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ORIGINAL RESEARCH

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Correlations between objective and subjective outcomes after adenotonsillar surgery in children with OSA

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Abstract

Objectives: To investigate whether the OSA-18 questionnaire and a postoperative patient-reported outcome measure (PROM) question correlated with polysomnography (PSG) data.

Methods: A prospective study of otherwise healthy young children with moderate to severe obstructive sleep apnea (OSA) to investigate if the obstructive apnea–hypopnea index (OAHI) before and 6–12 months after adenotonsil surgery correlated with the OSA-18 total symptom score (TSS) and the sleep disturbance subscale (SDS), as well as a PROM question on symptom improvement with responses on a 4-grade Likert scale.

Results: Of 201 children, 173 (86%) had complete data of OAHI and OSA-18 pre- and postoperatively. The mean age was 3.2 years (SD 1.0) and the mean OAHI was 15.9 (11.3). Significant correlations between changes in the OAHI and OSA-18 were found, both TSS ($r = 0.29$, $p < .001$) and SDS ($r = 0.53$, $p < .001$). A total of 136 (68%) patients responded to the PROM question, the majority of whose symptoms had disappeared ($n = 102$) or almost disappeared ($n = 30$). Four patients had unchanged symptoms, and none had worsening symptoms. A correlation was found between the PROM question and a change in the OAHI ($r = 0.36$, $p < .001$), as well as a change in the OSA-18 TSS ($r = 0.24$, $p = .006$) and the SDS ($r = 0.34$, $p < .001$). The specificity of the PROM question for prediction of a postoperative OAHI < 2 was 82%, and the sensitivity was 38%.

Conclusion: Changes in the OAHI significantly correlated with changes in the OSA-18, especially with the sleep disturbance scale, which could be an alternative for evaluation at follow-ups.

Level of Evidence: 3

Abbreviations: AHI, apnea–hypopnea index; APP, adenopharyngoplasty; ATE, adenotonsillectomy; ATT, adenotonsillotomy; HRQoL, health-related quality of life; OAHI, obstructive apnea/hypopnea index; ODI, oxygen desaturation index; OSA, obstructive sleep apnea; PROM, patient-reported outcome measure; PSG, polysomnography; RDI, respiratory disturbance index; SDS, sleep disturbance scale; TSS, total symptom score.

KEYWORDS
adenotonsillectomy, adenotonsillotomy, pediatric obstructive sleep apnea, polysomnography, sleep-disordered breathing

1 | INTRODUCTION

Pediatric obstructive sleep apnea (OSA) is the most severe form of obstructive sleep-disordered breathing (OSDB) in children. It is a common disorder with a prevalence peak among children aged 2–6 years.[1] Children with OSA and OSDB have a higher risk of morbidities, such as cardiorespiratory disorders and neurocognitive deficits, and their families have a significantly decreased quality of life.[2–5] The symptom spectrum is broad, and the diagnosis is not always clear. The standard test for the diagnosis of OSA is sleep registration with polysomnography (PSG), an advanced, resource-demanding technique.[6]

An incongruence between PSG and a child's medical history and clinical examination has been found.[7] Yet even children with primary snoring but without evident abnormal PSG findings could experience disturbing, harmful symptoms.[5,8] First-line treatment for OSA with enlarged tonsils and adenoid is adenotonsillar surgery with different techniques.

Adenotonsillar surgery is one of the most common surgical procedures among children worldwide. In Sweden, approximately 5000–8000 surgeries of this kind are performed annually.[9,10] Yet even if the adenotonsillar surgery often improves a child's signs and symptoms, it may not always cure the child of OSA. The number of persistent OSA cases differs depending on the patient's age, morbidity in the population, and the level of the apneahypopnea index (AHI) or the obstructive apneahypopnea index (OAHI). Approximately 60%–80% are cured according to different studies.[11,12] In a multicenter review, 21.6% of 578 children had an objective persistent disease with an AHI > 5.[13] There are no international guidelines with recommendations regarding the follow-up of children treated for OSA. The risk of persistent OSA is highest among children with obesity and a high preoperative AHI.[14] Polysomnography is recommended for follow-up among children with comorbidities, including obesity, since they are at a higher risk of having residual OSA and may need further treatment. PSG is a resource-demanding test, though. It is therefore not feasible to have every child who has had surgery for OSA undergo it. European guidelines recommend polygraphy or either oximetry or capnography as alternatives, but this type of follow-up for every child could also be difficult to manage.[15] The evaluation of other parameters, such as cognition,[16] behavior,[17] and quality of life,[18] have been studied using different questionnaires and patient-reported outcome measures (PROM).[10] For otherwise healthy children with OSA, this type of evaluation could be a better choice. Therefore, the aim of this study was to investigate the correlations between changes in objective and subjective outcomes after adenotonsillar surgery for young children with moderate to severe OSA.

