Adenotonsillectomy Reduces Obstructive Sleep Apnea and Improves Sleep Quality in Adult Patients

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Background: Adenotonsillectomy is widely established as a first-line treatment for obstructive sleep apnea (OSA) in children; however, its effectiveness and clinical role in adult patients remain less well defined.

Purpose: The study purpose was to measure changes in sleep quality and OSA risk in adults following adenotonsillectomy.

Study design, setting, sample: This was a prospective cohort study conducted at Unimed, in Itaperuna, RJ, Brazil, including 28 adult patients diagnosed with OSA.

Predictor/exposure/independent variable: The primary predictor variable was the time point (preoperative vs 2 months postoperative).

Main outcome variables: The main outcome variable was therapeutic response, measured using sleep quality, OSA risk, and daytime fatigue.

Covariates: Age, sex, body mass index, and baseline sleep quality.

Analyses: Descriptive and inferential analyses were performed using χ^2, Fisher's exact, and Wilcoxon tests ($P < .05$).

Results: The sample included 28 subjects with a mean age of 28.4 years (±9.1), of whom 15 (53.6%) were male. Adenotonsillectomy improved sleep quality and reduced OSA risk. The proportion of subjects classified as high-risk for OSA decreased from 71.73 to 0% ($P < .0001$). Median Pittsburgh Sleep Quality Index scores improved from 9.5 (interquartile range 6 to 11) presurgery to 2.0 (1 to 4) postsurgery ($P < .0001$). In addition, daytime fatigue and snoring frequency also showed marked reductions postoperatively ($P < .0001$).

Conclusions and relevance: Among adults with significant tonsillar or adenoidal hypertrophy and OSA, adenotonsillectomy was associated with improvements in sleep quality and reduced OSA risk. It may represent a viable alternative for patients who cannot tolerate continuous positive airway pressure or present anatomical upper airway obstruction.

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Obstructive sleep apnea (OSA) is a respiratory disorder characterized by recurrent episodes of partial or complete obstruction of the upper airways during sleep. This condition leads to respiratory interruptions and frequent awakenings, often without the patient being aware of them. These interruptions cause intermittent hypoxia and sleep fragmentation, resulting in poor sleep quality and excessive daytime sleepiness.[1-3] The pathophysiology of OSA involves anatomical factors, such as tonsillar and adenoidal hypertrophy, as well as alterations in the tone of the pharyngeal dilator muscles during sleep.[4-6]

Untreated OSA is strongly associated with several health complications, including hypertension, heart failure, stroke, and arrhythmias.[5] Studies show that OSA patients are at higher risk of developing cardiovascular and metabolic diseases, such as type 2 diabetes.[7-9] Furthermore, the impact on mental health is equally significant, with higher rates of depression and anxiety reported in untreated OSA patients.[10,11]

Adenotonsillectomy is a therapeutic option particularly indicated for patients with tonsillar or adenoidal hypertrophy, particularly in pediatric populations, where it has been extensively studied.[1,12] While evidence supporting its efficacy in adults remains more limited, emerging studies suggest potential benefits in select cases, particularly among patients with anatomical airway obstruction and continuous positive airway pressure (CPAP) intolerance. This intervention has been shown to effectively reduce OSA symptoms by improving airway patency and decreasing respiratory events during sleep.[13] The surgery is especially relevant for patients who cannot tolerate CPAP therapy. Clinical studies indicate that adenotonsillectomy can result in significant improvements in patients' overall health.[12-15]

Given the high prevalence and health burden of OSA, particularly in adults with significant tonsillar and adenoidal hypertrophy, this study aimed to evaluate the impact of adenotonsillectomy on sleep quality, OSA risk, and daytime fatigue. The study purpose was to measure changes in sleep quality and OSA risk in adults following adenotonsillectomy.

Material and Methods

STUDY DESIGN/SAMPLE

To address the research purpose, we conducted a prospective cohort study at Unimed, in Itaperuna, RJ, Brazil, between May and September 2024. Participants completed the Berlin Questionnaire and the Pittsburgh Sleep Quality Index (PSQI) at 2 time points: preoperatively and 2 months postoperatively. Adenoidal and tonsillar hypertrophy were assessed by an otolaryngologist using a standardized physical examination. Tonsillar hypertrophy was graded based on the Brodsky classification, ranging from 0 (no hypertrophy) to 4 (tonsils occupying >75% of the oropharynx). When clinically indicated, nasopharyngoscopy was performed to evaluate adenoidal hypertrophy and upper airway obstruction.

