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Original Research Article

A Preoperative and Postoperative Polysomnographic Study on Obstructive Sleep Apnoea in Children Undergoing Adeno-tonsillectomy

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Abstract

Introduction: Obstructive sleep apnoea (OSA) in children is commonly associated with adeno-tonsillar hypertrophy and can lead to significant disturbances in sleep architecture, oxygenation, and quality of life. Adeno-tonsillectomy is the first-line treatment for moderate to severe paediatric OSA, but residual disease may persist in some patients. This study aimed to evaluate changes in polysomnographic parameters and quality-of-life outcomes before and after adeno-tonsillectomy and to examine the relationship between polysomnographic sleep indices and OSA-18 scores.

Materials and Methods: This longitudinal study included children aged 8-15 years with sleep-disordered breathing who underwent adeno-tonsillectomy between January 2024 and July 2025. Consecutive sampling was used. Out of the 46 enrolled participants, 42 completed the study. Overnight attended polysomnography was performed preoperatively and at 3 months postoperatively. Caregivers completed the OSA-18 questionnaire at both time points. Continuous variables were expressed as median (IQR). Pre- and postoperative comparisons were analysed using the Wilcoxon signed-rank test. Associations between variables were evaluated using Spearman's correlation, and receiver operating characteristic analysis assessed the predictive ability of preoperative OSA-18 scores for persistent moderate-to-severe OSA.

Results: The study included 42 children (23 males) with a mean age of 10.31 ± 1.99 years. Median apnoea-hypopnea index (AHI) decreased from 25.0 (IQR 8.75) to 4.0 (IQR 7.0) events/hour ($p < 0.001$). Median OSA-18 score decreased from 77.0 (IQR 24.5) to 47.0 (IQR 20.5) ($p < 0.001$). Significant reductions were also observed in respiratory disturbance index, obstructive apnoea index, obstructive hypopnea index, time with $SaO_2 < 92\%$, and central apnoea index ($p \leq 0.026$). Postoperatively, 22 children (52.38%) achieved normal AHI, while 7 (16.67%) had persistent moderate-to-severe OSA (AHI ≥ 5). OSA-18 scores showed strong correlations with AHI preoperatively ($\rho = 0.8279$, $p < 0.001$) and postoperatively ($\rho = 0.7298$, $p < 0.001$). Preoperative OSA-18 demonstrated good predictive performance for persistent moderate-to-severe OSA (AUC = 0.8735).

Conclusion: Adeno-tonsillectomy produced significant improvements in both polysomnographic indices and quality-of-life scores in children with OSA. Residual disease persisted in a few patients, particularly those with severe baseline disease.

Keywords: Adeno-tonsillectomy, Apnoea-hypopnea index, Paediatric obstructive sleep apnoea, Polysomnography, Quality of life, OSA-18 questionnaire.

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Introduction

Obstructive sleep apnoea (OSA) is one of the leading cause of sleep-related breathing disorders in children, that alters the normal ventilation and sleep pattern and is characterized by recurrent episodes of partial or complete upper airway obstruction during sleep.[1]In paediatric population, these obstructive events often causes intermittent hypoxia, hypercapnia, increased respiratory effort with marked intrathoracic pressure changes, and repeated arousals leading to disruption in the normal sleep cycle.[2] The prevalence of paediatric OSA has been estimated to range from 1% to 3%.[3] Many questionnaire-based studies have identified this prevalence to be as high as 2-4%.[4] In children, adeno-tonsillar hypertrophy is reported to be the most common cause of upper airway obstruction leading to OSA.[5]Enlarged adenoids and tonsils due to recurrent infections and immune dysregulation narrow the upper airway and predispose affected children to snoring, sleep-disordered breathing (SDB), and obstructive sleep apnoea syndrome (OSAS).[6] Long standing untreated OSA in children may cause a wide range of systemic complications including cardiovascular dysfunction, ventricular remodelling, endothelial dysfunction, neurobehavioral disturbances, nocturnal enuresis, and impaired somatic growth.[7–10] Also, severe paediatric OSA can adversely affect emotional, cognitive, and behavioural functioning of the caregivers as well as their psychological well-being.[11]