2 | MATERIALS AND METHODS

2.1 | Study design

A prospective cohort study was performed between November 2011 and December 2017 on children who underwent adenotonsillar surgery at the Karolinska University Hospital, Department of Otorhinolaryngology in Stockholm. The participants had been enrolled in two other studies that our group had conducted.[19,20] PSG was performed, and the OSA-18 questionnaire was completed both before and after surgery. The patients' symptom degrees were assessed postoperatively with a PROM local questionnaire. The primary outcome in the present study was to investigate correlations between differences in pre and postoperative data from the obstructive AHI obtained from PSG and the OSA-18.

2.2 | Ethical considerations

Consent was obtained from all the patients' caregivers, and ethical approval was obtained from the Swedish Regional Ethics Board, Stockholm (DnR 2014/1000-31/1 and DnR 2011/333-31/4).

2.3 | Subjects

Data were collected from children between 2 and 6 years of age with moderate-to-severe OSA. A total of 10 children were obese (BMI *z*-score ≥ 1.66), but all the children were otherwise healthy. The children were randomized to either adenotonsillectomy (ATE) ($n = 126$), adenotonsillotomy with coblation (ATT) ($n = 39$), or ATE with the suturing of palatal pillars, or adenopharyngoplasty (APP) ($n = 36$).

2.4 | Polysomnography

All patients underwent overnight in-laboratory PSG at baseline and at follow-up after 6–12 months using EMBLA technology (Flaga Medical; Reykjavik, Iceland). The PSG included electroencephalography, electrooculography, electromyography, electrocardiography, pulse, oronasal airflow, transcutaneous oxygen saturation (SaO_2), respiratory movements (chest and abdomen), body position, and video and sound recordings.[21] A registered polysomnographic technologist scored all the polysomnographs manually according to guidelines issued by the American Academy of Sleep Medicine 2012.[6]

2.5 | OSA-18

Quality of life related to OSA was assessed using the OSA-18, the only validated questionnaire available in Swedish at the time. This questionnaire has shown poor validity when PSG is used to diagnose OSA, with a specificity and sensitivity of around 50% for a total symptom score (TSS) ≥ 60 and a positive predictive value to find an AHI ≥ 5 of 60% and a negative predictive value of 48%.[22] In this study, the parent/caregiver answered OSA-18 at baseline and at follow-up 6–12 months after surgery. The OSA-18 questionnaire consists of 18 items within 5 domains (seep disturbance, physical symptoms, emotional distress, daytime function, and caregiver concerns). Caregivers are asked to note how often their child has had specific symptoms in the five domains during the previous 4 weeks by scoring from 1 to 7 (1—none of the time, 2—hardly any of the time, 3—a little of the time, 4—some of the time, 5—a good bit of the time, 6—most of the time, and 7—all of the time). The TSS ranges from 18 to 126. A score above 60 is considered abnormal, and a score above 80 indicates a significant impact on quality of life.[23] The score from the sleep disturbance subscale (SDS) was calculated separately. This subscale consists of four items (loud snoring, breath-holding spells or pauses in breathing at night, choking or gasping sounds while asleep, and restless sleep or frequent awakenings from sleep), and the score can vary from 4 to 28. The Swedish version of the OSA-18 also contains a general global rating of health-related quality of life (HrQoL) using a visual analog face scale from 1 to 10, with 10 representing the "best possible quality of life."

TABLE 1 Baseline characteristics ($n = 201$)

Variable	Value
Age, mean (SD) years	3.2 (1.0)
Sex, No (%)	
Female	80 (40)
Male	121 (60)
BMI z-score mean (SD)	−0,2 (1,4)
Surgical procedure, No (%)	
Adenotonsillectomy	126 (63)
Adenotonsillotomy	39 (19)
Adenopharyngoplasty	36 (18)
Tonsil size[a], 1–4 median (range)	3 (1–4)
OAHI, mean (SD)	15.9 (11.3)
ATE	14.4 (11.4)
ATT	13.4 (7.2)
APP	23.8 (11.5)
OSA-18 TSS, median (range)[b]	64.5 (25–108)
OSA-18 SDS, median (range)[b]	18 (6–28)
HRQoL, median (range)[c]	7 (2–10)

Abbreviations: HRQoL, health-related quality of life; OAHI, obstructive apnea–hypopnea index; SD, standard deviation; SDS, sleep disturbance subscale; TSS, total symptom score.
[a]Tonsil size according to Brodsky,[25] occlusion of the oropharynx [%] 1: 0%–25%, 2: 26%–50%, 3: 51%–75%, 4: 76%–100%.
[b] $n = 194$.
[c] $n = 186$.

