the questionnaire. In comparison, Chervin et al., validated the SRBD scale with 162 subjects [12].

2.3. Translation and cross-cultural adaptation of the PSQ/SRBD

This process consisted of two phases: the translation of the PSQ/SRBD into French and its validation in a French pediatric cohort. The cross-cultural adaptation is aimed to maximize the attainment of semantic and conceptual equivalence between different language questionnaires. Thus, the version resulting from the translations fulfilled four criteria: clarity of the translation, use of vocabulary accessible to all (avoiding technical terms), use of correct grammatical terms, and neutral style and conceptual equivalence in line with the content of the original questionnaire. This process was carried out following steps recommended by Beaton et al. [23] including (1) forward translation of the questionnaire from English into French by two translators; (2) synthesis of the two translations; (3) back-translation; (4) evaluation by an expert committee; and (5) pretesting of the penultimate version.

Two native French translators who were perfectly bilingual translated each item of the English version of the SRBD scale independently. A committee compared the two translations, and differences were discussed. The translation process favored a conceptual rather than a literal translation and resulted first in a consensual French version of the questionnaire. Then, this version was subsequently back-translated into English by two independent translators who were blind to the original English version. Next, the committee compared the two back-translations to the original questionnaire to verify the literal, conceptual, and semantic equivalences. Very few discrepancies were found, which indicated a satisfactory back-translation, and a pre-final version of the questionnaire was obtained. This penultimate version was pre-tested on 20 parents by two investigators to assess clarity, appropriateness, and cultural relevance (ie, appropriate cultural adaptation). During this evaluation, one investigator asked questions, while the other investigator noted respondents' remarks on the items to evaluate their understanding. After a few minor adjustments, the French version of the SRBD scale was finalized (Appendix A).

2.4. Ethics approval

Permission to translate the SRBD scale into French was obtained from the first author (RD Chervin) and the University of Michigan, USA. This study was declared to the National Commission for Data Protection and Liberties (CNIL-France) and approved by the Research Project Ethics Evaluation Committee of the Robert Debré hospital in Paris (n°: 2016/281-2). An information note was provided to each parent who signed a consent form to participate in this study. Parents were instructed to anonymously self-complete the questionnaire.

2.5. Statistical analysis and validation

The data sets were analyzed using SPSS (Statistical Package for Social Science), version 24.0 (SPSS, Inc., USA). P-values < 0.05 were considered to be statistically significant. Descriptive analyses of the study population were performed. Data are expressed as the mean and standard deviation or median and range. Occasional missing answers or response of “don't know” were ignored because these comprised less than 10% of the responses [24].

The psychometric properties of the French-SRBD scale were determined in order to evaluate its performance. In the present study, we assessed the internal consistency, reliability, and test-retest reliability of the French-SRBD. Moreover, we tested the content and construct validity of the PSQ/SRBD. For reliability, the internal consistency of each scale was calculated using Cronbach's alpha [25], which measured the average correlation coefficient between each item and the scale. A value ≥ 0.7 indicated adequate reliability, 0.5 to 0.7 moderate, 0.2 to 0.4 fair, and ≤ 0.2 low reliability according to the recommendations of Nunnally and Bernstein for group comparisons. The cohesion of the questionnaire was evaluated from the correlation between subscales and between each subscale and the total of items [26]. The temporal stability of item responses was evaluated by test-retest reliability. Sixty-six parents completed the questionnaire twice, 15 days apart. Test-retest was evaluated using Spearman's correlation coefficient.

Content validity was assessed by a qualified pediatric pulmonologist (ie, it was verified that the items translated into French were relevant and correctly reflected the different aspects of sleep-disordered breathing). The correlations between the items and the entire questionnaire or the different subscales were tested using Pearson's correlation coefficient test. A value greater than 0.3 was considered a moderate correlation, whereas 0.8 and above was considered a strong correlation [27].

Construct validity was determined by confirmatory factor analysis of principal components with oblique rotation (Promax). Principal Component Analysis (PCA) is the most widely used extraction method and the most appropriate when the objective is to reduce the number of items to a smaller number of representative factors [12,28]. According to Hair et al., oblique rotation is more flexible and realistic because the theoretically underlying factors are not assumed to be uncorrelated with each other [24].

3. Results

3.1. Translation and adaptation of the SRBD scale

The translation/back-translation process did not lead to any major difficulties. The committee discussed only two items that could be better adapted to context or French expression. Question 19, “is easily distracted by extraneous stimuli” became “is easily distracted by everything going on around him,” and question 21 “driven by a motor” became “comme une pile” (like a battery). During the pretest, the French version of the questionnaire did not raise questions from parents.