Patients were included if they met the following criteria: *1)* clinical diagnosis of moderate-to-severe OSA based on the Berlin Questionnaire and clinical evaluation by a sleep medicine specialist, *2)* presence of significant tonsillar or adenoidal hypertrophy confirmed by otolaryngological examination, and *3)* persistent symptoms of excessive daytime sleepiness, snoring, and witnessed apneas. Exclusion criteria included previous CPAP treatment, prior upper airway surgery, neuromuscular disorders affecting respiration, and body mass index (BMI) >35 kg/m^2. The Research Ethics Committee of Centro Universitário Redentor (#76490623.0.0000.5648) approved all experimental procedures described below.

VARIABLES

The primary predictor variable in this study was the time of evaluation, categorized as preoperative and postoperative (2 months after surgery). This variable was chosen because adenotonsillectomy is expected to have a measurable impact on sleep quality and OSA risk over time.

The primary outcome variable was the therapeutic effect of the operation, which was measured using multiple indicators: sleep quality, OSA risk classification, and daytime fatigue. Sleep quality was assessed using the PSQI, a validated instrument that evaluates 7 components of sleep, with scores ranging from 0 to 21; higher scores indicate worse sleep quality, and a total score >5 suggests impaired sleep.[16] OSA risk classification was determined using the Berlin Questionnaire, which categorizes patients as high or low risk based on responses related to snoring, daytime fatigue, and history of hypertension/BMI.[17] Daytime fatigue was also assessed using the Berlin Questionnaire, specifically the questions addressing excessive daytime sleepiness and fatigue.

Covariates included age, sex, BMI, and baseline sleep quality scores, as these variables could influence the outcomes of interest. Age and sex were collected as demographic factors, while BMI was included due to its well-established relationship with OSA severity. Baseline sleep quality scores were recorded to account for interindividual variability in sleep patterns before the intervention.

DATA COLLECTION METHODS

Data collection was conducted using structured electronic questionnaires administered via Google

Forms. Participants completed the Berlin Questionnaire and the PSQI at two-time points: preoperatively and 2 months postoperatively. These instruments assessed OSA risk classification, sleep quality, and daytime fatigue. Demographic data, including age, sex, and BMI, were recorded at baseline. All collected data were securely stored in a password-protected database and identified for analysis. The study adhered to ethical guidelines for data protection and confidentiality.

DATA ANALYSES

Descriptive analysis of categorical variables was performed by calculating absolute and relative frequencies (%). Associations between categorical variables were evaluated using the χ^2 test or Fisher's exact test when necessary. Comparisons between variables and scores were made using the Wilcoxon test (for paired data) and the Mann-Whitney test (for unpaired data). The statistical analysis was conducted using R software (version 4.3.1, R Foundation for Statistical Computing, Vienna, Austria). All tests considered a 95% confidence level, with statistical significance set at $P < .05$.

Results

SUMMARY OF KEY RESULTS

This section presents the primary findings about the predictor and outcome variables. The results are structured to summarize and clarify the key statistical analyses, supported by tables.

Table 1 presents the study covariates with the predictor variable (preoperative vs postoperative), analyzing whether other variables besides the outcome variable are associated with the predictor. Descriptive and inferential statistics were used, with *P* values computed accordingly.

Table 2 examines the association between study covariates and the primary outcome variables, determining whether factors besides the predictor variable influence the outcomes. Appropriate descriptive and analytic statistics were applied, including χ^2 tests and regression analyses.

Table 3 presents a bivariate analysis of the primary predictor variable (preoperative vs postoperative) and the primary outcome variables (sleep quality, OSA risk, and daytime fatigue), evaluating whether the predictor variable is significantly associated with the outcomes. Paired statistical tests, such as Wilcoxon signed-rank tests and paired t-tests, were used to assess significant differences between preoperative and postoperative scores.

This model evaluates the independent effect of the predictor on the outcomes after controlling for covariates. Where necessary, secondary predictor and outcome variables were also analyzed using additional regression models.

Where necessary, Table 3 was replicated for secondary predictor and outcome variables to provide additional insights into potential associations and confounding effects.

MAIN STUDY RESULTS

The sample included 28 subjects with a mean age of 28.4 years (±9.1), of whom 15 (53.6%) were male. Regarding BMI, 78.57% were classified as having grade I obesity, 17.86% had a normal weight, and 3.57% were classified as having grade II obesity. In the presurgical evaluation, 71.73% (n = 20) of the participants were identified as being at high risk for OSA, while 28.57% (n = 8) were considered to be at low risk.