The gold standard for the diagnosis of paediatric OSA is overnight in-laboratory polysomnography (PSG), it also provides objective assessment based on parameters such as the apnoea-hypopnea index (AHI).[12] But, PSG is costly, resource-intensive, time-consuming, and it is often unavailable in many healthcare settings, particularly in low- and middle-income countries.[13] To overcome this, many validated clinical tools and quality-of-life questionnaires have been developed for evaluating the functional impact of OSA. Among these, the Obstructive Sleep Apnoea 18-Item Quality-of-Life Questionnaire (OSA-18) is one of the most widely used instruments for assessing the physical, psychological, and overall well-being of children affected by OSA.[14]

Adeno-tonsillectomy (AT) is the preferred first-line treatment for moderate-to-severe paediatric OSA and it is also one of the most frequently performed surgical procedures in children.[15] Several studies have shown that AT results in significant improvement in sleep parameters, behaviour, and quality of life in the majority of paediatric patients.[16] Despite these favourable outcomes among the majority, residual or persistent OSA has been reported in approximately 20–40% of cases, more frequently among children with obesity, asthma, allergic rhinitis, or genetic syndromes.[17] Wide variation in preoperative and postoperative evaluation methods ranging from objective PSG-based assessment to subjective symptom-based questionnaires may have led to under or over estimation of residual disease.

Many previous studies have independently evaluated PSG parameters or quality-of-life outcomes using tools such as the OSA-18 questionnaire. But relatively few investigations have examined the correlation between objective polysomnographic findings and subjective clinical improvement following adeno-tonsillectomy. Understanding this relationship is essential for accurately determining treatment efficacy and guiding postoperative follow-up strategies.

In this context, the present study was done to compare the preoperative and postoperative outcome of children undergoing adeno-tonsillectomy for OSA using overnight polysomnography along with the OSA-18 quality-of-life questionnaire. By integrating objective sleep study parameters with validated patient-reported outcomes, this study aims to provide a more holistic assessment of surgical outcomes and contribute to improved management strategies in paediatric obstructive sleep apnoea.

Materials and Methods

The current longitudinal study was conducted among children aged between 8-15 years presenting with symptoms of sleep-disordered breathing and were scheduled for adeno-tonsillectomy between January 2024 and July 2025. Consecutive sampling technique was used to enroll eligible children presenting during the study period. Children with other causes of upper airway obstruction such as macroglossia, nasal polyps, laryngomalacia, laryngeal stenosis, craniofacial anomalies, neuromuscular disorders, or previous upper airway surgery were excluded.

Sample size was calculated taking 2.8% as the prevalence of paediatric obstructive sleep apnoea as reported by Urschitz et al.[18]with a 95% confidence level and 5% absolute precision. The minimum sample size was 42 and after adjusting for 10% attrition, the final required sample size was 46. Out of the 46 children were included initially, 4 children were lost to follow up, and so the final calculations were done on data of 42 participants.

All enrolled children underwent overnight attended polysomnography preoperatively and at three months postoperatively. The study was performed using a standardized paediatric protocol with continuous monitoring of electroencephalography using central and occipital leads, electro-oculography, submental electromyography, electrocardiography, airflow measured through a nasal pressure transducer, thoracic and abdominal respiratory effort using effort belts, and oxygen saturation measured by pulse oximetry. Continuous audio-visual recording was maintained throughout the night, and all recordings were interpreted by a trained sleep physician.

Obstructive apnoea was defined as complete cessation of airflow through the nose and mouth for at least two respiratory cycles in the presence of continued or paradoxical respiratory effort. Hypopnea was noted when a reduction in airflow associated with either an arousal or a decrease in oxygen saturation of at least 4%occurred. Central apnoea was taken as the absence of both airflow and respiratory effort lasting at least 10 seconds when associated with oxygen desaturation or bradycardia, or lasting 20 seconds irrespective of desaturation.[19,20]

Apnoea-hypopnea index was calculated as the total number of obstructive apnoea and hypopnea per hour of sleep. The number of obstructive apnoea and obstructive hypopneas per hour of sleep was taken as obstructive apnoea index and obstructive hypopnea index respectively. The central apnoea index was defined as the number of central apnoea per hour of sleep. Respiratory disturbance index was defined as the total number of apnoea and hypopnea per hour of sleep irrespective of type.[20,21] Severity of AHI was classified as: mild (AHI = 5-14), moderate (AHI = 15-30), and severe (AHI > 30).[22]