3.2. Characteristics of the study population

We included 220 parents, 19 of which ultimately did not complete the questionnaire (91.4% participation). The study sample consisted therefore of 201 parents; the mean age (SD) of their children [104 girls (51.7%) and 97 boys (58.3%)] was 6.3 (2.8) years. The majority of respondents were the children's mother, at 78.1%.

Overall, the rate of “don't know” responses was 2.2% on average for the 22 questions, ranging between 0 and 7% depending on the items.

The calculation of body mass index [29] revealed that 79.3% of children had normal body weight, 12% were overweight, and 8.6% were obese (Table 1). Descriptive data of all French-SRBD items are presented in Table 2.

3.3. Reliability of the French-SRBD scale

The French-SRBD scale showed an adequate level of internal consistency, with a Cronbach's alpha coefficient of 0.776 for the total items, 0.711 for the snoring scale, 0.559 for the sleepiness scale, and 0.682 for the behavioral problems scale (Table 3). Regarding the long-term stability of the questionnaire, the correlation between the test and re-test was significant. Spearman's correlation coefficients were 0.835 for the total SRBD scale ($p < 0.005$), 0.642 for the snoring scale ($p < 0.005$), 0.846 for the sleepiness scale ($p < 0.005$), and 0.780 for the behavioral problems scale ($p < 0.005$).

3.4. Construct validity of the French-SRBD scale

The Pearson's correlation coefficients of the four items of snoring and sleepiness subscales as well as the six items of the behavior scale were significant (Table 4).

Before the application of the factor analysis, it was statistically verified that the data matrix had enough correlations; to do that, Bartlett's test of sphericity, a statistical test for the presence of correlations among the variables, and the measure of sampling adequacy (Kaiser-Meyer-Olkin index) were applied. The calculation of the Kaiser-Meyer-Olkin (KMO) index confirmed sampling adequacy, with a value of 0.721. Bartlett's test of sphericity was significant ($\chi^2 = 796.075$; $df = 231$; $p < 0.005$) indicating that the correlation matrix is suitable for factoring.

Before rotation, factor analysis by the principal components method revealed seven factors with an eigenvalue greater than 1, explaining 61.16% of the cumulative variance. After rotation, the final number of factors to be retained was based on the following three criteria (Fig. 1): factors with eigenvalues greater ≥ 1 , scree plot (extracted factors must be before inflection and eigenvalue > 1), and a predetermined number of factors based on documented factor structure [24,28,30,31]. We took these considerations into account; then, to confirm the presence of factors already known to and described by Chervin et al., in their original questionnaire, four factors were extracted and then compared to the factors of the original questionnaire, and named accordingly [12].

Factor structure is shown in Table 5, and the majority of the items presented the highest loading weight in the domains

Table 1
Characteristics of the sample.

Characteristics	n (%)
Gender, n (%)	
Male	97 (48.3)
Female	104 (51.7)
Age, years	
Mean \pm SD	6.29 \pm 2.8
Median	6.00
Range	2–16
Parents, n (%)	
Father	42 (20.9)
Mother	157 (78.1)
Legal representative	2 (1.0)
Body Mass Index, n (%)	
Normal	92 (79.3)
Overweight	14 (12.1)
Obesity	10 (8.6)

Table 2
Descriptive statistics for items of the French-SRBD (n = 201).

		Items	Yes n (%)
1	A2	Snore more than half the time	41 (20.4)
2	A3	Always snore	8 (4)
3	A4	Snore loudly	30 (14.9)
4	A5	Have “heavy” or loud breathing	46 (22.9)
5	A6	Have trouble breathing, or struggle to breathe	8 (4)
6	A7	Stop breathing during the night	8 (4)
7	A24	Tend to breathe through the mouth during the day	36 (17.9)
8	A25	Have a dry mouth on waking up in the morning	45 (22.4)
9	A32	Occasionally wet the bed	63 (31.3)
10	B1	Wake up feeling unrefreshed in the morning	86 (42.8)
11	B2	Have a problem with sleepiness during the day	30 (14.9)
12	B4	Has a teacher commented that your child appears sleepy during the day	22 (10.9)
13	B6	It is hard to wake your child up in the morning	58 (28.9)
14	B7	Does your child wake up with headaches in the morning	8 (4)
15	B9	Did your child stop growing at a normal rate at any time since birth	11 (5.5)
16	B22	Is your child overweight	11 (5.5)
17	C3	Does not seem to listen when spoken to directly	60 (29.9)
18	C5	Has difficulty organizing tasks and activities	43 (21.4)
19	C8	Is easily distracted by extraneous stimuli	104 (51.7)
20	C10	Fidgets with hands or feet or squirms in seat	54 (26.9)
21	C14	Is “on the go” or often acts as if “driven by a motor”	78 (38.8)
22	C18	Interrupts or intrudes on others	84 (41.8)

Table 3
Scoring internal consistency and test-retest reliability.

