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Original Research

Epidemiological Study on Prevalent Risk Factors and Craniofacial Skeletal Patterns in Obstructive Sleep Apnea among South Indian Population

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ABSTRACT:
Background: Obstructive Sleep Apnea (OSA) is a common sleep disorder characterized by recurrent upper airway obstruction during sleep. This epidemiological study investigates OSA in the South Indian population, focusing on prevalence, risk factors, and craniofacial skeletal patterns. **Methods:** A cross-sectional study enrolled 500 OSA patients and 500 age- and sex-matched controls from South Indian healthcare institutions. Data included demographics, lifestyle factors, anthropometrics, polysomnography, and cephalometric analysis. Statistical analysis employed chi-squared tests, logistic regression, ANOVA, and descriptive statistics. **Results:** OSA prevalence was significant among South Indians, with key risk factors including obesity ($p < 0.001$), smoking ($p < 0.001$), alcohol consumption ($p = 0.02$), and sedentary lifestyle ($p < 0.001$). Cephalometric analysis revealed maxillary and mandibular retrusion and increased soft palate thickness as associated with OSA severity. **Conclusion:** This study enhances understanding of OSA within the South Indian population, emphasizing the significance of risk factors and craniofacial patterns. It informs clinical practice, guiding interventions for improved OSA diagnosis and management in this unique demographic.
Keywords: Obstructive Sleep Apnea, South Indian Population, Risk Factors, Craniofacial Skeletal Patterns, Epidemiology

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INTRODUCTION

Obstructive Sleep Apnea (OSA) is a widespread sleep disorder characterized by recurrent episodes of partial or complete upper airway obstruction during sleep, leading to disrupted breathing patterns, decreased oxygen saturation, and frequent arousals from sleep [1]. These repeated nocturnal disturbances often result in excessive daytime sleepiness, impaired cognitive function, and increased cardiovascular morbidity [2]. OSA represents a significant public health concern worldwide, affecting millions of individuals across diverse ethnic and geographic populations.While OSA has garnered considerable attention in recent years, much of the existing research has predominantly focused on Western populations. There is a growing recognition that OSA may exhibit variations in prevalence, risk factors, and clinical presentations among different ethnic groups [3]. South India, with its unique genetic makeup, cultural practices, and lifestyle patterns, presents an intriguing and underexplored context for the study of OSA epidemiology.The South Indian population is

characterized by a rich diversity of languages, cultures, and dietary habits. This diversity extends to genetic factors that could potentially influence susceptibility to OSA. Genetic predisposition is recognized as a crucial factor in the development of OSA, with specific gene variants linked to increased risk [4]. Investigating the genetic underpinnings of OSA within the South Indian population may reveal novel insights into the condition's pathogenesis.Moreover, lifestyle factors play a pivotal role in OSA development and progression. South India's changing socioeconomic landscape has witnessed a surge in urbanization, leading to shifts in dietary preferences and physical activity levels. These lifestyle transitions may contribute to the rising prevalence of OSA in the region. Therefore, a comprehensive understanding of lifestyle-related risk factors specific to the South Indian population is essential.Cultural practices such as dietary choices and meal timing may also influence OSA susceptibility. For instance, the consumption of spicy and heavy meals late in the evening is a common culinary tradition in South India. Such practices may impact sleep quality and respiratory function, making it imperative to explore their potential associations with OSA.In addition to genetic and lifestyle factors, craniofacial skeletal patterns have gained attention as important determinants of OSA severity. Differences in facial and cranial morphology can affect upper airway dimensions and resistance, potentially increasing the risk of airway collapse during sleep [5-10]. Craniofacial diversity across populations underscores the need to investigate specific craniofacial characteristics prevalent in South Indian individuals with OSA.The current lack of comprehensive epidemiological data on OSA within the South Indian population limits our ability to implement effective prevention and management strategies tailored to this region. Existing studies often lack the necessary sample size, diversity, and specific focus on South India to provide meaningful insights.This epidemiological study aims to address these gaps by investigating the prevalence of OSA and identifying key risk factors within the South Indian population. We also seek to explore craniofacial skeletal patterns associated with OSA severity. By doing so, we hope to provide a nuanced understanding of OSA within this unique demographic, which can inform targeted interventions and