2.6 | PROM question

The parent/caregiver was asked: How have your child's symptoms changed after surgery? They answered by checking a box beside the response that best described the child´s situation:

1. The symptoms are gone.
2. My symptoms are almost gone.
3. My symptoms remain.
4. My symptoms have worsened.

The PROM question was asked in writing, for the majority of the patients (65%), at follow-up 6 months after surgery. For 35% of the patients, it was asked verbally by a doctor at a visit or by phone 12 months after surgery, and the responses were documented in their medical records.

2.7 | Statistical analysis

Per protocol analysis was performed. Quantitative data were presented as the mean (standard deviation) and ordinal data as the median (interquartile range) or range. The Kruskal–Wallis test was used to test for differences among > 2 groups. The Spearman's rank correlation coefficient was used to test the correlation between changes in the OAHI, RDI, and ODI with changes in the OSA-18 TSS, SDS, and the Health related quality of life (HRQoL). The PROM question was also correlated with postoperative data and changes in PSG-parameters and the OSA-18 TSS, SDS, and the HRQoL. Intention-to-treat analyses were performed after imputing the missing values of the postoperative OSA-18 and the OAHI using the last observation carried forward and backward. The correlation was interpreted as $0.1 < r < 0.39$ for weak, $0.4 \leq r < 0.69$ for moderate, and $r \geq 0.7$ for strong.[24] To evaluate the PROM question for cured OSA we used Chi-square with the dichotomized variable of postoperative OAHI < 2 as cured according to European guidelines[15] and OAHI ≥ 2 as not cured while the PROM answer "The symptoms are gone" considered as cured and any other answer as not cured. Sensitivity, specificity as well as positive and negative predictive value was calculated. Statistical analyses were performed using R Studio and Stata/SE 15.1 with the significance level defined as a two-sided p-value < .05.

3 | RESULTS

The mean OAHI at baseline for the 201 included children was 15.9 (SD 11.3). The baseline characteristics are shown in Table 1. Pre and postoperative data on the OAHI were obtained from 183 patients

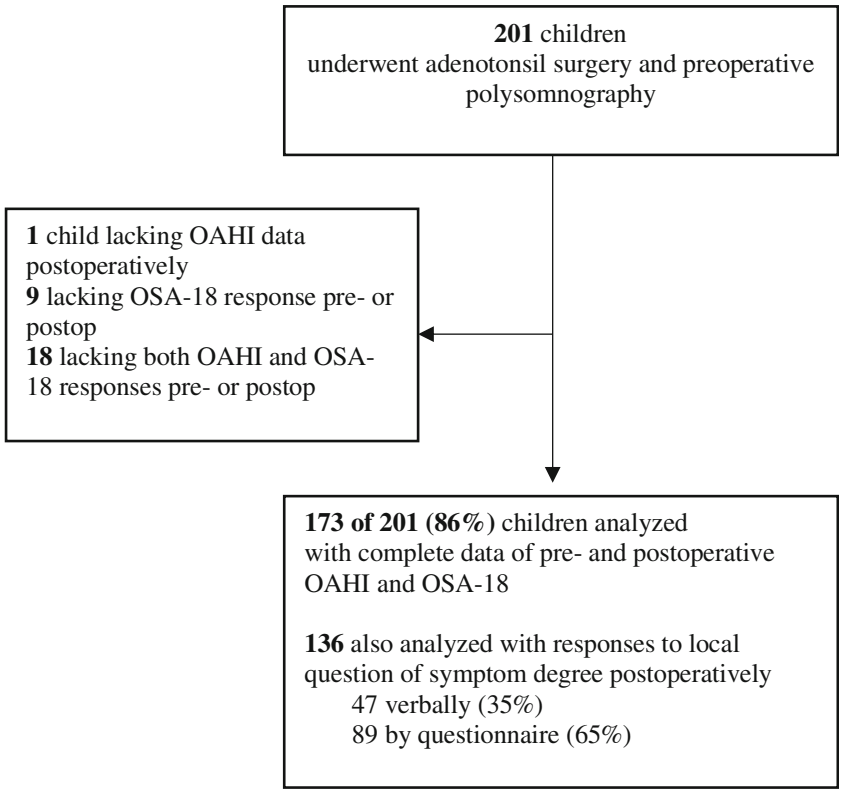

FIGURE 1 Flowchart of patients included in the per protocol analysis. OAHI, obstructive apnea–hypopnea index

