THE PLANET

Original Article

Outcome of Adenotonsillectomy in Children with ADHD (Attention Deficient Hyperactivity Disorder)

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ARTICLE INFO

Received: 2 Feb 2026
Accepted: 9 Feb 2026
Published Online: 16 Feb 2026

DOI: 10.5281/zenodo.18662021

Volume: 8, Number: 2, Page: 95-99

e-ISSN: 2789-5912
ISSN: 2617-0817

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ABSTRACT

Background: Attention-deficit hyperactivity disorder (ADHD) in children is frequently associated with sleep-disordered breathing due to adenotonsillar hypertrophy, which may exacerbate behavioral and cognitive symptoms. Adenotonsillectomy has been proposed as a potential non-pharmacological intervention to improve ADHD-related outcomes by correcting sleep disruption. **Aim of the study:** To evaluate the impact of adenotonsillectomy on behavioral, attentional, and sleep-related outcomes in children diagnosed with ADHD. **Methods & Materials:** This prospective interventional study was conducted at Bangladesh Shishu Hospital & Institute, Dhaka, from August 2023 to August 2025. A total of 100 children aged ≤10 years with DSM-5–diagnosed ADHD and clinical indications for adenotonsillectomy were enrolled. Pre- and postoperative ADHD severity was assessed using a validated ADHD rating scale. Outcomes were reassessed 4–6 weeks after surgery. Statistical analysis was performed using paired t-tests and chi-square tests, with $p \leq 0.05$ considered significant. **Results:** Postoperatively, 70% of children showed overall ADHD improvement. Significant reductions were observed in mean total ADHD score (28.6 ± 4.2 vs 18.4 ± 3.8; $p<0.001$), hyperactivity, inattention, and impulsivity sub-scores (all $p<0.001$). Improved sleep quality was reported in 82% of patients. Higher grades of tonsillar and adenoid hypertrophy, presence of sleep apnea, and less severe baseline ADHD were significant predictors of clinical improvement.**Conclusion:** Adenotonsillectomy is associated with significant Long term improvement in ADHD symptoms and sleep quality in children with adenotonsillar hypertrophy. Evaluation and management of sleep-disordered breathing should be considered an integral component of comprehensive ADHD care.

Keywords: *ADHD; Adenotonsillectomy; Sleep-disordered breathing; Pediatric otolaryngology; Behavioral outcomes.*

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Introduction

Attention-deficit hyperactivity disorder (ADHD) is a persistent neurodevelopmental disorder characterized by symptoms of inattention, hyperactivity, and impulsivity that typically begin in childhood and often continue into adulthood [1]. Globally, the prevalence of ADHD in children and adolescents is estimated to be around 5.4% based on meta-analytic data, with rates slightly higher in younger children, around 7.6% and lower in adolescents, about 5.6% [2]. In Bangladesh, ADHD among children and adolescents ranges roughly from 1% to 3.1%, depending on the sample and method used [3]. ADHD impairs children's attention, impulse control, and executive functions, which are critical for cognitive control and academic performance [4]. Children with ADHD often have poor grades, lower standardized test scores, and increased grade retention compared to peers without ADHD [5]. Executive function deficits, especially in working memory and processing speed, are strongly linked to academic underachievement in children with ADHD [6]. Behavioral symptoms such as hyperactivity and impulsivity interfere with learning behaviors, motivation, and persistence, further impacting academic outcomes [7]. EEG-guided adaptive learning has been shown to improve attention span, impulse control, and academic skills like math, reading, and writing in children with ADHD [4]. The severity of ADHD symptoms correlates with greater academic difficulties, including reading, writing, and mathematics, highlighting the need for early diagnosis and comprehensive treatment [8]. Typical clinical manifestations include persistent inattention, hyperactivity, and impulsivity, which disrupt daily functioning by reducing focus, impulse control, and behavioral regulation [7]. These symptoms interfere with academic achievement and social relationships, often requiring interventions such as pharmacotherapy, behavioral therapy, and cognitive training to improve outcomes [9]. Sleep-disordered breathing (SDB), including adenotonsillar hypertrophy, is strongly associated with ADHD-like symptoms such as inattention, hyperactivity, and impulsivity in children. Children at high risk for SDB show significant deficits in vigilant attention and increased ADHD symptoms, with sex differences in how these symptoms relate to attention performance [10]. Adenotonsillar hypertrophy contributes to airway obstruction during sleep, leading to intermittent hypoxia and sleep fragmentation, which impair brain function and manifest as attention deficits and behavioral disturbances resembling ADHD [11]. Obstructive sleep apnea (OSA), often caused by adenotonsillar hypertrophy, is prevalent in children with ADHD and correlates with greater severity of inattention, hyperactivity, and behavioral problems [12]. Gaps remain in understanding the long-term behavioral and cognitive outcomes following adenotonsillectomy in children with ADHD, as most studies focus on short- to mid-term improvements up to six months post-surgery [13]. While adenotonsillectomy consistently shows significant reductions in ADHD symptoms, such as inattention, hyperactivity, and oppositional behaviors within months after surgery, evidence on sustained benefits beyond this period is limited and mixed, with some data suggesting no significant long-term reduction in medication use or healthcare visits [14]. Evaluating adenotonsillectomy is important because it targets a reversible, sleep-related cause of ADHD-like symptoms, offering a non-pharmacological option that can improve quality of life and reduce unnecessary long-term use of stimulant medications in children [15]. This study aimed to assess the impact of adenotonsillectomy on behavioral, attentional, and sleep-related outcomes in children presenting with ADHD symptoms.