MATERIALS AND METHODS

Study Design: This cross-sectional epidemiological study was conducted to investigate the prevalence, risk factors, and craniofacial skeletal patterns associated with Obstructive Sleep Apnea (OSA) among the South Indian population. Ethical approval for the study was obtained from the Institutional Review Board.

Study Participants: The study enrolled a total of 1000 participants, consisting of 500 OSA patients and 500 age- and sex-matched controls. Participants were recruited from healthcare institutions and sleep clinics across South India. Informed written consent was obtained from all participants prior to their inclusion in the study.

Data Collection:

1. **Demographic and Clinical Data:** Detailed demographic information, including age, gender, and socioeconomic status, was collected through structured interviews. Participants' medical histories, comorbidities, and medication use were also recorded.
2. **Lifestyle Factors:** Participants completed standardized questionnaires to assess lifestyle factors such as smoking habits, alcohol consumption, physical activity levels, and dietary patterns. Information regarding the timing and content of evening meals was specifically recorded to investigate its potential association with OSA.
3. **Anthropometric Measurements:** Anthropometric measurements were taken for all participants, including height, weight, neck circumference, and waist circumference. Body Mass Index (BMI) was calculated as weight (in kilograms) divided by the square of height (in meters).
4. **Polysomnography (PSG):** OSA diagnosis and severity assessment were based on overnight PSG conducted in a controlled sleep laboratory setting. Key parameters measured during PSG included:

- Apnea-Hypopnea Index (AHI): The number of apneas and hypopneas per hour of sleep.
- Oxygen Desaturation Index (ODI): The number of oxygen desaturation events (≥3% drop in oxygen saturation) per hour of sleep.
- Sleep Efficiency: The percentage of time spent asleep during the total time in bed.
- Sleep Architecture: Evaluation of sleep stages, sleep latency, and wake after sleep onset.

Cephalometric Analysis: Craniofacial skeletal patterns were assessed using cephalometric analysis. Lateral cephalograms were obtained for a subset of participants (n=200) using standardized techniques. Cephalometric landmarks and measurements, including maxillary and mandibular positions, soft palate thickness, and cranial dimensions, were analyzed to identify specific craniofacial characteristics associated with OSA.

Statistical Analysis: Statistical analysis was conducted using appropriate software (SPSS ver 20). Descriptive statistics were used to summarize demographic and clinical data. Chi-squared tests were employed to assess associations between categorical

variables, while logistic regression analysis was utilized to identify independent risk factors for OSA. Analysis of variance (ANOVA) was used to compare craniofacial measurements among OSA severity groups. A p-value < 0.05 was considered statistically significant.

Sample Size Justification: The sample size of 1000 participants (500 OSA patients and 500 controls) was determined based on power calculations to ensure adequate statistical power for detecting significant associations between risk factors and OSA prevalence. This sample size allows for a robust investigation into the craniofacial patterns associated with OSA severity.

RESULTS

Demographic and Clinical Characteristics: The demographic and clinical characteristics of the study participants are summarized in Table 1. OSA patients exhibited a significantly higher BMI (31.4 ± 5.6 kg/m²) compared to controls (25.8 ± 3.7 kg/m², p < 0.001). Smoking prevalence was significantly higher in OSA patients (27.6%, p < 0.001), as was alcohol consumption (30.4%, p = 0.02), and sedentary lifestyle (37.6%, p < 0.001).

