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ORIGINAL ARTICLE

Validation of the Chinese version OSA-18 quality of life questionnaire in Taiwanese children with obstructive sleep apnea☆

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Background/Purpose: The OSA-18 questionnaire is one of the most widely-used sleep quality measurements in children. We tested the applicability and cross-cultural validation of the traditional Chinese version OSA-18 questionnaire.
Methods: This cross-sectional study was conducted in a tertiary medical referral center. The translation and cultural adaptation of the OSA-18 questionnaire were performed based on Brislin's revised model. A total of 109 children aged 2–18 years old with sleep problems were recruited. Overnight polysomnography and the OSA-18 questionnaire were administered. The reliability and validity of the traditional Chinese version of OSA-18 questionnaire were verified.
Results: Excellent test–retest reliability and good internal consistency were achieved, and the validity of OSA-18 with overnight polysomnography was confirmed. The domain of sleep disturbance, daytime function, caregiver concerns, and the OSA-18 total scores were significantly higher in sleep apnea patients. The domain of caregiver concern had the highest score, while

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those of emotional distress had the lowest scores. The optimal cut-off point of the OSA-18 total scores for detecting obstructive sleep apnea was 67.
Conclusion: The traditional Chinese version of OSA-18 demonstrated high reliability and good validity in our study. The domain of caregiver concern is the major element in Taiwanese children with sleep-disordered breathing.

Introduction

Sleep-disordered breathing (SDB) includes a spectrum of upper airway disorders ranging from primary snoring to obstructive sleep apnea (OSA).[1] The prevalence of OSA in children is reportedly 1—3%, while 9—10% are habitual snorers.[2,3] Snoring presents in almost all children with SDB, but only a few have OSA. Consequently, it is not rational to define children with OSA by snoring alone.[4]

Overnight polysomnography is the gold standard for diagnosing OSA.[5] It involves detailed laboratory evaluation of cardiopulmonary parameters and is therefore time-consuming, costly, entails a long waiting list, and not widely accessible.[6] A practical tool for the office-based screening of children with OSA is therefore desirable. The OSA-18 quality of life questionnaire was first described by Franco et al and is now the most widely-used quality of life survey for pediatric OSA in Western countries.[7,8] Review of the literature reveals that pediatric OSA has a significant impact on the quality of life, with significant improvements after adenotonsillectomy.[8,9] However, the applicability of the different language of OSA-18, including its reliability and validity, has not been verified in Taiwanese children with SDB.

The aims of the present study are to: (1) measure the reliability and validity of the traditional Chinese version of the OSA-18; (2) identify the correlation between OSA-18 total score and sleep parameters of overnight polysomnography; and (3) test the feasibility of applying OSA-18 as a screening tool in detecting pediatric OSA in clinics.

Materials and methods

The study protocol and the informed consent form were approved by the Ethics Committee of the National Taiwan University Hospital.

Study participants and setting

Children aged 2—18 years with sleep problems were recruited from the respiratory, pediatric, psychiatric, and otolaryngologic clinics between July 2009 and January 2011. The exclusion criteria were: (1) prior tonsil, adenoid, or pharyngeal surgery; (2) craniofacial anomalies; and (3) genetic disorders, neuromuscular diseases, cognitive deficits, or mental retardation.

Basic data, clinical history, and physical examination were recorded and lateral cephalometric radiographs were administered to determine adenoid size. All subjects completed the OSA-18 questionnaire on the first visit after providing written informed consent. The tonsils were graded according to the scheme proposed by Brodsky.[10] Adenoid hypertrophy was determined using lateral cephalometric radiographs to measure the adenoidal to nasopharyngeal (A/N) ratio, which was the ratio of adenoidal depth to the nasopharyngeal diameter. An A/N ratio $\geq$0.67 was considered adenoid hypertrophy.[11] The weight and height of each child were measured. The age and sex-corrected body mass index was applied for each child using established guidelines.[12]

