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Correlation of tonsillar size with severity of obstructive sleep apnea (OSA) in adult patients. A prospective observational study.

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Abstract

Background:
Obstructive sleep apnea (OSA) is a common disorder marked by recurrent upper airway obstruction during sleep. To evaluate the distribution of tonsillar size in adult patients with OSA and analyze its correlation with disease severity as measured by the apnea–hypopnea index (AHI).

Methods:
This prospective observational study was conducted on 50 adult patients diagnosed with OSA. Tonsillar size was graded using the Brodsky classification (Grade I–IV). Severity of OSA was determined according to AHI values obtained from overnight polysomnography: mild (5–14), moderate (15–29), and severe (≥30). Correlations between tonsillar grade and OSA severity were assessed, and mean AHI scores were compared across tonsillar grades. Statistical significance was set at $p < 0.05$.

Results:
The tonsillar size distribution showed that Grade II (28%) and Grade III (32%) hypertrophy were the most frequent, while Grades I and IV were observed in 20% each (Table 1). Among patients, 15 (30%) had mild OSA, 18 (36%) moderate OSA, and 17 (34%) severe OSA (Table 2). Significant correlations were found between tonsillar grade and OSA severity: Grade I was predominantly associated with mild OSA, while Grade IV was strongly correlated with severe OSA ($p = 0.001$) (Table 3). Mean AHI increased progressively with higher tonsillar grades: 9.5 ± 2.1 (Grade I), 16.8 ± 3.2 (Grade II), 27.5 ± 4.6 (Grade III), and 35.2 ± 6.1 (Grade IV) (Table 4).

Conclusion:
Increasing tonsillar size is directly associated with greater OSA severity in adults. Tonsillar hypertrophy, particularly Grades III and IV, strongly predicts moderate to severe OSA. Integrating tonsillar assessment into clinical evaluation may enhance risk stratification and guide treatment decisions.

Recommendation:
Routine tonsillar grading should be incorporated into OSA evaluation to improve risk prediction and guide timely surgical or non-surgical interventions.

Keywords: *Obstructive sleep apnea, tonsillar hypertrophy, Brodsky grading, apnea–hypopnea index, airway obstruction*
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Introduction
Obstructive sleep apnea (OSA) is a common sleep-related breathing disorder characterized by recurrent episodes of partial or complete upper airway obstruction during sleep, resulting in intermittent hypoxia, sleep fragmentation, and significant cardiovascular as well as metabolic consequences [1]. The prevalence of OSA in adults is steadily increasing worldwide, with obesity, craniofacial abnormalities, and structural narrowing of the upper airway identified as major risk factors [2].

Among the anatomical factors contributing to airway obstruction, tonsillar hypertrophy has an important role, particularly through the reduction of oropharyngeal airway space. While its significance has been extensively studied in pediatric OSA, recent evidence has highlighted its relevance in adult populations as well [3,4]. The Brodsky grading system remains a widely accepted clinical tool for

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assessing tonsillar size and provides a standardized framework for evaluating its contribution to airway narrowing [5].

Given that the severity of OSA is typically measured using the apnea–hypopnea index (AHI) obtained from overnight polysomnography, determining how tonsillar grade correlates with OSA severity is clinically important. Establishing this association in adults not only aids in risk stratification but also supports decision-making for surgical interventions such as tonsillectomy or uvulopalatopharyngoplasty.

The present study was conducted to evaluate the distribution of tonsillar size in adult patients with OSA and analyze its correlation with disease severity, as measured by the AHI.

Methodology

Study Design and Setting

This prospective observational study was conducted in the Department of ENT at Government General Hospital (GGH), Kothagudem, Telangana. The study was carried out over six months, from February 2025 to July 2025. During this time, 50 adult patients with a confirmed diagnosis of obstructive sleep apnea (OSA) were recruited after obtaining written informed consent. Approval for the study was granted by the Institutional Ethics Committee before the initiation of data collection.

Participants

Eligibility Criteria and Selection Methods

Adults 18–65 years with a confirmed diagnosis of OSA by overnight polysomnography were included. Participants were selected consecutively from the ENT outpatient and sleep clinic during the study period.

Inclusion criteria

Adults aged 18–65 years

Confirmed OSA diagnosis through overnight polysomnography

Ability and willingness to provide written informed consent

Exclusion criteria

Previous tonsillectomy or upper airway surgery

Craniofacial anomalies, nasal polyposis, or significant septal deviation

Neuromuscular disorders or uncontrolled systemic illness

Conditions known to alter sleep architecture

Sampling method

A consecutive sampling technique was used. All eligible patients presenting during the study period were evaluated, ensuring maximal recruitment while minimizing selection bias.