Polysomnography (PSG) Data: Table 2 presents PSG data for OSA patients stratified by severity. A clear trend of increasing Apnea-Hypopnea Index (AHI) and Oxygen Desaturation Index (ODI) with OSA severity is observed. Mild OSA patients had an AHI of 16.4 ± 5.2 events/hour, moderate OSA patients had an AHI of 32.7 ± 6.8 events/hour, and severe OSA patients had an AHI of 48.9 ± 7.4 events/hour. Similarly, ODI increased with severity: 13.6 ± 4.9 events/hour in mild, 26.5 ± 7.2 events/hour in moderate, and 39.2 ± 8.3 events/hour in severe OSA. Sleep efficiency showed a decreasing trend with severity, with mild OSA patients having the highest sleep efficiency (78.5 ± 5.7%) compared to moderate and severe OSA patients.

Cephalometric Measurements: Table 3 displays cephalometric measurements in OSA patients across different severity groups. Maxillary and mandibular retrusion were more pronounced in patients with severe OSA, with mean values of -4.8 mm and -4.6 mm, respectively, compared to mild OSA patients (-2.1 mm and -1.8 mm). Soft palate thickness also increased with OSA severity, ranging from 6.2 mm in mild OSA to 10.9 mm in severe OSA. Cranial dimensions varied across individuals but did not show consistent associations with OSA severity.

These results indicate significant associations between OSA and various demographic, clinical, and cephalometric factors within the South Indian population. The data highlight the importance of assessing both risk factors and craniofacial characteristics when evaluating OSA in this specific demographic.

Table 1: Demographic and Clinical Characteristics of Study Participants

Variable	OSA Patients (n=500)	Controls (n=500)	p-value
Age (years)	45.2 ± 9.1	45.1 ± 9.0	0.85
Gender (Male/Female)	270/230	272/228	0.91
BMI (kg/m²)	31.4 ± 5.6	25.8 ± 3.7	<0.001
Smoking (Yes/No)	138/362	96/404	<0.001
Alcohol (Yes/No)	152/348	118/382	0.02
Sedentary Lifestyle (Yes/No)	188/312	94/406	<0.001

Table 2: Polysomnography (PSG) Data for OSA Patients

Parameter	OSA Severity Group	AHI (events/hour)	ODI (events/hour)	Sleep Efficiency (%)
Mild OSA (n=150)	16.4 ± 5.2	13.6 ± 4.9	78.5 ± 5.7	
Moderate OSA (n=200)	32.7 ± 6.8	26.5 ± 7.2	70.2 ± 6.1	
Severe OSA (n=150)	48.9 ± 7.4	39.2 ± 8.3	62.4 ± 7.5	

Table 3: Cephalometric Measurements in OSA Patients

Cephalometric Parameter	Mean ± SD (Mild OSA)	Mean ± SD (Moderate OSA)	Mean ± SD (Severe OSA)
Maxillary Position (mm)	-2.1 ± 1.0	-3.5 ± 1.2	-4.8 ± 1.5
Mandibular Position (mm)	-1.8 ± 0.9	-3.2 ± 1.0	-4.6 ± 1.2
Soft Palate Thickness (mm)	6.2 ± 1.4	8.5 ± 1.6	10.9 ± 2.0
Cranial Dimensions (mm)	Varied findings across OSA severity groups		

DISCUSSION

The findings of this epidemiological study provide valuable insights into the prevalence, risk factors, and craniofacial skeletal patterns associated with Obstructive Sleep Apnea (OSA) within the South Indian population. In this discussion, we will interpret

the results and their implications, highlighting the significance of our research in the broader context of sleep medicine.

Prevalence of OSA in South India: Our study revealed a substantial prevalence of OSA within the South Indian population. This finding aligns with the global trend of increasing OSA prevalence [6]. The estimated prevalence of OSA in our sample was consistent with findings from other Asian populations, suggesting that OSA is a significant health concern in South India [7]. The higher prevalence of OSA among South Indians underscores the importance of proactive screening and intervention efforts.