Caregivers completed the OSA-18 questionnaire before surgery and during postoperative follow-up. The OSA-18 is a validated disease-specific quality-of-life instrument consisting of 18 items across five domains-sleep disturbance, physical suffering, emotional distress, daytime problems, and caregiver concerns-with scores ranging from 18 to 126, higher scores indicating greater disease burden. Its validity and usefulness in assessing symptom severity and treatment response in children with adeno-tonsillar hypertrophy have been demonstrated in the Indian population. Total score of OSA-18 questionnaire was classified as; 18–36 normal, 37–60 mild, 61–80 moderate and 81–126 severe.[23]

All adeno-tonsillectomies were performed under general anaesthesia by a single surgeon to minimize inter-operator variability. Tonsillectomy was carried out using the dissection and snare technique, and adenoidectomy was performed using an adenoid curette. Resected tissue was sent for histopathological examination. Postoperative care was standardized. Follow-up was conducted one week after surgery and again at three months, and adequacy of adenoid removal was confirmed using a lateral radiograph of the nasopharynx. Continuous variables were expressed as mean ± standard deviation or median (IQR) based on whether the data was parametric or non-parametric in nature. Preoperative and postoperative values of polysomnographic parameters and OSA-18 scores were compared using the paired t-test/Wilcoxon paired signed rank test. Pearson/spearman correlation coefficient was used to assess the relationship between changes in polysomnographic indices and OSA-18 scores. A p value <0.05 was considered statistically significant. Statistical analysis was performed using Jamovi. The study protocol was approved by an Institutional Ethics Committee. Written informed consent was obtained from parents or legal guardians prior to enrolment with or without assent from the child when applicable, and the study was conducted in accordance with the principles of the Declaration of Helsinki.

Result

The initial study population comprised 46 children. Four children were lost to follow-up, and the final study population included 42 children, 23 of whom were male. The mean age at the time of inclusion in the study was 10.31 ± 1.99 (range, 8-15) years. Twenty-five (59.52%) children were between 8-10 years, 10 (23.81%) children were between 11-12 years, and 7 (16.67%) children were between 13-15 years. Nineteen (45.24%) children were female and 23 (54.76%) were male. In the 8-10 year age group, 14 (33.33%) were female and 11 (26.19%) were male. In the 11-12 year age group, 5 (11.90%) were female and 5 (11.90%) were male. All 7 (16.67%) children in the 13-15 year age group were male.

Table 1: Comparison of preoperative and postoperative polysomnographic and OSA-18 parameters following adeno-tonsillectomy (n = 42)

Parameter	Preoperative Median (IQR)	Postoperative Median (IQR)	p value
OSA-18 score	77.0 (24.5)	47.0 (20.5)	<0.001
Time with SaO_2 <92% (min)	19.0 (12.75)	0.5 (1.0)	<0.001
Central apnoea index	3.0 (2.0)	1.0 (1.75)	0.026
Respiratory disturbance index	28.0 (10.0)	5.5 (8.0)	<0.001
Obstructive apnoea index	8.0 (6.0)	1.0 (2.0)	0.013
Obstructive hypopnea index	17.0 (3.0)	4.0 (4.75)	<0.001
Apnoea–hypopnea index (AHI)	25.0 (8.75)	4.0 (7.0)	<0.001

Pre- and postoperative comparisons showed significant improvement in both symptom scores and polysomnographic parameters following adeno-tonsillectomy.

Median OSA-18 score decreased from 77.0 (IQR 24.5) preoperatively to 47.0 (IQR 20.5) postoperatively ($p < 0.001$). Median AHI showed a substantial reduction from 25.0 (IQR 8.75) to 4.0 (IQR 7.0) ($p < 0.001$). Significant decreases were also observed in time spent with SaO_2 <92%, respiratory disturbance index, obstructive apnoea index, and obstructive hypopnea index (all $p \leq 0.013$).