The OSA-18 quality of life questionnaire

The OSA-18 is a caregiver-administered quality of life survey that contains 18 items divided into five subscales: sleep disturbance, physical symptoms, emotional distress, daytime function, and caregiver concerns. Each item is scored on a seven-point ordinal scale. The OSA-18 is graded to produce each item score, additional scores for five subscales, and total score. The OSA-18 total score is the sum of the 18 items, and therefore ranges from 18 (no impact on quality of life) to 126 (major negative impact). A value $>$60 was considered abnormal by a previous original study.[7]

Translation and adaptation process

The traditional Chinese version of the OSA-18 questionnaire was developed after obtaining permission from the original authors[7] using Brislin's model.[13,14] The translation from original English to traditional Chinese was first performed by two otolaryngologists in the research team. The translation was then reviewed and amended by other professionals and native speakers. Back-translation from the Chinese version into English was then performed and tested by bilingual researchers for equivalence of meaning. Through these, the traditional Chinese translation of OSA-18 was modified and polished.

All caregivers completed the questionnaire at clinics according to the sleep properties of their children. Caregivers were blinded to the results of the sleep study because they completed the questionnaires before polysomnography was administrated. Caregivers were asked to complete the questionnaires again 4 weeks later to determine the test—retest reliability of the OSA-18.

Polysomnography

Overnight polysomnography (Embla N7000, Medcare Flaga, Reykjavik, Iceland) was performed in the sleep lab following a previously described protocol.[15] The sleep stage and respiratory event was scored according to the 2007 American Academy of Sleep Medicine standard.[16] Obstructive apnea was defined as the presence of continued inspiratory effort associated with $>$90% decrease in airflow

for duration of ≥2 breaths. Hypopnea was defined as ≥50% decrease in airflow for duration of ≥2 breaths associated with arousal, awakening, or reduced arterial oxygen saturation in ≥3% of breaths. All of the sleep studies were analyzed by the same investigator to maximize inter- and intra-scorer reliability. Pediatric OSA was defined as apnea/hypopnea index (AHI) ≥1 in this study.[17]

Statistical analysis

All analyses were carried out with the SPSS software (SPSS Inc, version 15.0, Chicago, IL, USA). A value of $p < 0.05$ was considered statistically significant.

Reliability

The reliability of disease specific quality of life for children with obstructive sleep apnea 18 items survey (OSA-18) was examined by item—total correlation, test—retest reliability, and internal consistency. Pearson's correlation between the score of each item and the total score was calculated to evaluate the homogeneity of items, where a value >0.2 was regarded as appropriate. Test—retest reliability was also measured using Pearson's correlation, and a correlation coefficient of at least 0.70 was regarded as acceptable. Internal consistency was measured by Cronbach α, which required a minimum acceptable level of 0.65.[18]

Validity

The validity of OSA-18 was assessed by examining the correlation between the OSA-18 scores and external parameters, including sleep parameter (AHI), tonsil size, and adenoid size. Spearman rank correlation was used for validity analysis. Independent sample *t* test was used to compare continuous clinical characteristics, whereas the Chi-square test or Fisher's exact test were used for categorical variables. Comparisons of OSA-18 scores between different OSA groups were tested using one-way analysis of variance with Bonferroni *post hoc* procedure. Additionally, linear contrast in a general linear model was used to examine the trend of OSA-18 total score across the OSA groups with different severities.

Receiver operating characteristics analysis was applied to assess the validity of OSA-18 total score in predicting pediatric OSA and determining the optimal cut-off point in our children.

Results

Study groups

During the 19-month study, 109 children were recruited. Their mean age was 6.6 ± 3.9 years. Of these, 21 were

Table 1 Reliability and validity of each OSA-18 item, subscale and total score.