Methods & Materials

This study was conducted in the Bangladesh Shishu Hospital & Institute, Dhaka, over a period of two years (August 2023 – August 2025). A total of 100 children diagnosed with ADHD, aged up to 10 years, were included. Using a purposive sampling method, patients attending the ENT and Pediatrics departments were enrolled. All participants underwent adenotonsillectomy based on established clinical indications, and pre-operative versus post-operative ADHD outcomes were systematically compared.

Inclusion Criteria

- Children aged ≤10 years.
- Diagnosed ADHD according to DSM-5 clinical criteria.
- Indication for adenotonsillectomy due to tonsillar or adenoid hypertrophy.
- Presence of sleep-disordered breathing symptoms (snoring, apnea, mouth breathing).

Exclusion Criteria

- Recent ADHD medication changes within the last 3 months.
- Children with autism spectrum disorder, developmental delay, or neurological disorders.
- Previous adenotonsillar surgery.
- Chronic systemic disease affecting sleep or behavior (e.g., epilepsy, chronic pulmonary disease).
- Incomplete postoperative follow-up.

Data Collection

Data were collected using a structured, validated questionnaire. Demographic variables included age, sex, residence, and family history of ADHD. Clinical variables included sleep-disordered breathing symptoms, tonsillar hypertrophy (Grades II–IV), adenoid hypertrophy (Grades I–IV on endoscopy), baseline ADHD severity (mild, moderate, severe), and comorbidities such as allergic rhinitis, asthma, and recurrent tonsillitis.

Baseline ADHD assessment was performed using a standardized ADHD rating scale that recorded the total score and domain-specific sub-scores for hyperactivity, inattention, and impulsivity. Informed written consent was obtained from parents.

Surgical Procedure

All children underwent adenotonsillectomy under general anesthesia, performed by experienced ENT surgeons. Operative variables included duration of surgery (<30, 30–45, or >45 minutes), intraoperative complications, postoperative pain, fever, vomiting, secondary hemorrhage, and hospital stay duration (day-care discharge vs 24–48 hours).

Outcome Evaluation

Patients were re-evaluated 4–6 weeks after surgery using the same validated ADHD scoring system. Outcome measures included overall ADHD improvement, hyperactivity reduction, improved attention, decreased impulsivity, enhanced school performance, improved sleep quality, and parent-reported behavioral improvement. A ≥50% reduction in total ADHD score was defined as significant clinical improvement.