However, in the postsurgical evaluation, all 28 participants were classified as low risk for OSA. In addition, a statistically significant association was found between the analyzed variables ($\chi^2_{(1)} = 28.078$; $P < .0001$), indicating that the change in the participants' OSA risk classification is statistically significant after surgery.

Our results demonstrated that adenotonsillectomy improved the participants' sleep quality. Snoring frequency decreased drastically, with 75% of participants reporting "never or almost never" snoring after surgery ($P < .0001$). Furthermore, the perception that someone noticed episodes of sleep apnea increased, with 92.86% reporting "never or almost never" ($P = .03726$). Reports of tiredness or fatigue upon waking also showed statistically significant improvement, with 92.86% of participants stating they "never or almost never" felt tired ($P < .0001$). Similarly, 78.57% of participants reported feeling "never or almost never" tired during the day ($P = .0001$). These results indicate that adenotonsillectomy had a statistically significant positive impact on participants' sleep quality and fatigue reduction (Table 1).

When analyzing sleep quality, we observed a statistically significant difference between the presurgery [median scores of 9.5 (6 to 11)] and postsurgery [median scores of 2 (1 to 4)] phases ($W = 348.5$; $P < .0001$). However, when evaluating the variable of sex, no statistically significant difference was found, either in the presurgery phase ($U = 90.5$, $P = .8$) or in the postsurgery phase ($U = 108$, $P = .6$) (Table 2).

Bivariate analyses were conducted to examine whether covariates such as age, sex, BMI, and baseline sleep quality were associated with changes in the main outcome measures. No statistically significant associations were found between these covariates and

Table 1. BIVARIATE ANALYSIS OF THE PREVALENCE OF OSA RISK PREADENOTONSILLECTOMY AND POSTADENOTONSILLECTOMY (N = 28)

Questions	Presurgery	Postsurgery	*P* Value
Do you snore?			
Yes	27 (96.43%)	23 (82.14%)	.2
I am not sure	01 (3.57%)	05 (17.86%)	
Is your snoring?			
Louder than your breathing	14 (51.85%)	-	.2
Slightly louder than your breathing	09 (33.33%)	01 (100%)	
Louder than talking	02 (7.41%)	-	
Very loud, can be heard in nearby rooms	02 (7.41%)	-	
How often do you snore?			
Never or almost never	02 (7.14%)	21 (75%)	**<.0001**
1 to 2 times per week	05 (17.86%)	06 (21.43%)	
3 to 4 times per week	06 (21.43%)	01 (3.57%)	
Almost every day	15 (53.57%)	-	
Does your snoring bother anyone?			
Yes	22 (78.57%)	27 (96.43%)	.1
No	06 (21.43%)	01 (3.57%)	
Has anyone noticed that you stop breathing while sleeping?			
Never or almost never	17 (60.71%)	26 (92.86%)	**.03726**
1 to 2 times per week	04 (14.29%)	01 (3.57%)	
3 to 4 times per week	04 (14.29%)	01 (3.57%)	
Almost every day	03 (10.71%)	-	
How often do you feel tired or fatigued after waking up?			
Never or almost never	03 (10.71%)	26 (92.86%)	**<.0001**
1 to 2 times per week	12 (42.86%)	01 (3.57%)	
3 to 4 times per week	06 (21.43%)	01 (3.57%)	
Almost every day	07 (25%)	-	
When you are awake, do you feel tired, fatigued, or unwell?			
Never or almost never	08 (28.57%)	22 (78.57%)	**.0001**
1 to 2 times per week	05 (17.86%)	05 (17.86%)	
3 to 4 times per week	10 (35.71%)	01 (3.57%)	
Almost every day	05 (17.86%)	-	
Have you ever dozed off or fallen asleep while driving?			
Yes	03 (89.29%)	-	.2
No	25 (10.71%)	28 (100%)	
Do you have high blood pressure?			
Yes	04 (14.29%)	04 (14.29%)	1.000
No	23 (3.57%)	23 (3.57%)	
I am not sure	01 (3.57%)	01 (3.57%)	

Note: Bivariate comparisons performed using Fisher's exact test; statistically significant differences considered at $P < .05$ are set in bold.

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changes in PSQI scores or OSA risk classification. These results are presented in Tables 2 and 3.

When the association between sleep quality and the preadenotonsillectomy and postadenotonsillectomy phases was analyzed, we found that the number of patients with good sleep quality increased statistically significantly after the surgery ($\chi^2_{(2)} = 31.212$; $P < .0001$) (Table 3). These data demonstrate that the intervention had a considerable positive impact on the participants' sleep quality.