Study Size

A total of 50 adult patients were included in the study. The sample size was determined based on:

Feasibility within the six-month study duration, considering the average OSA patient flow in the ENT and sleep clinic.

The expected prevalence of tonsillar hypertrophy among OSA patients ranges between 20% and 40% in prior adult OSA clinic cohorts.

The requirement to detect a moderate association (effect size ~0.3) between tonsillar grade and OSA severity, with a power of 80% and alpha of 0.05.

Using these parameters, the minimum required sample was approximately 44, and we enrolled 50 patients to account for incomplete data and ensure adequate statistical power.

Clinical Evaluation

All patients underwent a detailed clinical history and ENT examination. Tonsillar size was graded using the Brodsky grading system (Grade I to IV), which assesses the proportion of the oropharyngeal airway occupied by the tonsils.

Polysomnography and OSA Severity

Each patient underwent overnight polysomnography. The Apnea–Hypopnea Index (AHI) was calculated as the number of apnea and hypopnea events per hour of sleep. OSA severity was categorized as:

Mild: AHI 5–14 events/hour

Moderate: AHI 15–29 events/hour

Severe: AHI ≥30 events/hour

Bias and Efforts to Minimize Bias

Several steps were taken to reduce potential sources of bias:

Selection bias: Consecutive sampling ensured that all eligible patients during the study period were included, avoiding preferential selection.

Observer bias: Tonsillar grading was performed by ENT specialists trained in using the Brodsky classification to maintain uniformity.

Measurement bias: Polysomnography was conducted using a standardized diagnostic protocol, and AHI was calculated automatically using validated software.

Confounding bias: Patients with craniofacial abnormalities, neuromuscular diseases, and upper airway pathology (other than tonsillar hypertrophy) were excluded to reduce anatomical confounders.

Data analysis bias: Blinded statistical analysis was performed without knowledge of participant tonsillar grade during computation of AHI values.

Data Analysis

The distribution of tonsillar size and OSA severity was tabulated. Correlations between Brodsky grades and OSA severity were analyzed using a chi-square test for

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categorical variables and one-way ANOVA for mean AHI scores across tonsillar grades. A p-value <0.05 was considered statistically significant. Data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA).

Results

Participant Flow

During the study period, 62 adults were screened as potential participants. Of these, 56 individuals underwent further evaluation for eligibility based on clinical suspicion of obstructive sleep apnea (OSA). After applying the inclusion and exclusion criteria, 50 patients were found eligible and provided written informed consent. All 50 completed clinical assessment, tonsillar grading, and overnight polysomnography. No participants were lost during the process, and all were included in the final analysis (Figure 1).

Reasons for Exclusion (n = 6)
Previous upper airway surgery (n = 2)
Significant septal deviation or nasal pathology (n = 2)
Neuromuscular illness affecting sleep architecture (n = 1)
Craniofacial anomaly (n = 1)

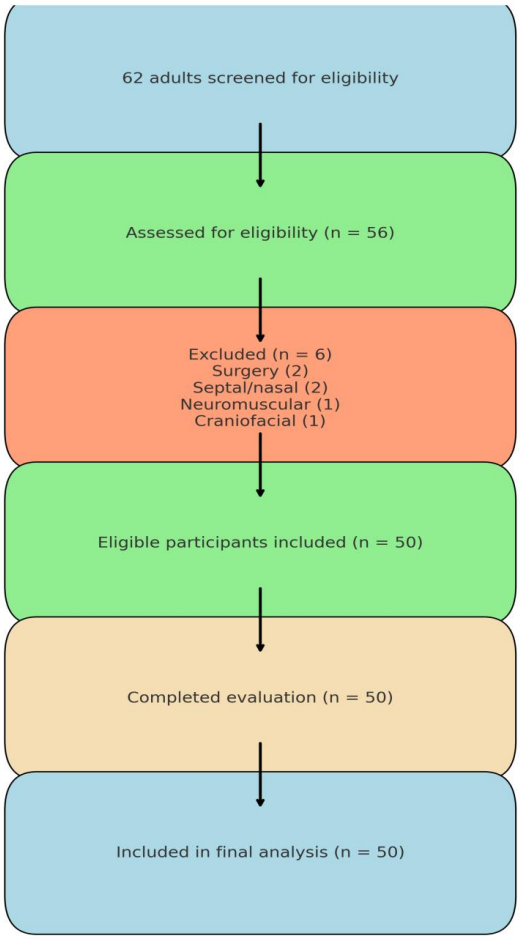

Figure 1: Participant flow diagram

Descriptive Data

The study included 50 adult patients diagnosed with OSA. The mean age was 44.8 ± 9.6 years, with most participants belonging to the 40–59-year age group. Males constituted 64% (n=32) of the sample, while females accounted for 36% (n=18) (Table 1).