(91%, 114 treated with ATE, 39 treated with ATT and 30 with APP). Pre and postoperative data of the OSA-18 were obtained from 174 children, one of them had not completed the postoperative PSG. A total of 173 (86%) patients had pre and postoperative data from both PSG and OSA-18 to analyze for correlations. Of these children, 167 (96%) had completed the HRQoL, and 136 (78%) had completed the PROM question. A flow chart of the patients is shown in Figure 1. Postoperatively, 11 children scored an OAHI > 5, 72 scored OAHI ≥ 2, and 7 scored an OSA-18 TSS > 60. The mean change in the OAHI in total was −13.8 (SD 11.5), this was the only variable that differed between the three surgical treatment arms (Table 2). The correlation between changes in the OAHI and the OSA-18 TSS showed a significant but weak correlation: $r = 0.28$, $p < .001$. The correlation between changes in the OAHI and the OSA-18 sleep disturbance subscale (SDS) was moderate: $r = 0.53$, $p < .001$ (Figures 2 and 3 and Table 3). Changes in RDI and ODI showed the same pattern as OAHI with moderate correlation to SDS. The correlation between changes in the HRQoL and the OAHI was also significant but weak: $r = -0.16$, $p = .045$ ($n = 165$). Intention-to-treat analysis did not change the results (Table 3).

The correlation between the preoperative values of the OSA-18 TSS and the OAHI was significant but weak ($r = 0.23$, $p = .002$), while the correlation between the OSA-18 SDS and the OAHI was significant and moderate ($r = 0.4$, $p < .001$). The postoperative correlation between the OSA-18 and the OAHI was not significant for the TSS ($p = .6$) but was for the SDS ($r = 0.17$, $p = .02$) (Table 3).

The median of the PROM question was 1 (range 1–3) at follow-up. No patient answered the fourth answer choice ("My symptoms have worsened"). The changes in the OAHI and the OSA-18 (TSS and SDS) were divided into three groups according to the results of the PROM question, and there were significant group differences for changes in the OAHI and the OSA-18 SDS, illustrated as boxplots in Figure 4A ($p < .001$), Figure 4B ($p = .08$), and Figure 4C ($p = .002$). The correlation between the PROM question and changes in the OAHI was $r = 0.36$, $p < .001$, and changes in the OSA-18 TSS was $r = 0.20$, $p = .03$, respectively. The correlation between the PROM question and changes in the OSA-18 SDS was $r = 0.31$, $p < .001$, while the correlation between the PROM question and the postoperative values of the OSA-18 TSS and SDS was $r = 0.36$, $p < .001$, and $r = 0.58$, $p < .001$, respectively (Table 3).

Chi-square table of "cured patients" using the cut-off value of postoperative OAHI < 2 resulted in a sensitivity of 38%, a specificity of 82%, a positive predictive value of 53% and a negative predictive value of 70% for PROM.

4 | DISCUSSION

The main finding in this prospective study of 173 young children operated on for moderate-to-severe OSA is a moderate correlation between changes in the OAHI, ODI, and RDI and the OSA-18 sleep disturbance subscale (SDS). The correlation between changes in the OSA-18 total symptom score (TSS) and changes in the OAHI was weak. The correlations between the responses from the PROM question and changes in the OAHI and the OSA-18 TSS were also weak, but they are difficult to interpret, as the majority (97%) responded