Discussion

Our study aimed to evaluate the impact of adenotonsillectomy on sleep quality, OSA risk, and daytime fatigue in adult patients with significant tonsillar and adenoidal hypertrophy. We hypothesized that adenotonsillectomy would lead to statistically significant improvements in these parameters by eliminating anatomical airway obstruction. The specific aims of this study were to assess changes in sleep quality using

Table 2. BIVARIATE ANALYSIS OF SLEEP QUALITY INDICATORS BEFORE AND AFTER ADENOTONSILLECTOMY (N = 28)

Questions	Presurgery	Postsurgery	*P* Value
Subjective sleep quality			
Good	10 (35.71%)	12 (42.86%)	**<.0001**
Very good	01 (3.57%)	16 (57.14%)	
Bad	12 (42.86%)	-	
Very bad	05 (17.86%)	-	
Time to fall asleep			
15 minutes or less	07 (25%)	16 (59.27%)	**.0001**
16 to 30 minutes	07 (25%)	11 (40.74%)	
31 to 60 minutes	09 (32.14%)	-	
More than 60 minutes	05 (17.86%)	-	
Did it take you more than 30 minutes to fall asleep in the past month?			
Not at all during the week	01 (3.57%)	12 (42.86%)	**<.0001**
Less than once a week	04 (14.29%)	10 (35.71%)	
Once or twice a week	11 (39.29%)	05 (17.86%)	
Three or more times a week	12 (42.86%)	01 (3.57%)	
Sleep duration			
5 hours	03 (10.71%)	-	
5 to 6 hours	06 (21.43%)	01 (3.57%)	
6 to 7 hours	13 (46.43%)	12 (42.86%)	**0.0125**
More than 7 hours	06 (21.43%)	15 (53.57%)	
Sleep efficiency			
Less than 65%	06 (21.43%)	-	**<.0001**
65 to 74%	09 (32.14%)	-	
75 to 84%	11 (39.29%)	08 (28.57%)	
More than 84%	02 (7.14%)	20 (71.43%)	
Sleep disorders			
Not at all during the week	10 (35.71%)	24 (85.71%)	**.0007**
Less than once a week	09 (32.14%)	03 (10.71%)	
Once or twice a week	06 (21.43%)	01 (3.57%)	
Three or more times a week	03 (10.71%)	-	
Do you use sleep medications?			
Not at all during the week	23 (82.14%)	27 (96.43%)	.3
Less than once a week	01 (3.57%)	01 (3.57%)	
Once or twice a week	02 (7.14%)	-	
Three or more times a week	02 (7.14%)	-	
Daytime sleepiness – difficulty staying awake in the past month?			
Not at all during the week	11 (39.29%)	21 (77.78%)	**.0002**
Less than once a week	04 (14.29%)	06 (22.22%)	
Once or twice a week	10 (35.71%)	-	
Three or more times a week	03 (10.71%)	-	
Discomfort or lack of enthusiasm to perform daily activities?			
No discomfort	03 (10.71%)	23 (82.14%)	**<.0001**
Mild discomfort	12 (42.86%)	05 (17.86%)	
Moderate discomfort	08 (28.57%)	-	
Severe discomfort	05 (17.86%)	-	

Note: Bivariate comparisons conducted using the Wilcoxon signed-rank test or Mann–Whitney U test, where appropriate; bold indicates statistically significant difference ($P < .05$).

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the PSQI, evaluate modifications in OSA risk classification based on the Berlin Questionnaire, and analyze improvements in daytime fatigue following surgical intervention. Our findings confirmed this hypothesis, demonstrating that adenotonsillectomy significantly improved sleep quality, reduced OSA risk, and alleviated daytime fatigue. The proportion of high-risk OSA patients decreased from 71.73% preoperatively to 0% postoperatively, and PSQI scores showed a statistically significant improvement. These results highlight adenotonsillectomy as an effective therapeutic option for adult patients with anatomical upper airway

Table 3. BIVARIATE ASSOCIATION BETWEEN SLEEP QUALITY CLASSIFICATION AND SURGICAL PHASE (PREADENOTONSILLECTOMY VS POSTADENOTONSILLECTOMY) (N = 28)

Sleep Quality	Presurgery	Postsurgery	*P* Value
Good	02 (7.14%)	22 (78.57%)	$\chi^2_{(2)} = 31.212$ **$P < .0001$**
Bad	16 (57.14%)	06 (21.43%)	
Presence of sleep disorder	10 (35.71%)	-	

Note: Bivariate associations analyzed using χ^2 test; statistical significance considered at $P < .05$ is set in bold.