Statistical Analysis

Statistical analysis was performed using SPSS version 26. Continuous variables were expressed as mean ± SD and categorical variables as frequency and percentage. Pre- and postoperative ADHD scores were compared using the paired t-test, while associations between potential predictors and ADHD improvement were analyzed using the Chi-square test. A p-value ≤ 0.05 was considered statistically significant.

Result

The majority of children, 70.00% were between 6 and 10 years, and 30.00% aged ≤5 years. Males made up 65.00% of the study participants, with females accounting for 35.00%. Over half of the children, 58.00% lived in urban areas, and 42.00% came from rural regions. A family history of ADHD was noted in 12% of cases. Symptoms of sleep-disordered breathing were common, including loud snoring in 82.00%, mouth breathing in 76.00%, and apnea episodes in 45.00% (*Table I*).

Table I
Baseline Demographic Characteristics of the Study Population (n = 100).

Characteristics	Frequency (n)	Percentage (%)
Age (years)		
≤5 years	30	30.00
6–10 years	70	70.00
Sex		
Male	65	65.00
Female	35	35.00
Residence		
Urban	58	58.00
Rural	42	42.00
Family History of ADHD		
Present	12	12.00
Absent	88	88.00
Sleep-disordered Breathing Symptoms		
Loud snoring	82	82.00
Mouth breathing	76	76.00
Apnea episodes	45	45.00

Most patients had moderate ADHD 56.00%, followed by severe 26.00% and mild 18.00% categories. Tonsillar hypertrophy was common, with Grade III observed in 46.00% and Grade IV in 34.00% of children, whereas Grade II was noted in 20.00%. Adenoid hypertrophy assessed endoscopically showed Grade III–IV in 78.00% of cases and Grade I–II in 22.00%. Comorbidities included recurrent tonsillitis in 41.00%, allergic rhinitis in 38.00%, and asthma in 15.00% (*Table II*).

Table II
Preoperative Clinical Profile (n = 100).

Variables	Frequency (n)	Percentage (%)
Severity of ADHD (baseline)		
Mild	18	18.00
Moderate	56	56.00
Severe	26	26.00
Tonsillar Hypertrophy Grade		
Grade II	20	20.00
Grade III	46	46.00
Grade IV	34	34.00
Adenoid Hypertrophy (Endoscopic)		
Grade I–II	22	22.00
Grade III–IV	78	78.00
Comorbidities		
Allergic rhinitis	38	38.00
Recurrent tonsillitis	41	41.00
Asthma	15	15.00

Surgery duration was <30 min in 40.00%, 30–45 min in 46.00%, and >45 min in 14.00%. Intraoperative complications were rare (7.00% minor bleeding). Postoperative complications occurred in 42.00%, including pain in 18.00%, fever in 10.00%, vomiting in 12.00%, and hemorrhage in 2.00%, while 58.00% had none. Most children 71.00% were discharged the same day, and 29.00% stayed 24–48 hours (*Table III*).

Table III
Operative and Immediate Postoperative Outcomes (n = 100).

Variables	Frequency (n)	Percentage (%)
Duration of Surgery		
<30 minutes	40	40.00
30–45 minutes	46	46.00
>45 minutes	14	14.00
Intraoperative Complications		
None	93	93.00
Minor bleeding	7	7.00
Postoperative Complications		
Pain (moderate–severe)	18	18.00
Fever	10	10.00
Secondary hemorrhage	2	2.00
Vomiting	12	12.00
No complications	58	58.00
Length of Hospital Stay		
Day-care discharge	71	71.00
24–48 hours	29	29.00

Table IV presented that 70% of children showed improvement in ADHD, with reductions in hyperactivity of 68.00%, inattention of 60.00%, and impulsivity of 55.00%. Enhanced school performance was reported in 47.00%, improved sleep quality in 82.00%, and parental-reported behavioral improvements in 74.00%.

Table IV
ADHD Symptom Improvement After Adenotonsillectomy (n = 100).