	Reliability (R)[a]		Validity (ρ)[b]		
	Consistency	Test—retest	AHI	Tonsil size[d]	Adenoid
OSA-18 total scores	0.84[c]	0.97*	0.40*	0.17	0.16
Sleep disturbance:	0.77[c]	0.92	0.48*	0.15	0.18
1. Loud snoring	0.38	0.92	0.49*	0.30*	0.26*
2. Breath holding/pauses	0.49	0.85	0.51*	0.07	0.11
3. Choking or gasping	0.50	0.80	0.39*	0.06	0.19
4. Fragmented sleep	0.58	0.93	0.09	0.19	−0.08
Physical symptoms:	0.70[c]	0.86	0.19	0.16	0.29*
5. Mouth breathing	0.47	0.93	0.29*	0.15	0.33*
6. Frequent colds or upper respiratory tract infections (URIs)	0.34	0.70	0.08	0.21	0.02
7. Rhinorrhea	0.29	0.88	0.03	0.26*	0.04
8. Dysphagia	0.30	0.80	0.10	0.20	0.04
Emotional distress:	0.78[c]	0.89	−0.04	0.05	−0.05
9. Mood swings or tantrums	0.35	0.79	−0.09	0.02	0.08
10. Aggression/hyperactivity	0.25	0.93	−0.06	−0.07	−0.05
11. Discipline problems	0.29	0.87	0.01	0.00	0.08
Daytime function:	0.62[c]	0.89	0.22*	0.11	−0.02
12. Daytime drowsiness	0.48	0.77	0.17	0.04	0.12
13. Poor attention span	0.57	0.88	0.20	−0.18	0.08
14. Difficulty awakening	0.33	0.91	0.08	0.09	0.01
Caregiver concerns:	0.79[c]	0.90	0.24*	−0.03	0.05
15. Caregiver worried over child health	0.57	0.93	0.36*	0.12	0.19
16. Caregiver concerned the child does not get enough air	0.58	0.86	0.32*	0.11	0.08
17. Caregiver missed activities	0.36	0.90	−0.04	−0.08	−0.13
18. Caregiver frustration	0.55	0.87	0.14	−0.03	−0.07

* Significant at $p < 0.05$.
[a] R for Pearson's correlation and all coefficients were significant at $p < 0.05$.
[b] ρ for Spearman rank correlation.
[c] Consistency of the subscales was measured by Cronbach α coefficient.
[d] Size was graded as 1 for 0—25% obstruction, 2 for 26—50%, 3 for 51—75%, and 4 for 76—100%.

Table 2 Comparison of disease specific quality of life for children with obstructive sleep apnea 18 items survey (OSA)-18 between the two groups (apnea/hypopnea index (AHI) ≥1 as obstructive sleep apnea).[a]

OSA-18	Non-OSA (n = 31)	OSA (n = 78)	p
OSA-18 total scores	58.81 ± 10.90	71.05 ± 16.77	<0.001
Sleep disturbance:	12.39 ± 4.56	16.96 ± 5.70	<0.001
1. Loud snoring	3.81 ± 1.49	5.23 ± 1.74	<0.001
2. Breath holding/pauses	1.84 ± 1.21	3.49 ± 1.93	<0.001
3. Choking or gasping	3.29 ± 1.53	4.46 ± 1.79	0.002
4. Fragmented sleep	3.45 ± 1.63	3.78 ± 1.95	0.406
Physical symptoms:	14.71 ± 3.42	16.64 ± 5.07	0.054
5. Mouth breathing	4.65 ± 1.76	5.26 ± 1.75	0.104
6. Frequent colds or upper respiratory tract infections (URIs)	4.13 ± 1.48	4.42 ± 1.71	0.403
7. Rhinorrhea	4.19 ± 1.60	4.54 ± 1.72	0.338
8. Dysphagia	1.74 ± 1.21	2.42 ± 1.69	0.044
Emotional distress:	7.94 ± 3.60	8.74 ± 3.88	0.319
9. Mood swings or tantrums	3.13 ± 1.38	3.19 ± 1.64	0.850
10. Aggression/hyperactivity	2.74 ± 1.61	3.00 ± 1.56	0.442
11. Discipline problems	1.94 ± 1.06	2.55 ± 1.52	0.041
Daytime function:	8.68 ± 2.91	10.73 ± 4.17	0.014
12. Daytime drowsiness	2.42 ± 1.36	2.97 ± 1.65	0.100
13. Poor attention span	3.16 ± 1.27	4.04 ± 1.91	0.020
14. Difficulty awakening	3.10 ± 1.37	3.72 ± 1.95	0.108
Caregiver concerns:	15.23 ± 4.40	17.97 ± 5.75	0.018
15. Caregiver worried over child health	5.65 ± 1.50	5.73 ± 1.70	0.806
16. Caregiver concerned not enough air	4.13 ± 1.96	5.26 ± 1.82	0.005
17. Caregiver missed activities	2.52 ± 1.34	3.26 ± 1.92	0.053
18. Caregiver frustration	2.94 ± 1.59	3.73 ± 1.87	0.039