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obstruction, confirming findings previously described in the literature.[12,13,15]

In addition to the significant improvement in sleep quality and reduction in OSA risk, we also identified important secondary findings. The decrease in daytime fatigue was particularly relevant, with 92.86% of participants reporting a significant reduction in tiredness upon waking and during the day. Furthermore, snoring frequency was markedly reduced, and most patients (75%) reported never or almost never snoring after surgery, compared to only 7.14% preoperatively. These findings reinforce the comprehensive benefits of adenotonsillectomy beyond the primary outcomes measured.

Adenotonsillectomy has been identified as an effective therapeutic option, especially for patients who are unable to tolerate CPAP therapy. Studies show that adenotonsillectomy offers a favorable alternative for patients with significant tonsillar hypertrophy.[12,18] In addition, the results of our study highlight the importance of continuous postoperative evaluation. In our study, the postoperative analysis was conducted 2 months after the surgery. In this context, Bhattacharjee et al[19] observed that adenotonsillectomy improved the apnea-hypopnea index in children in the short term. However, some patients exhibited residual OSA following the procedure, suggesting the need for continuous monitoring, especially among children with obesity, where improvement was less consistent.

Another relevant aspect is the psychological impact of OSA. Patients with OSA experience symptoms of anxiety and depression, which can be alleviated after adenotonsillectomy due to improved sleep quality and increased daytime energy.[20] For instance, Mitchell et al[12] reported that adenotonsillectomy led to statistically significant improvements in sleep quality, behavior, and overall quality of life in children. Similarly, Redline et al[15] observed that surgical intervention reduced apnea-hypopnea index and improved sleep perception in pediatric populations. The study by Galluzzi and Garavello[6] conducted a systematic review to evaluate the impact of adenotonsillectomy in children with severe OSA. The results indicated that the surgery significantly reduces the severity of apneas in otherwise healthy children with severe OSA. While these studies establish adenotonsillectomy as an effective treatment in children, our findings contribute to the growing evidence that adults with significant tonsillar hypertrophy may also experience substantial benefits. Our results corroborate studies evaluating adenotonsillectomy in adult populations. Jung et al[20] found that adenotonsillectomy significantly improved psychological factors such as anxiety and stress, which corresponds with our observations of reduced daytime fatigue and enhanced sleep quality. Also, Camacho et al[21] mention adenotonsillectomy as the first-line treatment recommended for children with adenotonsillar hypertrophy who present with OSA. These findings indicate that the benefits of adenotonsillectomy extend beyond respiratory function, potentially improving overall well-being and mental health in adults with OSA. Our study reinforces this perspective by demonstrating statistically significant improvements in subjective sleep perception and a marked reduction in daytime fatigue following surgery.

This study has several strengths. First, it is one of the few prospective studies evaluating the impact of adenotonsillectomy on OSA risk and sleep quality in adults. Second, the use of validated instruments, such as the Berlin Questionnaire and the PSQI, strengthens the reliability of our findings. However, some limitations should be acknowledged. The sample was a convenience sample, which may limit the generalizability of the findings. The study relied on self-reported measures rather than polysomnography, which is considered the gold standard for diagnosing OSA. Also, the absence of objective sleep assessments, such as polysomnography and airway volume analysis, restricts the ability to draw definitive conclusions about the physiological effects of adenotonsillectomy on OSA. In addition, the follow-up period was limited to 2 months postoperatively, and longer-term outcomes remain uncertain. These factors should be considered when interpreting the results, as future studies with objective measures and extended follow-up periods may provide additional insights into the durability of these effects.

These findings reinforce the importance of addressing both the physiological and psychological aspects of sleep in the management of OSA. In the Brazilian context, where OSA prevalence may be high due to limited access to advanced therapies such as CPAP,[12,18] adenotonsillectomy emerges as a significant public health intervention. The findings of this study

underscore the need for public policies that promote early diagnosis and surgical treatment to enhance patients' quality of life. These findings align with existing literature,[12,15,18-20] reinforcing adenotonsillectomy as an essential intervention in the management of OSA and the promotion of sleep health, contributing to both physical health and psychological well-being. Future research should focus on evaluating long-term outcomes, exploring objective measures such as polysomnography, and assessing the effects of adenotonsillectomy in different OSA severity subgroups. In addition, investigating the psychological and metabolic impacts of improved sleep following surgery could further elucidate the broader benefits of this procedure.

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