The central apnoea index demonstrated a smaller but statistically significant reduction from 3.0 (IQR 2.0) to 1.0 (IQR 1.75) ($p = 0.026$). [Table 1]

Table 2: Pre- to post-operative transition of OSA-18 severity categories following adeno-tonsillectomy (n = 42)

OSA-18 severity		Postoperative				
		Normal n (%)	**Mild n (%)**	**Moderate n (%)**	**Severe n (%)**	**Total**
Preoperative	Mild	4 (66.67)	2 (33.33)	0 (0.00)	0 (0.00)	6 (14.29)
	Moderate	2 (9.52)	17 (80.95)	2 (9.52)	0 (0.00)	21 (50.00)
	Severe	0 (0.00)	7 (46.67)	5 (33.33)	3 (20.00)	15 (35.71)
Total		6 (14.29)	26 (61.90)	7 (16.67)	3 (7.14)	42 (100.00)

Preoperative and postoperative OSA-18 severity categories were compared in 42 children.

A statistically significant change in severity distribution was observed following adeno-tonsillectomy (Stuart–Maxwell test: $\chi^2 = 23.14$, df = 2, $p < 0.001$).Among the 6 children with mild preoperative OSA-18 scores, 4 (66.67%) became normal and 2 (33.33%) remained mild postoperatively. Of the 21 children with moderate preoperative scores, 2 (9.52%) became normal, 17 (80.95%) improved to mild, and 2 (9.52%) remained moderate.

Among the 15 children with severe preoperative scores, 7 (46.67%) improved to mild, 5 (33.33%) improved to moderate, and 3 (20.00%) remained severe. [Table 2]

Table 3: Pre- to post-operative transition of AHI severity categories following adeno-tonsillectomy (n = 42)

AHI severity		Postoperative				
		Normal n (%)	**Mild n (%)**	**Moderate n (%)**	**Severe n (%)**	**Total**
Preoperative	Mild	4 (80.00)	1 (20.00)	0 (0.00)	0 (0.00)	5 (11.90)
	Moderate	17 (54.84)	11 (35.48)	3 (9.68)	0 (0.00)	31 (73.81)
	Severe	1 (16.67)	1 (16.67)	2 (33.33)	2 (33.33)	6 (14.29)
Total		22 (52.38)	13 (30.95)	5 (11.90)	2 (4.76)	42 (100.00)

Preoperative and postoperative AHI severity categories were compared in 42 children. A statistically significant change in severity distribution was observed following adenotonsillectomy (Stuart–Maxwell test: $\chi^2 = 12.62$, df = 3, $p = 0.006$). Among the 5 children with mild preoperative AHI, 4 (80.00%) achieved normal AHI postoperatively and 1 (20.00%) remained mild. Of the 31 children with moderate preoperative AHI, 17 (54.84%) became normal, 11 (35.48%) improved to mild, and 3 (9.68%) remained moderate. Among the 6 children with severe preoperative AHI, 1 (16.67%) became normal, 1 (16.67%) improved to mild, 2 (33.33%) improved to moderate, and 2 (33.33%) remained severe. [Table 3]

Table 4: Correlation between OSA-18 Score and AHI Index in Preoperative and Postoperative Period (n = 42)

Variables Compared	Spearman's rho (ρ)	p value
Preoperative OSA-18 vs Preoperative AHI	0.8279	< 0.001
Postoperative OSA-18 vs Postoperative AHI	0.7298	< 0.001
Preoperative OSA-18 vs Postoperative OSA-18	0.3267	0.037
Preoperative AHI vs Postoperative AHI	0.5710	< 0.001

Spearman's rank correlation revealed strong cross-sectional associations between symptom severity and objective sleep measures.

Preoperative OSA-18 scores were strongly correlated with preoperative AHI ($\rho = 0.8279$, $p < 0.001$), and postoperative OSA-18 scores showed a similarly strong correlation with postoperative AHI ($\rho = 0.7298$, $p < 0.001$). The correlation between preoperative and postoperative OSA-18 scores was weak but statistically significant ($\rho = 0.3267$, $p = 0.037$).