[a] Data are expressed as mean ± standard deviation; comparisons were made using the unpaired t test.

toddlers (<3 years), 49 were preschool age (3—5 years), 27 were school age (6—12 years), and 12 were adolescents (13—18 years). Eighty-one children were male (74%) and 28 were female (26%). Tonsillar hypertrophy was observed in 70.6% (77/109) of all children, whereas adenoid hypertrophy was found in 68.8% (75/109). Weight status was defined by age and sex-corrected body mass index. The distribution of weight status in our study was as follows: 12 were underweight, 68 were normal weight, 14 were overweight, and 15 were obese.

Reliability and validity of the OSA-18

Reliability

Item—total correlations ranged from 0.29 to 0.58. All 18 items and all five subscales had excellent test—retest reliability, indicating good stability. The internal consistency coefficient of subscales (Cronbach α) ranged from 0.62 to 0.84. Except for daytime function, Cronbach α values of the remaining subscales were >0.70, indicating acceptable internal consistency (Table 1).

Validity

Criterion validity between each item and AHI, tonsil size, and adenoid size were examined. Items 1, 2, 3, 5, 15, and 16 significantly correlated with AHI. Tonsil size significantly correlated with items 1 (loud snoring) and 7 (rhinorrhea); while adenoid size significantly correlated with items 1 (loud snoring) and 5 (mouth breathing). With the exception of the physical symptoms and emotional distress subscales, the remaining OSA-18 subscales and total score suggested significant correlation with AHI, while physical

Table 3 Comparison of the OSA-18 scores among different age groups.[a]

	Age group				p (ANOVA)
	Toddler	Preschool	School	Adolescence	
OSA-18					
Total score	66.7 ± 16.2	66.6 ± 16.9	73.1 ± 13.6	60.5 ± 17.5	0.130
Sleep disturbance	15.2 ± 5.2	16.0 ± 6.0	16.3 ± 6.0	13.6 ± 5.1	0.540
Physical symptoms	15.8 ± 5.2	16.6 ± 5.0	16.5 ± 3.7	13.8 ± 4.8	0.321
Emotional distress	10.1 ± 4.3	7.9 ± 3.2	9.0 ± 4.0	6.9 ± 4.0	0.051
Daytime function	9.0 ± 3.7	9.6 ± 3.3	11.5 ± 4.3	11.4 ± 5.2	0.070
Caregiver concern	16.5 ± 5.9	16.9 ± 5.4	19.4 ± 5.3	14.8 ± 4.8	0.069

[a] Data are expressed as mean ± standard deviation. Comparisons among age groups were made by one-way analysis of variance (ANOVA) following Bonferroni *post hoc* procedure.