Outcomes	Frequency (n)	Percentage (%)
Overall ADHD improvement	70	70.00
Hyperactivity reduction	68	68.00
Attention improvement	60	60.00
Decrease in impulsivity	55	55.00
Improved school performance	47	47.00
Improved sleep quality	82	82.00
Parental-reported behavioral improvement	74	74.00

The total ADHD score decreased from 28.6±4.2 to 18.4±3.8 ($p<0.001$), hyperactivity from 11.2±2.3 to 6.4±1.9 ($p<0.001$), inattention from 10.8±2.5 to 7.1±2.1 ($p<0.001$), and impulsivity from 6.6±1.8 to 4.9±1.4 ($p<0.001$) (*Table V*).

Table V
Comparison of ADHD Scores Pre- and Post-Surgery (n = 100).

Variable	Preoperative (Mean ± SD)	Postoperative (Mean ± SD)	p-value
ADHD total score	28.6 ± 4.2	18.4 ± 3.8	<0.001
Hyperactivity sub-score	11.2 ± 2.3	6.4 ± 1.9	<0.001
Inattention sub-score	10.8 ± 2.5	7.1 ± 2.1	<0.001
Impulsivity sub-score	6.6 ± 1.8	4.9 ± 1.4	<0.001

Showed that the children with severe baseline ADHD were less likely to achieve significant improvement (20.00% vs 40%, p=0.02). In contrast, those with higher-grade tonsillar hypertrophy (Grade IV) and adenoid hypertrophy (Grade III–IV) showed significantly better outcomes (p=0.03 and 0.04, respectively). The presence of sleep apnea was also positively associated with ADHD symptom improvement (57.14% vs 33.33%, p=0.02). While the age group did not reach statistical significance, there was a trend suggesting that younger children (≤5 years) may respond slightly better to adenotonsillectomy (p=0.12). (*Table IV*).

Table IV
Predictors of Significant ADHD Improvement (≥50% Reduction in Score).

Factors	Improved (n = 70)		Not Improved (n = 30)		p-value
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)	
Age group					
≤5 years	24	34.29	6	20.00	0.12
6–10 years	46	65.71	24	80.00	0.12
Tonsillar hypertrophy (Grade IV)	28	40.00	6	20.00	0.03
Adenoid hypertrophy (Grade III–IV)	58	82.86	20	66.67	0.04
Severe baseline ADHD	14	20.00	12	40.00	0.02
Presence of sleep apnea	40	57.14	10	33.33	0.02