Demographic and Clinical Factors: Our results demonstrated that OSA patients had a significantly higher Body Mass Index (BMI) than controls, highlighting the well-established association between obesity and OSA [8]. Obesity contributes to the accumulation of adipose tissue in the upper airway, increasing the risk of airway obstruction during sleep. This finding emphasizes the need for weight management and lifestyle interventions to mitigate OSA risk in South Indian individuals.Furthermore, our study identified smoking, alcohol consumption, and sedentary lifestyle as significant risk factors for OSA. Smoking and alcohol use have been linked to OSA due to their relaxing effects on the upper airway muscles and respiratory control centers [9]. The prevalence of these risk factors in South India emphasizes the importance of public health campaigns to promote smoking cessation and responsible alcohol consumption.Sedentary lifestyle, characterized by insufficient physical activity, was also associated with OSA in our study. Physical inactivity can contribute to obesity and exacerbate OSA symptoms [10]. Promoting regular physical activity is crucial for OSA prevention and management, particularly in populations with sedentary habits.

Craniofacial Skeletal Patterns: Our cephalometric analysis revealed distinct craniofacial skeletal patterns associated with OSA severity. Maxillary and mandibular retrusion and increased soft palate thickness were significantly associated with more severe OSA. These findings align with previous research highlighting the importance of craniofacial morphology in OSA pathogenesis [11]. The retrusion of maxilla and mandible reduces the pharyngeal airway space, making it more prone to collapse during sleep, while a thicker soft palate can contribute to airway obstruction.Cranial dimensions did not show consistent associations with OSA severity in our study. This suggests that specific craniofacial features, rather than overall cranial size, play a more critical role in OSA development. Understanding these craniofacial characteristics is essential for tailoring treatment approaches, such as orthodontic interventions or surgical procedures, to address the anatomical factors contributing to OSA.

Implications for Clinical Practice: The implications of our findings for clinical practice are significant. First and foremost, our study underscores the importance of early OSA detection, particularly in individuals with obesity, a sedentary lifestyle, and a history of smoking or alcohol consumption. Identifying these high-risk groups can facilitate timely interventions, which may include lifestyle modifications, continuous positive airway pressure (CPAP) therapy, or surgical interventions.Craniofacial assessment should also be integrated into OSA diagnosis and treatment planning. Patients with craniofacial features associated with OSA severity may benefit from targeted interventions, such as maxillomandibular advancement surgery or orthodontic treatments, to address anatomical abnormalities contributing to airway obstruction [12].Furthermore, our findings emphasize the need for region-specific guidelines for OSA management in South India. These guidelines should consider the prevalence of specific risk factors and craniofacial characteristics within this population. Tailored approaches to OSA prevention and treatment, informed by our study, can lead to more effective outcomes and improved quality of life for affected individuals.

Limitations and Future Directions: This study has certain limitations that warrant consideration. The cross-sectional design limits our ability to establish causal relationships between risk factors and OSA. Longitudinal studies are needed to explore the temporal relationships between lifestyle factors, craniofacial patterns, and OSA development.Additionally, the cephalometric analysis was conducted on a subset of participants, which may introduce selection bias. Future research should aim to include larger sample sizes for more robust craniofacial assessments.Finally, while our study provides valuable insights into OSA among South Indians, it is essential to recognize the ethnic and geographic diversity within the South Indian population. Further research should investigate potential variations in OSA prevalence and risk factors across different subgroups.

CONCLUSION

In conclusion, this epidemiological study sheds light on the prevalence, risk factors, and craniofacial skeletal patterns associated with OSA in the South Indian population. The findings underscore the need for proactive OSA screening, lifestyle interventions, and craniofacial assessments in clinical practice. Region-specific guidelines should be developed to address the unique characteristics of OSA within South India. Ultimately, our research contributes to the broader understanding of OSA epidemiology and

has the potential to improve the diagnosis and management of OSA in this specific population.

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