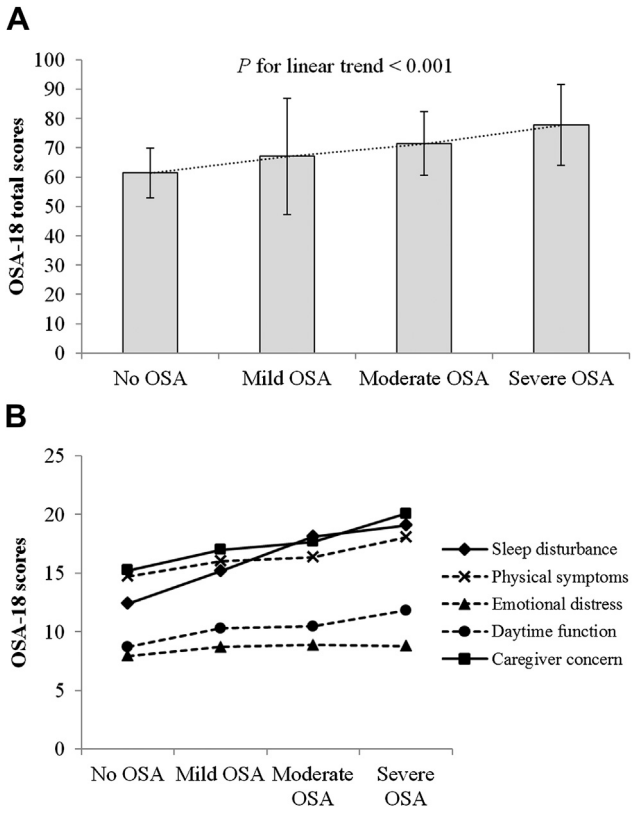

Figure 1 Comparison of the OSA-18: (A) total scores and (B) subscale scores among the four different OSA groups.

symptoms were significantly correlated with adenoid size (Table 1).

Comparison of the non-OSA and OSA groups

The children were divided into the OSA group (AHI $\geq$1, $n = 78$) and non-OSA group (AHI $<$1, $n = 31$) according to sleep parameters. Snoring, breathing pauses, nasal speech, and mouth breathing were significantly higher in the OSA group than in the non-OSA group ($p = 0.002$, 0.003, 0.020 and 0.043, respectively). Snoring was also the leading symptom in children with OSA (92%). Poor attention, excessive daytime sleepiness, and low academic performance were also more frequently reported in the OSA group, though at statistically insignificant levels.

Demographic characteristics including age, sex, history of nasal allergy, otitis media with effusion, and sinusitis were not significantly different between the two groups. Tonsillar hypertrophy was significantly more frequent in the OSA group ($p = 0.016$). Adenoid hypertrophy is also more frequently seen in the OSA group but was not statistically significant.

The mean OSA-18 total score was 71.05 $\pm$ 16.77 in the OSA group and 58.81 $\pm$ 10.90 in the non-OSA group (mean $\pm$ standard deviation), see Table 2. The OSA group also had significantly higher scores in three of the five subscales (sleep disturbance, daytime function, and caregiver concern) and in the OSA-18 total score (Table 2). Higher OSA-18 scores indicated poorer disease-specific quality of life in the OSA group. Moreover, 32% of the OSA group and 11% of the non-OSA group had an OSA-18 total score $>$80.

Comparison of the OSA-18 among age groups

The OSA-18 total score and subscale scores among different age groups were determined (Table 3). School-aged children had the highest scores in the subscales of sleep disturbance, daytime function, caregiver concern, and the OSA-18 total score. The OSA-18 subscale and total score were not significantly different between the distinct age groups.

Comparison of the non-OSA and different OSA groups

The severity of pediatric OSA was defined as mild OSA (1$\leq$ AHI $<$5), moderate OSA (5$\leq$ AHI $<$10), or severe OSA (10 $\leq$ AHI). The OSA-18 total score gradually increased among the four groups, which showed a reduced quality of life proportional to the severity of OSA. Children with severe OSA also had the highest scores in four of the five subscales (except emotional distress) as well as higher OSA-18 total scores. There were significant differences in sleep disturbance, daytime function, caregiver concern subscales, and the OSA-18 total score between severe OSA and non-OSA

Table 4 Comparison of OSA-18 among the four different obstructive sleep apnea (OSA) groups.[a]