TABLE 2 Characteristics at follow-up

Variable	Treatment	*n*	Value	*p*
Age, years mean (SD)		182	4.2 (1.0)	.0004
OAHI, mean (SD)		183	2.0 (3.2)	.4
	ATE	114	2.0 (3.0)	
	ATT	39	2.2 (4.5)	
	APP	30	2.1 (1.7)	
OSA-18 TSS, median (range)		178	31 (18–82)	.7
	ATE	111	31 (18–78)	
	ATT	38	31.5 (20–59)	
	APP	29	30 (18–82)	
OSA-18 SDS, median (range)		178	6 (4–24)	.2
	ATE	111	6 (4–24)	
	ATT	38	6.5 (4–24)	
	APP	29	6 (4–20)	
HRQoL, median (range)		176	9 (4–10)	1.0
	ATE	111	9 (4–10)	
	ATT	37	9 (5–10)	
	APP	28	9 (5–10)	
ΔOAHI, mean (SD)		183	−13.8 (11.5)	.0001
	ATE	114	−12.6 (11.2)	
	ATT	39	−11.2 (9.1)	
	APP	30	−21.7 (12–2)	
ΔOSA-18, TSS, median (SD)		174	−27.5 (18.5)	.4
	ATE	107	−28 (18.7)	
	ATT	38	−26.5 (17.7)	
	APP	29	−31 (18.7)	
ΔOSA-18, SDS, median (SD)		174	−11 (6.1)	.3
	ATE	107	−11 (6.2)	
	ATT	38	−9.5 (6.2)	
	APP	29	−11 (5.4)	
ΔHRQoL, median (SD)		167	2 (2.1)	.5
	ATE	106	2 (2.3)	
	ATT	34	2 (1.9)	
	APP	27	2 (2.3)	
PROM question		136	100%	
The symptoms are gone[1]		102	75%	
My symptoms are almost gone[2]		30	22%	
My symptoms remain[3]		4	3%	
My symptoms have worsened[4]		0	0%	

Note: Δ is the changes between preoperative and postoperative values. *p*-value calculated with Kruskal Wallis-test for differences between surgical treatment groups.

with two alternatives ("My symptoms are gone," or "my symptoms are almost gone"). There was also a moderate correlation between the preoperative OAHI and the OSA-18 SDS. The sensitivity of the PROM question for cure was low (38%) and the specificity was high (82%).

Although many questionnaires are available to assess a child's subjective symptoms of OSA, such as psychometric properties and sleep disturbance,[25] the OSA-18 is the only validated questionnaire currently available in Swedish. Several studies have demonstrated poor validity for the OSA-18 TSS compared to PSG for young children for diagnostic purposes.[22,26–28] On the other hand, improvements in quality of life measured by the OSA-18 survey after adenotonsillar surgery have previously been indicated.[29,30]

Only a few studies have reported a correlation between changes in subjective and objective outcomes before and after surgical

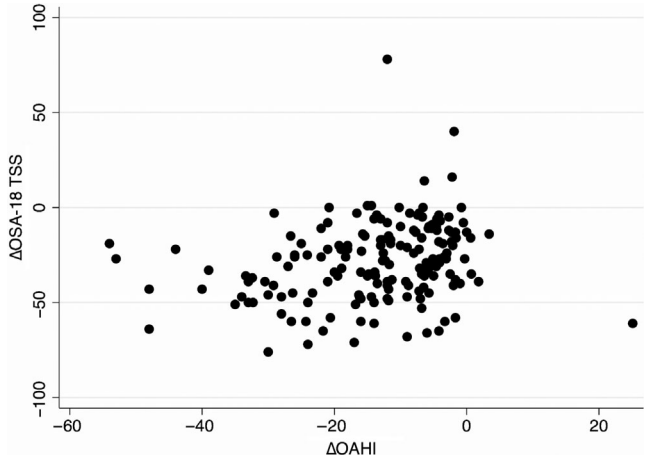

FIGURE 2 Scatterplot of differences between the pre-and postoperative values of obstructive apnea–hypopnea index (OAHI) and the OSA-18 total symptom score (TSS). Correlation $r = 0.29$, $p < .001$

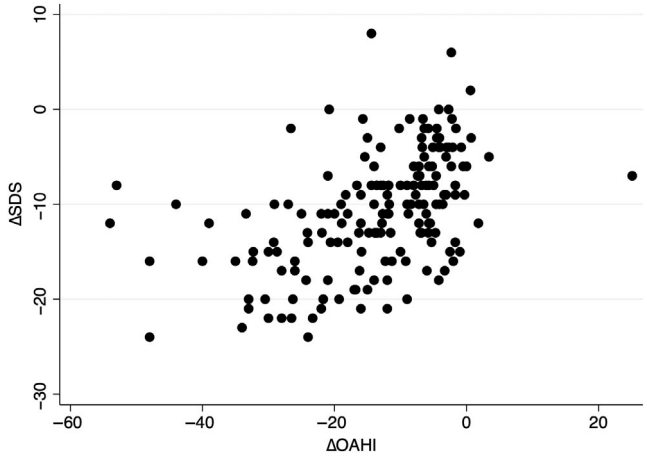

FIGURE 3 Scatterplot of differences between the pre-and postoperative values of the obstructive apnea–hypopnea index (OAHI) and the OSA-18 sleep disturbance subscale (SDS). Correlation $r = 0.53$, $p < .001$