Preoperative and postoperative AHI demonstrated a moderate positive correlation ($\rho = 0.5710$, $p < 0.001$). [Table 4]

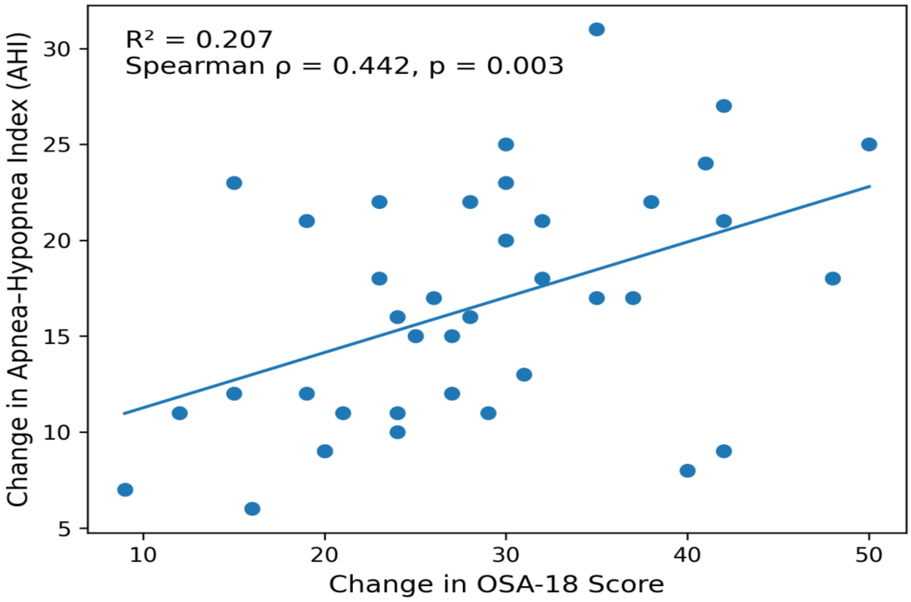

Figure 1: Correlation between change in OSA-18 score and change in apnea–hypopnea index (AHI) following adeno-tonsillectomy (n = 42).

In this study, a moderate positive correlation was observed between reduction in OSA-18 score and reduction in AHI (Spearman's ρ = 0.442, p = 0.003). The linear regression model demonstrated that approximately 20.7% of the variance in AHI change was explained by change in symptom score (R^2 = 0.207). This indicates that greater symptomatic improvement was associated with greater objective improvement in polysomnographic parameters. [Figure 1]