French-SRBD scales	Cronbach's Alpha (consistency)	Spearman's Correlation* (test-retest)
	n = 201	n = 66
Snoring (4 items)	0.711	0.642
Sleepiness (4 items)	0.559	0.846
Behavior (6 items)	0.682	0.780
VF-SRBD (22 items)	0.776	0.835

*p < 0.005.

allocated by Chervin et al. [12], in the original questionnaire: “breathing,” “behavior,” “sleepiness” and “other.” There were two differences between the factors of the original questionnaire and the translated version. In the French version, the item “is your child overweight” belonged to the domain “breathing” (instead of “other” in the original version), while the item “does your child wake up with headaches in the morning” belonged to the factor “sleepiness” (instead of “breathing” in the original scale). All items

Table 4
Pearson's correlation coefficients.

item	French-SRBD subscales	Pearson's correlation*	
		n = 201	
1	Snoring (4 items)		
	A2	Snore more than half the time	0.838
2	A3	Always snore	0.586
3	A4	Snore loudly	0.765
4	A5	Have “heavy” or loud breathing	0.686
	Sleepiness (4 items)		
10	B1	Wake up feeling unrefreshed in the morning	0.767
11	B2	Have a problem with sleepiness during the day	0.602
12	B4	Your child appears sleepy during the day	0.527
13	B6	It is hard to wake your child up in the morning	0.713
	Behavior (6 items)		
17	C3	Does not seem to listen when spoken to directly	0.624
18	C5	Has difficulty organizing tasks and activities	0.537
19	C8	Is easily distracted by extraneous stimuli	0.687
20	C10	Fidgets with hands or feet or squirms in seat	0.598
21	C14	Is “on the go” or often acts as if “driven by a motor”	0.660
22	C18	Interrupts or intrudes on others	0.547

*p < 0.005.

belonged to only one factor, except two items that saturated with a significant close value with the right factors. Item C5 correlated with factor 3; however, the logic of these factors allowed this item to be regarded as belonging to factor 2. The same reasoning could be followed for item A24, which correlated with factor 1 instead of factor 4.

We calculated the questionnaire score of each participant as the mean (SD). The French-SRBD scale score was 0.216 (0.16), ranging between 0 and 0.773. The distribution of respondents by percentage of scores showed that 19.9% of children scored ≥ 0.33 (cutoff value).

4. Discussion

The SRBD is an instrument used to screen for OSA even though PSG remains the current reference standard for diagnosis. However, given that the use of PSG is restrictive, it is important to have a valid and more accessible screening tool. The performance of the SRBD scale to reveal signs of SDB was proven by the authors [12] with significantly high sensitivity (0.85) and specificity (0.87). The PSQ

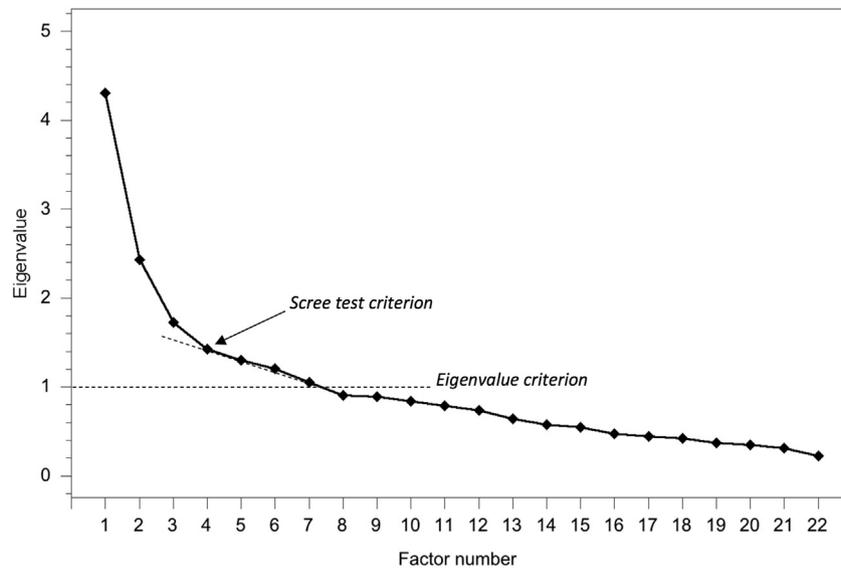


Fig. 1. Factor analysis of principal components, scree plot of eigenvalues.

Table 5

Factor structure of the French-SRBD questionnaire.