	Study group				*p* (ANOVA)
	No OSA $<$1	Mild OSA 1$\leq$AHI $<$5	Moderate OSA 5$\leq$AHI $<$10	Severe OSA $\geq$10	
N	31	37	20	21	
Sleep disturbance	12.4 $\pm$ 4.6	15.2 $\pm$ 6.0	18.1 $\pm$ 5.0*	19.1 $\pm$ 4.9*,**	$<$0.001
Physical symptoms	14.7 $\pm$ 3.4	16.0 $\pm$ 5.2	16.4 $\pm$ 3.8	18.1 $\pm$ 5.8	0.095
Emotional distress	7.9 $\pm$ 3.6	8.7 $\pm$ 3.7	8.9 $\pm$ 4.2	8.8 $\pm$ 4.1	0.799
Daytime function	8.7 $\pm$ 2.9	10.3 $\pm$ 4.8	10.5 $\pm$ 2.9	11.8 $\pm$ 4.2*	0.041
Caregiver concern	15.2 $\pm$ 4.4	17.0 $\pm$ 6.8	17.7 $\pm$ 4.3	20.1 $\pm$ 4.5*	0.019
Total score	58.8 $\pm$ 10.9	66.8 $\pm$ 19.6	71.4 $\pm$ 10.9	78.2 $\pm$ 13.8*	0.025

*$p < 0.05$ vs. no OSA.
**$p < 0.05$ vs. mild OSA.
[a] Data are presented as mean $\pm$ standard deviation. All comparisons among groups were made by one-way analysis of variance (ANOVA) following Bonferroni *post hoc* procedure.

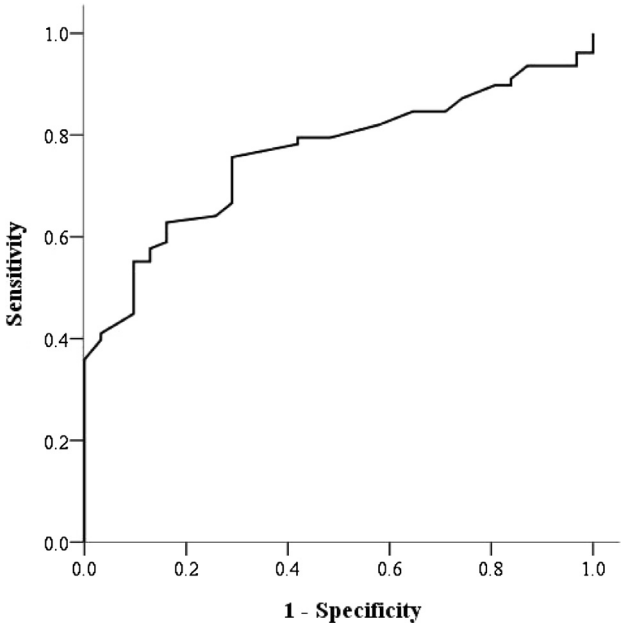

Figure 2 Receiver operating characteristic curve analysis of OSA-18 total score in predicting apnea/hypopnea index $\geq$1. Area under the receiver operating characteristic curve and its corresponding 95% confidence interval was 0.761 (0.672—0.850) with $p < 0.001$.

groups ($p < 0.001$, 0.041, 0.019 and 0.025, respectively) (Fig. 1A and 1B, and Table 4). The OSA-18 total scores were increased with the increasing severity of OSA (linear trend $p < 0.001$).

Receiver operating characteristic curve

The receiver operating characteristic curve analysis of OSA-18 total score is illustrated in Fig. 2 (95% CI = 0.672—0.850, $p < 0.001$). The optimal cut-off point of OSA-18 total score was 67, which had 63% sensitivity and 84% specificity in predicting OSA. The sensitivity, specificity, positive predictive value, negative predictive value in all participants and each age group are listed in Table 5.