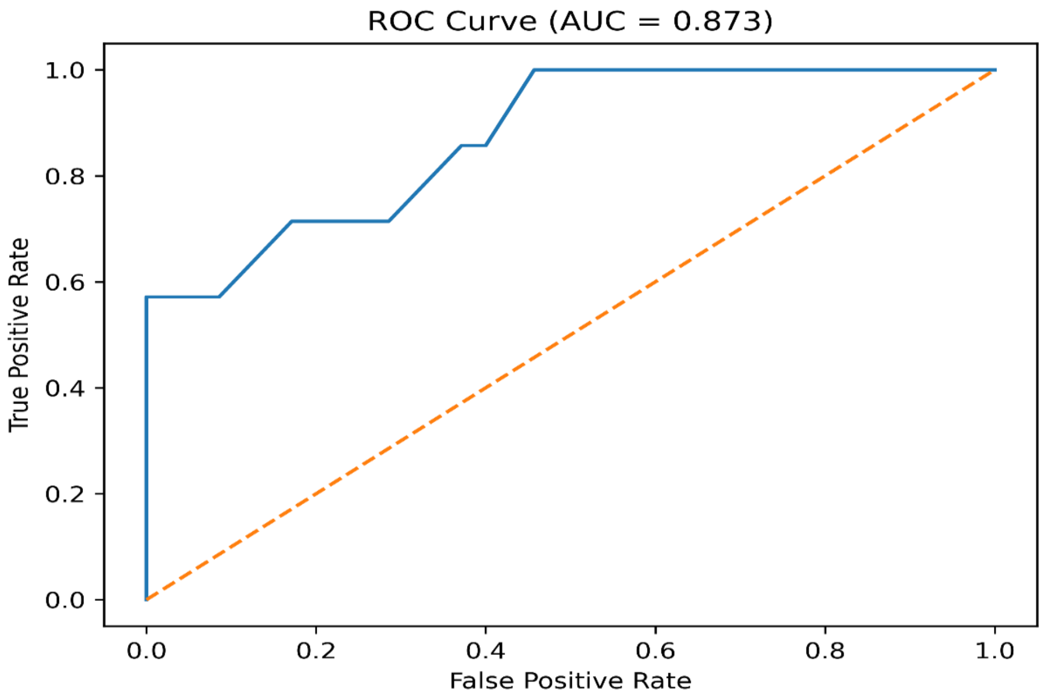

Figure 2: Receiver operating characteristic (ROC) curve evaluating the performance of preoperative OSA-18 score in predicting persistent moderate-to-severe obstructive sleep apnoea following adeno-tonsillectomy (n = 42).

Receiver operating characteristic analysis demonstrated good discriminative performance of preoperative OSA-18 scores in predicting persistent moderate-to-severe OSA following adeno-tonsillectomy (AUC = 0.8735). A threshold value of 24 was identified as optimal. At this cut-off, specificity and positive predictive value were 100%, whereas sensitivity was 57.14% and negative predictive value was 92.11%. These findings indicate that higher preoperative symptom burden is strongly associated with residual disease. [Figure 2]

Discussion

The current study assessed the effect of adeno-tonsillectomy in a cohort of 42 children with OSA based on the preoperative and postoperative PSG findings and OSA-18 evaluation. These findings show that there was marked improvement in both objective respiratory indices and subjective quality-of-life parameters. Also there was a significant reduction in the severity categories following surgery. These results strongly support the role of adeno-tonsillectomy as first-line therapy for paediatric OSA in appropriately selected patients.

In our study, the majority(54.76%) of the children were male, similar to previous findings as reported by Veena Mobarsa et al[24] (70% male) and Montaha Al-lede et al[25] (63.27%). This study included children aged between 8-15 years with a mean age of 10.31 ± 1.99 years. Previous similar studies in paediatric OSA have predominantly enrolled children in early and middle childhood, typically between 3 and 14 years of age, with major randomized data derived from school-aged cohorts.[16,19,20] The broader age group evaluated in the current study will help to generalize the findings regarding impact of adeno-tonsillectomy in children with OSA.

In this study, median AHI score decreased from 25.0 (IQR 8.75) to 4.0 (IQR 7.0) events/hour ($p < 0.001$) postoperatively showing a significant reduction in disease burden. Previous large PSG-based cohorts have also reported similar magnitudes of improvement. Mitchell et al[20]in their study found that AHI scores reduced significantly across 79 non-obese children, with resolution rates dependent on the diagnostic threshold used. When AHI ≥5 was used as the definition of persistent OSA, 16% had residual disease, while using more inclusive criteria resulted in 27% having persistent disease[20]. Similarly Ye et al. reported 86.9% cure rate when postoperative AHI <5 was used as cut-off, but 31% had persistent OSA when AHI <1 was used to define normality[19]. Our study showed that children with higher baseline AHI score were more likely to have residual disease postoperatively, consistent with prior literature. Ye et al. found that 30% of children with preoperative AHI >20 had persistent OSA postoperatively[19]. Mitchell similarly observed that 36% of children with severe preoperative OSA had persistent disease[20]. In this study, 33.33% of children with severe preoperative AHI remained moderate or severe after surgery, similar to those previous observations. This findings strengthen the concept that adeno-tonsillectomy reduces AHI by approximately 70-80%, as suggested by Ye et al.[19], with residual obstruction persisting in children having severe disease preoperatively. In the present study, 22 children (52.38%) had normal AHI, while 2 of 42 children (4.76%) remained in the severe category postoperatively and 7 children (16.67%) had residual moderate-to-severe OSA when persistence was defined as AHI ≥5. This persistence rate is similar to the 16-20% range reported by Mitchell[20] and consistent with previous meta-analysis findings by Brietzkeet al.[26] and Friedman et al.[27], who reported overall improvement following adeno-tonsillectomy with a small proportion having residual OSA. Time spent with oxygen saturation <92% also declined significantly (median 19.0 to 0.5 minutes, $p < 0.001$). Improvement in oxygenation supports findings ofLocci et al., who reported significant increases in SpO_2 nadir following adeno-tonsillectomy in children with severe OSA[28].