intervention. In 2007, Mitchell et al. published a study of 79 children treated with ATE for OSA. They found a poor correlation ($r = 0.09$) between changes in the AHI and quality of life with the OSA-18 total score.[29] A Norwegian study from 2021, which included 56 children, found a non-significant correlation between changes in the OAHI and the OSA-18 TSS ($r = 0.26$, $p = .05$).[31] In a similar 2014 study of 119 children, Kang et al. compared differences in the AHI pre- and postoperatively after ATE with changes in the OSA-18 TSS. Similar to the findings of the present study, they found a significant but weak correlation ($r = 0.26$, $p = .004$) and concluded that subjective measurements improve more than objective measurements after surgery.[32] To our knowledge, no previous study has compared the correlation between changes in OSA-18 SDS and the OAHI.

Previous studies have attempted to determine the correlation between the OSA-18 and the OAHI before intervention. For instance, in a Norwegian study which included 97 children, a weak correlation between the OAHI and the TSS was found ($r = 0.21$, $p = .04$), and a stronger correlation between the SDS and the OAHI ($r = 0.51$, $p < .01$) was also indicated.[33] These results are similar to those of the present study. An American study from 2014 with 127 children also noted a significant correlation between the SDS and the OAHI before intervention ($r = 0.22$, $p = .01$)[34] but no significant correlation between the TSS and the OAHI. Similar results were reported in a Japanese study with 45 patients that found a correlation between the SDS and the OAHI ($r = 0.35$, $p = .018$),[35] but not the TSS. We have previously published a study of a mixed population of 225 children that is in line with these results that used the OSA-18 before intervention. It indicated a significant weak correlation between the AHI and the TSS ($r = 0.17$, $p < .05$) and a strong correlation between the AHI and the SDS ($r = 0.34$, $p < .05$).[22] Mitchell's 2009 study of 89 children (normal weight and obese) compared their preoperative AHI and postoperative AHI with the OSA-18 TSS, with no clinically significant correlations.[36]

Since polysomnography is rarely used to assess the outcomes of adenotonsillar surgery in children with OSA, there is limited information in the literature on its objective determination of effects. The discrepancy between subjective measurements in questionnaires and objective parameters from PSG have been discussed, and the question of whether PSG results are neglecting important issues and outcomes related to OSA has been highlighted.[37] Recent research has suggested that subjective symptom assessments are important for patients and their families and for determining the physical effects of OSDB and OSA.[8,38,39] Symptoms, such as snoring and mild OSA, have been associated with changes in brain structure,[5] neurocognitive parameters,[40] and behavior.[4] Measuring the subjective symptoms of OSA and OSDB, such as habitual snoring and quality of life, with questionnaires is also an easy, inexpensive way to evaluate a child after surgery.

The sensitivity and specificity for the PROM response "symptoms gone" versus OAHI < 2 has not been studied before. The low sensitivity of 38% but high specificity of 82% indicate a majority for true negative. However, since the variability in responses was small, the clinical importance of this PROM question is uncertain. Since 1997, the National Tonsil Surgery Register in Sweden (NTSRS) has collected data on indications for surgery. Every patient receives a follow-up 6 months after surgery, either by mail or email, with a PROM question, which is identical in its formulation and answer choices to the present study.[41] This register includes indications for tonsil surgery for all ages, but the majority (56%) are children with OSDB.[10] The results from a previous study from the NTSRS database showed that 70% of respondents noted that "my symptoms are gone," and 25% noted that "my symptoms are almost gone."[10] These results are in line with the present study in which 75% of respondents stated that "my symptoms are gone" and 22% stated that "my symptoms are almost gone." A more recent study from the NTSRS found that in the pediatric obstructive group, the proportion of respondents answering "the symptoms are gone" decreased from 85% in 2009 to 65% in 2018, a

TABLE 3 Correlations between objective and subjective data from polysomnography and questionnaires divided into pre-and postoperative categories and changes between pre-and postoperative values