Discussion

The World Health Organization in 1947 defined health as "the state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity".[19] Quality of life is now recognized as an important health outcome measure in clinical medicine. Measuring quality of life involves the use of self- or caregiver-administered instruments to quantify impact on emotional state, physical symptoms, and family interaction.

Both general and disease-specific instruments have been used to define the impact of pediatric OSA on quality of life. Validated disease-specific quality of life surveys enable clinicians to measure life quality changes before and after treatment and thus are widely used in children with sleep problems. Several disease-specific instruments, including the Obstructive Sleep Disorders-6 survey (OSD-6),[20] the Tonsil and Adenoid Health instrument,[21] and OSA-18[7] have been developed for children with OSA. The OSA-18 is the most widely-used survey for pediatric OSA and has been validated as an evaluative and discriminative instrument.[7,8] To date, however, a cross-cultural validation of the OSA-18 in Taiwanese children with OSA has not been achieved.

The traditional Chinese version of OSA-18, compared to the original version,[7] had a similar test—retest and item—total reliability to the current study. Our study demonstrated construct validity when OSA-18 was coupled with proper objective parameters, such as tonsil size, adenoid size, and AHI. Sleep studies in the original paper were from NAP studies rather than overnight polysomnography.[7] The NAP studies involve portable sleep apnea-monitoring devices and last approximately 90 minutes. According to Man et al,[22] the device is calculated to have 85.7% sensitivity and 94.7% specificity compared to standard polysomnogram tests. Interestingly, Constantin et al[6] reported poor sensitivity for detecting moderate-to-severe OSA in which nocturnal pulse oximetry was used as an objective study of sleep. The way sleep in which studies are conducted is imperative. For this reason, we applied overnight polysomnography because it is still the gold standard for the diagnosis of pediatric OSA.[23]

The OSA-18 is a care-giver administered survey that consists of five important elements in quality of life, including sleep disturbance, physical symptoms, emotional symptoms, daytime function, and caregiver concern.[7,8] Determination of those scores depends on the domain that is more influenced by the disease itself and the domain that is the major concern for caregivers, and thus the reason for medical consultation. From previous literature, emotional distress and daytime function have the lowest scores, indicating that OSA has the lowest impact on quality of life in these two domains. The domain of sleep disturbance has the highest score and is therefore the major problem for Western children with OSA.[24—29] In our study, while the domains of emotional distress and daytime

Table 5 The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) in all subjects and each age group.

	Cut-off point[a]	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
All	67	62.8	83.9	90.7	47.3
Toddler	63	78.6	85.7	91.7	66.7
Preschool	63	78.8	62.5	81.2	58.8
School	67	81.0	100.0	100.0	60.0
Adolescence	60	60.0	100.0	100.0	33.3

[a] All cut-off points were selected according to the Youden index.

function also had the lowest scores, the domain of caregiver concern had the highest score, followed by the domains of physical symptoms and sleep disturbance. We therefore found that caregiver concern was the major issue in Taiwanese children with OSA because parents take care of children in a way that reflects their culture.

The relationships between OSA-18 total score and severity of OSA were also shown in the current study. There is a consensus that children with OSA have poorer life quality than children without OSA.[21] However, controversies exist as to whether the OSA-18 scores are sensitive enough to detect OSA with different severities. Franco et al[7] reported that children with severe OSA had higher OSA-18 scores than those with moderate OSA, while children with none or mild OSA had the lowest scores. Interestingly, Mitchell et al[25] showed that children with severe

Appendix 1 Traditional Chinese version OSA-18 questionnaire.