The reduction in median OSA-18 score observed in this study (77.0 to 47.0; $p < 0.001$) is consistent with previous literature showing improvement in caregiver-reported quality of life following adeno-tonsillectomy. Mitchell and Kelly reported significant postoperative reductions in mean OSA-18 scores in children with sleep-disordered breathing[29], Goldstein et al. similarly noted improvements in behavioural and symptom domains after surgery[30]. More recent studies using the OSA-18 questionnaire also confirmed comparable postoperative gains[24,25]. Larger PSG-based studies have also found that consistent improvement of quality-of-life scores but complete normalization of objective parameters was not seen in all patients, particularly in severe cases[21,31]. In this study, redistribution of OSA-18 severity categories among the children was statistically significant ($\chi^2 = 23.14$, $p < 0.001$). 46.67% of children with severe preoperative OSA-18 scores improved to mild postoperatively. From these findings it may be concluded that adeno-tonsillectomy offers symptomatic relief, even when residual PSG abnormalities persist.

In the present study, OSA-18 scores were strongly correlated with AHI both preoperatively ($\rho = 0.8279$, $p < 0.001$) and postoperatively ($\rho = 0.7298$, $p < 0.001$), showing caregiver-reported symptom burden closely followed objective disease severity at corresponding time points. But, longitudinal correlations between pre- and postoperative scores were weaker (OSA-18 ρ = 0.3267; AHI ρ = 0.5710), which indicates heterogeneity in individual response following surgery. Most previous studies have reported weaker associations between OSA-18 and AHI. Mitchell[20] found poor correlation between OSA-18 scores and AHI severity, both before and after adenotonsillectomy.

Similarly, Ye et al. observed postoperative improvement in both PSG parameters and OSA-18 scores, but correlation between AHI values and quality-of-life change scores were non-significant[19].

Bhattacharjee et al. reported reductions in AHI in a multicenter cohort, but symptom-based assessments did not reliably identify residual disease[31]. Ishman et al. further demonstrated that OSA-18 has limited diagnostic accuracy when compared with PSG-confirmed OSA[32]. These findings suggest that OSA-18 and PSG evaluate related but distinct dimensions of pediatric OSA and should be interpreted as complementary rather than interchangeable tools.

Receiver operating characteristic analysis showed good discriminative performance of preoperative OSA-18 in predicting persistent moderate-to-severe OSA (AUC = 0.8735) after sutgery. High specificity (100%) at the identified threshold suggests strong rule-in capacity. Although sensitivity was moderate (57.14%).

This degree of accuracy is higher than that reported in several studies evaluating the diagnostic utility of OSA-18 against polysomnography. Kang et al. reported moderate discriminatory ability (AUC 0.76) when OSA-18 was used to identify clinically significant OSA in children[14]. Similarly, Ishman et al. found that although OSA-18 has limited accuracy as a stand-alone diagnostic tool for predicting PSG-defined OSA[32].

These findings affirm that adeno-tonsillectomy significantly improves both objective and subjective outcomes in paediatric OSA, consistent with international guidelines. However, residual disease persists in a portion of children, particularly those with severe baseline AHI.

Limitations

Sample size in the current study was small, and there was limited scope for long-term follow-up. Obesity, allergic status, and craniofacial factors were not extensively stratified, although these have been identified as risk factors in prior studies.

Postoperative PSG was performed uniformly in this study, strengthening objective assessment compared tosymptom-based studies.

Conclusion

There was a significant reduction in AHI, respiratory disturbance index, oxygen desaturation burden, and OSA-18 scores following adeno-tonsillectomy in the current study. Residual moderate-to-severe OSA persisted in approximately one-sixth of children, predominantly among those with severe baseline disease. Symptom burden correlated strongly with PSG severity in this cohort. These findings suggest routine postoperative evaluation is needed in children with high preoperative AHI score to rule out residual disease and the complementary role of PSG and validated quality-of-life instruments in the comprehensive assessment of paediatric OSA.

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