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Table 1. Socio-Demographic Profile of Study Participants (n = 50)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–29	6	12
	30–39	10	20
	40–49	18	36
	50–59	12	24
	≥60	4	8
Mean age	—	**44.8 ± 9.6**	—
Gender	Male	32	64
	Female	18	36

A total of 50 adult patients diagnosed with obstructive sleep apnea (OSA) were evaluated for tonsillar size and its correlation with disease severity. The distribution of tonsillar size according to the Brodsky scale demonstrated that Grade II (28%) and Grade III (32%) hypertrophy were the most common, followed by Grade I (20%) and Grade IV (20%) (Table 2).

Table 2. Distribution of Tonsillar Size in Adult Patients with OSA (n=50)

Tonsillar grade (Brodsky scale)	Frequency (n)	Percentage (%)
Grade I	10	20
Grade II	14	28
Grade III	16	32
Grade IV	10	20

Based on the apnea–hypopnea index (AHI), 15 patients (30%) had mild OSA, 18 patients (36%) had moderate OSA, and 17 patients (34%) were categorized as severe cases (Table 2).

Table 2. Severity of OSA based on Apnea-Hypopnea Index (AHI) (n=50)

OSA severity	AHI range (events/hr)	Frequency (n)	Percentage (%)
Mild	5–14	15	30
Moderate	15–29	18	36
Severe	≥30	17	34

Correlation analysis between tonsillar size and OSA severity revealed significant associations. Grade I tonsils were predominantly observed in patients with mild OSA (53%), whereas Grades III and IV were more frequently associated with moderate and severe OSA. Specifically, Grade IV tonsils were strongly linked with severe OSA (41%) and showed the highest statistical significance (p=0.001). Grades II and III also demonstrated significant correlations with OSA severity (p=0.04 and p=0.02, respectively), indicating a clear trend of increasing tonsillar size with rising OSA severity (Table 3).

Table 3. Correlation of Tonsillar Size with OSA Severity (n=50)

Tonsillar grade	Mild OSA (n=15)	Moderate OSA (n=18)	Severe OSA (n=17)	p-value
Grade I	8	2	0	<0.01*
Grade II	5	6	3	0.04*
Grade III	2	7	7	0.02*
Grade IV	0	3	7	0.001*

*(*Significant association)*

The mean AHI scores further substantiated this relationship, showing a progressive increase with higher tonsillar grades: 9.5 ± 2.1 in Grade I, 16.8 ± 3.2 in Grade II, 27.5 ± 4.6 in Grade III, and 35.2 ± 6.1 in Grade IV. This gradient confirmed the direct association between tonsillar hypertrophy and the severity of OSA (Table 4).

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Table 4. Mean AHI Scores according to Tonsillar Grade (n=50)

Tonsillar grade	Mean AHI ± SD
Grade I	9.5 ± 2.1
Grade II	16.8 ± 3.2
Grade III	27.5 ± 4.6
Grade IV	35.2 ± 6.1

Discussion

Obstructive sleep apnea (OSA) is a multifactorial disorder in which anatomical, neuromuscular, and functional abnormalities contribute to upper airway collapse. Tonsillar hypertrophy represents a significant anatomical factor that compromises oropharyngeal airway patency. The present study, conducted at Government General Hospital, Kothagudem, demonstrated a clear association between tonsillar size and the severity of OSA in adults.

In the study cohort, Grade II (28%) and Grade III (32%) tonsillar hypertrophy were the most common, whereas Grades I and IV were observed in 20% each. Larger tonsillar grades showed a progressive relationship with increasing OSA severity as measured by the apnea–hypopnea index (AHI). Grade IV tonsils demonstrated the strongest association with severe OSA ($p = 0.001$), indicating that advanced hypertrophy is a critical risk factor. The observed trend of rising mean AHI values from Grade I (9.5 ± 2.1) to Grade IV (35.2 ± 6.1) further supports this association.

These findings are consistent with predictive models indicating that tonsillar hypertrophy is an important determinant of surgical outcomes in adults with OSA. The outcome prediction model for radiofrequency uvulopalatopharyngoplasty with tonsillectomy has also highlighted the relevance of tonsil size in preoperative planning [6]. Previous literature has underscored the role of tonsillectomy in adults with hypertrophy-related OSA, demonstrating notable improvements in airway patency and reductions in AHI [7].

However, evidence suggests that not all patients achieve uniform benefit from tonsillectomy alone. Several reviews have emphasized that surgical success depends on multifactorial assessment, and in some cases, tonsillectomy may be insufficient as a standalone procedure [8]. Meta-analyses of palatopharyngeal surgery techniques have shown that combined or tailored surgical approaches provide superior outcomes compared with isolated procedures [9]. In alignment with these reports, adjunctive procedures such as pharyngoplasty have been advocated to enhance outcomes when performed alongside tonsillectomy, particularly in adults with multilevel airway obstruction [10].