Patient No.:

兒童阻塞性睡眠呼吸中止症生活品質問卷
(Disease specific quality of life for children with obstructive sleep apnea 18 items survey, OSA-18)

【請以最近一個月/四周內您的小孩的睡覺情況與症狀發生頻率作答，每個題目僅圈選一項，謝謝】

		從未有過	很少有過	曾經有過	約一半的時間有	大部分是如此	經常是如此	總是如此
一	睡眠障礙問題：(1～4)							
1	大聲打鼾	1	2	3	4	5	6	7
2	夜間發生呼吸中斷或停頓	1	2	3	4	5	6	7
3	睡眠時有呼吸阻塞或喘息聲	1	2	3	4	5	6	7
4	睡眠不安穩或經常驚醒	1	2	3	4	5	6	7
二	身體不適症狀：(5～8)							
5	因鼻塞而張口呼吸	1	2	3	4	5	6	7
6	經常感冒或上呼吸道感染	1	2	3	4	5	6	7
7	有鼻分泌物或黏鼻涕	1	2	3	4	5	6	7
8	吞嚥食物困難	1	2	3	4	5	6	7
三	情緒障礙問題：(9～11)							
9	情緒不穩定或脾氣暴躁	1	2	3	4	5	6	7
10	好動或有攻擊性行為	1	2	3	4	5	6	7
11	有違反紀律現象	1	2	3	4	5	6	7
四	白天功能狀態：(12～14)							
12	白天困倦或嗜睡	1	2	3	4	5	6	7
13	注意力差或精神不集中	1	2	3	4	5	6	7
14	早上不能按時起床	1	2	3	4	5	6	7
五	照顧人員(父母)關切的問題：(15～18)							
15	擔心孩子的總體健康	1	2	3	4	5	6	7
16	擔心孩子是否能呼吸到足夠的空氣	1	2	3	4	5	6	7
17	影響照顧人白天的工作或家務	1	2	3	4	5	6	7
18	因上述問題而感到挫折沮喪	1	2	3	4	5	6	7

OSA did not necessarily have poorer quality of life than children with mild SDB. The sleep studies used by these two studies were different. Moreover, the OSA-18 relies on a caregiver to evaluate a child's symptoms and behavior. Caregivers may not be able to observe the child throughout the night in the way that the recording machine does. In our study, children with severe OSA diagnosed by overnight polysomnography had higher OSA-18 scores than children with milder forms of OSA, but the differences were statistically insignificant. We might assume that the OSA-18 score is not sensitive enough to distinguish varying severities of OSA, or that children with OSA, regardless of severity, all suffer from poorer quality of life by OSA-18 scoring.

One of the main purposes of this study was to use OSA-18 to detect pediatric OSA in clinics. The OSA-18 is an easily administered, office-based survey with good reliability and validity. This is the first study to clearly calculate the cut-off point of OSA-18 for detecting pediatric OSA. Based on our study, the optimal cut-off point of OSA-18 total score for detecting OSA was 67, indicating that children with a higher total score need early referral for overnight sleep studies to define the severity of their condition. Moreover, the cut-off point of 67 yielded 63% sensitivity, 84% specificity, 91% positive predictive rate, and 47% negative predictive rate in our study. The above findings indicate that some children with OSA may be missed by the OSA-18 screen alone. The OSA-18 is a subjective life-quality measurement and may not thoroughly represent the complexities of overnight polysomnography, therefore children with other symptoms and signs suggestive of OSA still require further sleep studies.

This study does have limitations. Children with SDB were enrolled from the clinics rather than from the general population. Difficulties were encountered in collecting data from children without symptoms in the community and performing sleep studies on them. A selection-bias may exist because caregivers who come to the clinics for further medical advice may have more concerns about their children. The ages of the subjects recruited ranged from 2 to 18 years. Since airway development is quite different in children at different ages, sleeping behaviors may change with aging. The modest sample size in this study does not, however, allow us to distinguish differences in quality of life among children of different ages, sex, and weights.

In conclusion, the applicability of the traditional Chinese version OSA-18 is demonstrated by its high reliability and good validity. The OSA-18 total scores are significantly higher in children with OSA, and those with severe OSA have higher scores than those with milder forms. The domain of caregiver concern is the major issue in Taiwanese children with OSA. Further studies should be planned to measure the sleep behavior differences among children of different ages and sexes, and to determine the changes in quality of life after treatment. Post-treatment cross-cultural differences may exist.

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