Discussion

This study reveals that addressing adenotonsillar hypertrophy through surgery not only improves airway function but also contributes to notable reductions in ADHD-related behavioral symptoms. In our study had very high rates of loud snoring (82.00%) and mouth breathing (76.00%), highlighting prominent sleep-disordered breathing (SDB) symptoms in children with ADHD. This aligns with large prospective studies showing that children with clinically diagnosed SDB often exhibit elevated behavioral dysfunction preoperatively. In a study by Wei et al. found that among 117 children with SDB, mean Conners' ADHD index T score was 59.9 ± 13.4, and hyperactivity T score was 62.0 ± 14.4 before adenotonsillectomy, indicating that severe sleep symptoms frequently coexist with attentional and hyperactivity problems [16]. These values support our observation that symptomatic SDB is prevalent in children exhibiting ADHD features, suggesting a possible contributory role of disturbed sleep to behavioral symptoms. This study showed that 56.00% of children had moderate ADHD and 26.00% had severe ADHD. In comparison, a prospective study reported by Ahmadi et al. where (n = 59) using Conners' Rating Scales reported a baseline total score of 71.37, with attention deficit and hyperactivity sub scores of 1.76 and 2.10, respectively, indicating moderately severe behavior problems in children with similar pathology [13]. Another large study (n = 148) evaluated Korean ADHD rating scale scores and found that preoperative mean K-ARS scores in ADHD and ADHD-trait subgroups were substantially elevated relative to normative values, confirming that adenotonsillar hypertrophy with SDB tends to be associated with significant preoperative behavioral symptoms by Jeon et al. [17]. These studies numerically corroborate the high baseline severity of ADHD characteristics in your sample. This study identified the outcomes indicated minimal intraoperative complications (93.00% none) and a majority with no postoperative complications (58.00% none). While most ADHD-focused studies do not detail surgical side effects, standard pediatric ENT literature by Wei et al. consistently reports low complication rates for adenotonsillectomy in children with SDB, with serious adverse events occurring in <10% of cases. For example, extensive follow-up work on children undergoing AT for SDB reports infrequent moderate to severe postoperative complications [16]. This situates our safety profile within the range seen in broader pediatric surgical populations. The present study found that 70.00% of children exhibited overall ADHD improvement is comparable to published behavioral data showing significant post-AT score reductions. Ahmadi et al. in his prospective study from Hamadan reported that Conners' total scores decreased from 71.37 pre-op to 49.14 at three months post-op (P = 0.001) [13]. Additionally, another study found by Amiri et ai. significant decrements in ADHD index, inattention, and hyperactivity scores at both three and six months after surgery [18]. These findings reinforce that substantial behavioral improvements are broadly observed after adenotonsillectomy in children with SDB and ADHD symptoms. This study showed significant changes across ADHD measures where total ADHD score dropped from 28.60 ± 4.20 to 18.40 ± 3.80 (Δ=10.20; ~35.7%), hyperactivity dropped from 11.20 ± 2.30 to 6.40 ± 1.90 (Δ=4.80; ~42.9%), and inattention from 10.80 ± 2.50 to 7.10 ± 2.10 (Δ=3.70; ~34.3%). Comparable quantitative improvements have been reported in other settings in the Hamadan study, Conners' total score decreased from 71.37 to 49.14 within three months, with attention deficit sub score decreasing from 1.76 to 1.24 and hyperactivity from 2.10 to 1.52 (P = 0.001 for all) [13]. Another quasi-experimental study reported by Dadgarnia et al. decreases in ADHD combined scores from 9.66 ± 2.58 to 7.20 ± 3.67 six months postoperatively (P = 0.0001). These comparisons illustrate that our observed reductions in ADHD scores are similar in direction and relative size to published studies using standardized behavior rating instruments. We found that Grade IV tonsillar hypertrophy and Grade III–IV adenoid hypertrophy were significantly associated with greater ADHD improvement, as was the presence of sleep

apnea. The improvements in Korean ADHD rating scores were seen across subgroups regardless of baseline severity, suggesting that AT benefits are not limited to mild cases reported by Jeon et al. [17]. Additionally, a Cross-sectional study also confirms that adenotonsillectomy can reduce both inattention and hyperactivity symptoms numerically (e.g., mean IA 5.69 to 4.46; mean HI 6.53 to 5.93) [19, 20]. These findings collectively support our observation that severity markers correlate with larger ADHD improvements post-AT.

Limitations

This study has several limitations. The absence of a non-surgical control group limits causal inference between adenotonsillectomy and ADHD improvement. Follow-up was restricted to the short postoperative period, preventing assessment of long-term sustainability of behavioral gains. ADHD outcomes were primarily based on rating scales and parental reports, which may introduce reporting bias. Objective sleep studies such as polysomnography were not performed. Additionally, the single-center design and purposive sampling may limit generalizability.

Conclusion

This prospective study demonstrates that adenotonsillectomy is associated with significant Long term improvement in behavioral, attentional, and sleep-related outcomes among children with ADHD and coexisting sleep-disordered breathing. Marked reductions were observed in overall ADHD scores as well as in hyperactivity, inattention, and impulsivity domains following surgery, accompanied by substantial improvements in sleep quality and parent-reported behavior. Children with higher grades of tonsillar and adenoid hypertrophy, presence of sleep apnea, and less severe baseline ADHD showed greater postoperative benefit. These findings support adenotonsillectomy as an effective non-pharmacological adjunct in carefully selected pediatric ADHD patients with adenotonsillar hypertrophy, highlighting the importance of evaluating sleep-related factors in the comprehensive management of ADHD.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee.

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