Clinical literature continues to highlight the role of tonsillar hypertrophy in contributing to OSA severity. Silberthau and Thaler reported an adult case in which marked tonsillar enlargement was the primary factor responsible for airway obstruction [11]. Additionally, lingual tonsil hypertrophy has been recognized as another anatomical contributor, and hypertrophy at both palatine and lingual levels may coexist and exacerbate disease severity [12].

Clinical Implications

The findings of this study reinforce that Brodsky Grade III and IV hypertrophy constitute strong anatomical predictors of moderate-to-severe OSA in adults. Recognition of these associations is essential for appropriate risk stratification and individualized surgical decision-making. Tailored surgical planning that includes tonsillectomy, and when indicated, adjunctive palatal or pharyngeal procedures, may enhance treatment outcomes.

Generalizability

The findings of this study, though derived from a single-center cohort, provide clinically relevant insights into the relationship between tonsillar hypertrophy and OSA severity in adults. Given the consistent correlation across tonsillar grades and AHI values, the results are likely generalizable to similar adult populations presenting with OSA in tertiary care settings. However, regional variations in anatomical risk factors, comorbidities, and referral patterns should be considered, and multicentric studies with larger cohorts are needed to enhance external validity.

Conclusion

The present study establishes a significant correlation between tonsillar size and the severity of obstructive sleep apnea (OSA) in adults. Patients with larger tonsils, particularly Brodsky Grades III and IV, demonstrated markedly higher apnea–hypopnea index (AHI) scores and were more likely to present with moderate-to-severe disease. In contrast, Grade I tonsils were predominantly associated with mild OSA. These findings highlight the importance of tonsillar hypertrophy as a key anatomical risk factor in adult OSA. Incorporating tonsillar grading into routine clinical evaluation may enhance diagnostic accuracy, aid in risk stratification, and help identify patients who may benefit from surgical interventions.

Limitations

The study was limited by its sample size and single-center design. Additional anatomical and functional contributors, such as tongue base collapse and craniofacial structure, were not assessed. Future studies integrating

polysomnography, drug-induced sleep endoscopy, and long-term surgical follow-up are warranted.

Recommendations

Based on the observed correlation between tonsillar size and severity of obstructive sleep apnea (OSA), we recommend that routine tonsillar grading using the Brodsky classification should be integrated into the standard clinical evaluation of adult OSA patients. Patients with Grade III and IV hypertrophy warrant early consideration for surgical interventions such as tonsillectomy, with or without adjunctive palatopharyngeal procedures, particularly when non-surgical measures are inadequate. Multidisciplinary assessment, including ENT specialists, sleep physicians, and anesthesiologists, is essential to optimize patient-specific management. Further multicentric studies are encouraged to validate these findings and refine risk stratification protocols in diverse populations.

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Abbreviations

OSA – Obstructive Sleep Apnea
AHI – Apnea–Hypopnea Index
GGH – Government General Hospital
SPSS – Statistical Package for the Social Sciences
DLO – Diploma in Otorhinolaryngology
ENT – Ear, Nose, and Throat

Source of funding

The study had no funding.

Conflict of interest

The authors declare no conflict of interest.

Author contributions

KVVR-Concept and design of the study, results interpretation, review of literature, and preparation of the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript. **RS-**Concept and design of the study, results interpretation, review of literature, preparing the first draft of the manuscript, and revision of the manuscript**.MS-**Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript.**BN-**Review of literature and preparing the first draft of the manuscript. Statistical analysis and interpretation

Data availability

Data available on request

Author Biography

Dr. K. V. V. Ramji completed his MBBS from Bhaskara Medical College, followed by post-graduation in ENT at Osmania Medical College (2013–2016). He pursued Senior Residency at Gandhi Medical College and subsequently served in Government service under TVVP as an ENT Specialist from 2019 to 2023. Since October 2023, he has been working as an Assistant Professor in the Department of ENT at Gandhi Medical College. His areas of expertise include micro ear surgeries, endoscopic nasal and skull base surgeries, and thyroid surgeries. He has a keen interest in academics and has been recognized with medals at various conferences.ORCID iD: https://orcid.org/0009-0008-8716-0010

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He then worked as Registrar, Surgical Oncology – Head & Neck Services at Basavatarakam Indo American Cancer Institute (2017–2018). Under TVVP, he served as Civil Assistant Surgeon Specialist (ENT) at Gadwal (2018) and later at Sangareddy (2018–2023), where he also held the position of CAS RMO II (2021–2023). Subsequently, he was absorbed into DME and is currently serving as Assistant Professor, ENT at Gandhi Medical College (2023–present).

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