Correlations	Per protocol			Intention to treat		
	N	*r*	*p*	*n*	*r*	*p*
Preoperative						
OAHI ~ OSA-18 TSS	194	0.23	.002	198	0.35	<.001
OAHI ~ OSA-18 SDS	194	**0.4**	**<.001**	198	**0.51**	**<.001**
OAHI ~ HRQoL	186	−0.07	.33			
ODI ~ OSA-18 TSS	194	0.17	.02			
ODI ~ OSA-18 SDS	194	0.35	<.001			
RDI ~ OSA-18 TSS	193	0.23	.001			
RDI ~ OSA-18 SDS	193	0.37	<.001			
Postoperative						
OAHI ~ OSA-18 TSS	177	0.04	.6	198	0.17	.01
OAHI ~ OSA-18 SDS	177	0.17	.02	197	0.28	.001
OAHI ~ PROM	136	0.19	.03	136	0.19	.03
OAHI ~ HRQoL	175	−0.08	.28			
ODI ~ OSA-18 TSS	174	0.03	.7			
ODI ~ OSA-18 SDS	174	0.06	.5			
ODI ~ PROM	133	0.22	.01			
RDI ~ OSA-18 TSS	171	0.004	.96			
RDI ~ OSA-18 SDS	171	0.21	.007			
RDI ~ PROM	132	0.36	.003			
PROM ~ OSA-18 TSS	133	0.36	<.001			
PROM ~ OSA-18 SDS	133	**0.58**	**<.001**			
Changes pre and postoperatively						
ΔOAHI ~ ΔOSA-18 TSS	173	0.28	<.001	198	0.36	<.001
ΔOAHI ~ ΔOSA-18 SDS	173	**0.53**	**<.001**	198	**0.51**	**<.001**
ΔOAHI ~ ΔHRQoL	165	−0.16	.045			
ΔOAHI ~ PROM	136	0.36	<.001	136	0.36	<.001
ΔODI ~ ΔOSA-18 TSS	173	0.20	.01			
ΔODI ~ ΔOSA-18 SDS	173	**0.42**	**<.001**			
ΔODI ~ ΔHRQoL	166	−0.03	.7			
ΔODI ~ PROM	136	0.24	.004			
ΔRDI ~ ΔOSA-18 TSS	174	0.25	<.001			
ΔRDI ~ ΔOSA-18 SDS	174	**0.46**	**<.001**			
ΔRDI ~ ΔHRQoL	167	−0.1	.2			
ΔRDI ~ PROM	136	0.34	<.001			
PROM ~ ΔHRQoL	124	−0.11	.23			
PROM ~ ΔOSA-18 TSS	129	0.20	.03	136	0.24	.004
PROM ~ ΔOSA-18 SDS	129	0.31	<.001	136	0.37	<.001

Note: Correlations calculated with the Spearman's rank correlation. Moderate correlations (*r*-values ≥ 0.4) and significant *p*-values are marked in bold.
Abbreviations: HRQoL, health-related quality of life; OAHI, obstructive apnea–hypopnea index; ODI, oxygen desaturation index, OSA-18; OSA-18 SDS, OSA-18 sleep disturbance subscale; PROM, patient-related outcome measures; RDI, respiratory disturbance index; TSS, OSA-18 total symptom score.

reduction of 20% over 10 years.[42] The authors do not have a plausible explanation for this decline, since the incidence of tonsil surgery has been stable, although the increased rate of adenotonsillotomies (instead of tonsillectomies) could have been impactful. The authors also suggest that a validated questionnaire to assess the disease burden before and after surgery may elucidate this drop.

4.1 | Strengths and limitations

A strength of the present study is its relatively large sample size and high-response rate of 87% after surgery. Moreover, the findings of the correlations between the OSA-18 sleep disturbance subscale and the PROM question versus polysomnographic OAHI have to our

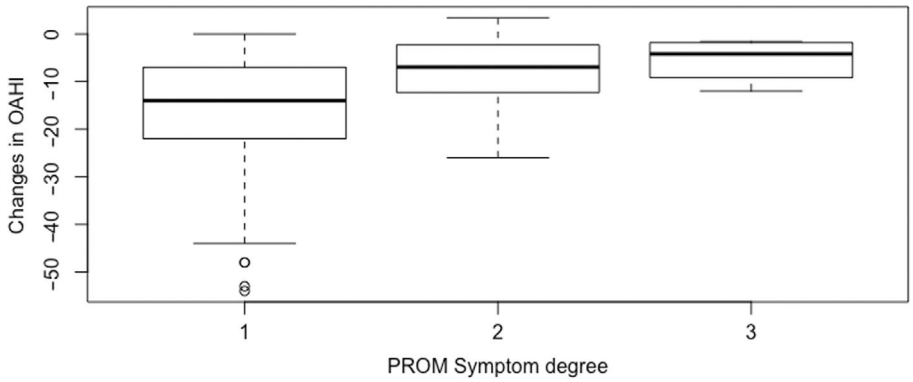

FIGURE 4A Boxplot showing changes in the OAHI divided into three groups according to the responses to the PROM question on symptom degree at follow-up: 1 = the symptoms are gone ($n = 102$), 2 = my symptoms are almost gone,[30] and 3 = my symptoms remain ($n = 4$). For group comparisons with the Kruskal–Wallis test, $p < .001$