		Factor 1	Factor 2	Factor 3	Factor 4
French-SRBD items		<i>breathing</i>	<i>behavior</i>	<i>sleepiness</i>	<i>other</i>
A2	Snore more than half the time	0.784			
A6	Have trouble breathing, or struggle to breathe	0.712			
A4	Snore loudly	0.663			
A3	Always snore	0.635			
A7	Stop breathing during the night	0.554			
A5	Have "heavy" or loud breathing	0.542			
B22	Is your child overweight	<i>0.469</i>			
A25	Have a dry mouth on waking up in the morning	0.445			
A24	Tend to breathe through the mouth during the day	0.357			0.411
C8	Is easily distracted by extraneous stimuli		0.737		
C14	Is "on the go" or often acts as if "driven by a motor"		0.672		
C3	Does not seem to listen when spoken to directly		0.611		
C18	Interrupts or intrudes on others		0.553		
C10	Fidgets with hands or feet or squirms in seat		0.506		
C5	Has difficulty organizing tasks and activities		0.326	0.462	
B7	Does your child wake up with headaches in the morning			<i>0.755</i>	
B4	Has a teacher commented that your child appears sleepy during the day			0.741	
B2	Have a problem with sleepiness during the day			0.679	
B6	It is hard to wake your child up in the morning				0.777
B1	Wake up feeling unrefreshed in the morning				0.766
A32	Occasionally wet the bed				0.296
B9	Did your child stop growing at a normal rate at any time since birth				0.252

Items in bold present highest loading as in the original version; items in italic indicate highest loading on other factors than the original; items with a gray background designate items saturating with a significant close value with the good factor.

questionnaire has been adapted to other languages [16–20] and has demonstrated its utility on childhood OSA.

The present study described the cross-cultural adaptation and validation of the French version of the SRBD scale. In this process, we followed the international recommendations for transcultural adaptation [23]. Indeed, while translating the questionnaire, it was necessary to adapt items 19 and 21 because of different cultural expressions without changing the meaning, like the Malaysian version [18].

The French-SRBD scale showed adequate internal consistency with a correct Cronbach alpha value for the four subscales. Similar results were found for the reliability of the Spanish, Turkish, Malaysian, Chinese and Portuguese versions of the questionnaire and as reported by Chervin et al., for the original version [12,16–20]. Test-retest reliability of the questionnaire, evaluated by Spearman's correlation was high, suggesting that the scores remained stable over two weeks. These results were similar to those reported by Chervin et al., and in the Malaysian, Chinese and Portuguese adaptations [12,18–20]. These results allow us to consider that the French-SRBD is reliable.

A Pearson's correlation was run to assess the relationship between the items and the subscales. There was a strong correlation between the items of each subscale, indicating good validity of the linguistic constructs.

Factor analysis has shown that the questionnaire could be divided into the same dimensions as the original American SRBD (“breathing,” “behavior,” “sleepiness” and “other”). In our validation study, there were slight differences between the results of the factor analysis of the French-SRBD and the original version, similar to what was observed with the Chinese version [19]. It can be assumed that these minor differences were related to linguistic and cultural specificities [12]. The other foreign adaptations did not evaluate construct validity by factor analysis.

Adenotonsillar hypertrophy is the primary cause of OSA. However, apart from this etiology, SDB symptoms are common in pediatric populations with congenital craniofacial anomalies and syndromes or with moderate craniofacial problems such as vertical growth direction, mandibular retrognathia or hyperdivergence, maxillary endognathia or retrognathia, and a narrow ogival palate [32–35]. Dentists and orthodontists who see children regularly are therefore particularly well placed to identify the symptoms of SDB, especially if the clinical examination is associated with the SRBD-scale.

Thus, the French-SRBD questionnaire is a reliable screening tool that can be used by dentists or orthodontists to improve the referral process to sleep specialists.

The present study has some strengths and limitations. We applied a strict protocol of back-translation as described by Beaton et al., [23], to translate into French the original SRBD questionnaire, we carried out a complete cross-cultural adaptation of the questionnaire, we tested its content and construct validity, and we validated its internal consistency and reliability. However, we did not validate the diagnostic accuracy of the questionnaire, in terms of sensibility and specificity against a gold standard (eg, polysomnography). This definitely represents an objective for further research. Moreover, future studies in different populations (eg, age) should verify the psychometric properties of this instrument.

5. Conclusion

In conclusion, the French-SRBD scale has been successfully translated and cross-culturally adapted. It showed similar psychometric properties as the original English questionnaire, with the same factorial structure, suggesting that it may be used to assess

SDB in French pediatric populations. Future studies will determine the relevance of the use of this translated questionnaire.

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Conflict of interest

The authors declare that they have no conflicts of interest.

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: <https://doi.org/10.1016/j.sleep.2019.02.021>.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.sleep.2019.02.021>.

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