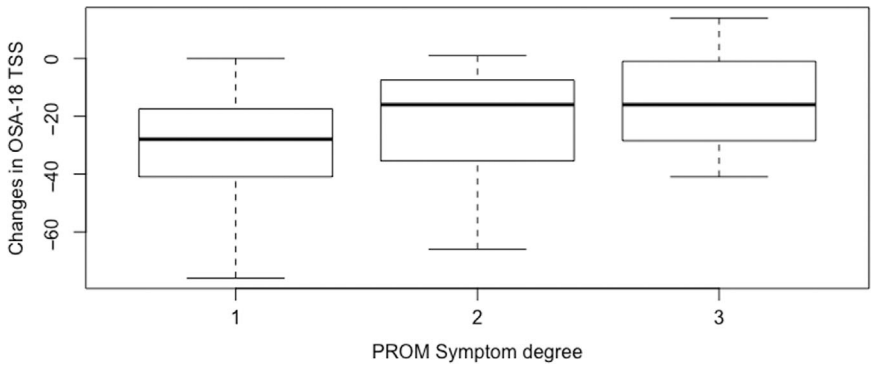

FIGURE 4B Boxplot showing changes in the OSA-18 total symptom score (TSS) divided into three groups according to the responses to the PROM question on symptom degree at follow-up: 1 = the symptoms are gone ($n = 102$), 2 = my symptoms are almost gone,[30] and 3 = my symptoms remain ($n = 4$). For group comparisons with the Kruskal–Wallis test, $p = .08$

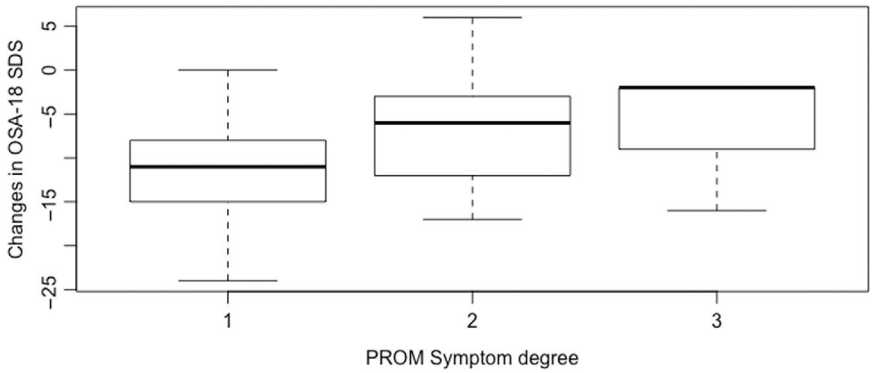

FIGURE 4C Boxplot showing changes in the OSA-18 sleep disturbance score divided into three groups according to the responses to the PROM question on symptom degree at follow-up: 1 = the symptoms are gone ($n = 102$), 2 = my symptoms are almost gone,[30] and 3 = my symptoms remain ($n = 4$). For group comparisons with the Kruskal–Wallis test, $p = .002$

knowledge not been investigated before and could be of clinical interest. The selected study population of children between 2 and 6 years of age is not well studied and therefore a strength. However, together with the high mean OAHI of 16 and the small number of obese children, the generalizability and external validity of the present study are limited. Further limitation is that the PROM question was assessed in three different ways with different follow-up times which could have affected the responses.

5 | CONCLUSION

A moderate correlation was found between changes in the OAHI and the OSA-18 SDS in otherwise healthy young children treated with adenotonsillar surgery for moderate to severe OSA. The specificity of the PROM question versus OSA-cure was high, however, since the variability in the responses was small, its clinical importance is uncertain. For the clinician, measuring changes in the OSA-18 SDS could be an alternative at follow-ups, but further studies are needed.

AUTHOR CONTRIBUTIONS

Dr Isabella Sjölander was involved in the data collection and analysis, interpreted the data, and wrote the manuscript. Dr Anna Borgström, Dr Johan Fehrm, and Dr Pia Froissart Nerfeldt were involved in the study design and the data collection and analysis and reviewed and revised the manuscript. Prof Danielle Friberg conceptualized and designed the study, coordinated, and supervised data collection, and reviewed and revised the manuscript. All authors approved the final manuscript as submitted.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest that are relevant to this article.

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