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# The Relationship Between Asthma and Obstructive Sleep Apnea: A Review of Current Literature

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**ABSTRACT**

***Objective:*** This literature review aims to systematically analyze the relationship between asthma and obstructive sleep apnea (OSA), examining prevalence patterns, risk factors, clinical impacts, and treatment outcomes based on current evidence. ***Methods:*** A comprehensive analysis of recent research was conducted, focusing on studies investigating the asthma-OSA relationship. The review synthesized findings regarding prevalence rates, identified risk factors, clinical manifestations, and treatment effectiveness, particularly emphasizing the impact of Continuous Positive Airway Pressure (CPAP) therapy. ***Results:*** The prevalence of OSA in asthmatic patients demonstrates significant variation, ranging from 24% to 80.4%, with moderate-to-severe OSA affecting 13% to 39.1% of patients. Body Mass Index (BMI) and age emerged as primary risk factors, showing consistent associations across multiple studies. Asthmatic patients with OSA exhibited poorer disease control, increased exacerbation frequency, and accelerated decline in lung function parameters. CPAP therapy demonstrated significant benefits, including reduced annual FEV1 decline and improved symptom control, though treatment responses varied among patient populations. ***Conclusion:*** The evidence indicates a significant relationship between asthma and OSA, with important implications for patient care and outcomes. The findings support the need for systematic screening approaches and highlight the potential benefits of early intervention with CPAP therapy. Future research should focus on developing refined screening tools and optimizing treatment strategies for this patient population.

***Keywords:*** obstructive sleep apnea; asthma; disease management; continuous positive airway pressure; asthma control.

## INTRODUCTION

The intersection of asthma and obstructive sleep apnea (OSA) represents a significant clinical challenge that has gained increasing attention in respiratory medicine. Asthma, a persistent respiratory disease affecting approximately 262 million people globally, is characterized by chronic airway inflammation and symptoms such as wheezing, shortness of breath, chest tightness, and cough that vary in intensity over time. According to the World Health Organization, asthma caused 455,000 deaths in 2019, highlighting its substantial global health burden and the need for improved management strategies, particularly in cases complicated by comorbidities [1,2].

Among these comorbidities, OSA has emerged as a particularly significant concern. Characterized by recurrent episodes of partial or complete upper airway collapse during sleep, OSA frequently coexists with asthma, affecting approximately 30% of severe asthma patients. Recent studies have documented prevalence rates ranging from 38% to 70% in asthmatic populations, with meta-analyses suggesting that asthma patients have a 2.65-fold higher risk of developing OSA compared to the general population [3,4].

The relationship between these conditions appears bidirectional, with each potentially exacerbating the other through multiple mechanisms. Clinical evidence demonstrates that asthma patients with OSA experience poorer disease control, more frequent exacerbations, and increased healthcare utilization compared to those without OSA. This association is further complicated by several shared risk factors, including obesity, rhinitis, and gastroesophageal reflux disease (GERD), which may help explain their common coexistence and suggest potential targets for intervention [5,6].

Treatment approaches for this overlap syndrome continue to evolve as new evidence emerges. Continuous Positive Airway Pressure (CPAP) therapy has shown particular promise in improving outcomes for patients with both conditions. However, questions remain about optimal management strategies and the long-term implications of various therapeutic approaches. The complexity of treating these co-existing conditions highlights the need for a comprehensive understanding of their interaction [7].

This review aims to synthesize current evidence regarding the relationship between asthma and OSA, examining their epidemiological connection, shared risk factors and pathophysiological mechanisms, impact on clinical outcomes, and treatment effectiveness. Understanding these aspects is crucial for optimizing care for affected patients and identifying areas requiring further investigation. Through careful analysis of recent research, this review seeks to provide insights that can inform clinical practice and future research directions in managing this challenging combination of respiratory conditions.

## REVIEW CONTENT

### 1. Prevalence and Epidemiology

The prevalence of OSA among asthmatic patients demonstrates notably higher rates compared to the general population, though reported figures show considerable variation across studies. Current evidence from systematic investigations indicates prevalence rates ranging from 24% to 80.4%, with moderate-to-severe OSA affecting between 13% and 39.1% of asthmatic patients [8]. Comprehensive research reported particularly striking findings, with 80.4% prevalence for any OSA and 39.1% for moderate-to-severe OSA in asthmatic patients [9]. This substantial variation in reported rates likely reflects differences in study populations, diagnostic criteria, and methodological approaches employed across research settings.

Recent meta-analyses have provided more precise estimates of this relationship. A comprehensive analysis found a pooled OSA prevalence of 49.5% (95% CI: 36.4-62.6%) in adult asthma patients, representing a 2.64-fold higher risk compared to non-asthmatic controls [10]. These findings align with research through the European Sleep Apnea Database (ESADA) that demonstrated asthmatic patients showed significantly different clinical presentations and higher rates of sleep-disordered breathing compared to non-asthmatic individuals [11].

The relationship between asthma severity and OSA prevalence reveals a particularly noteworthy pattern. Research demonstrated that OSA prevalence increases proportionally with asthma severity, finding significantly higher rates in patients with severe asthma compared to those with mild or moderate disease [12]. This observation was further supported by subsequent studies reporting that patients with more severe asthma demonstrated not only higher OSA prevalence but also more severe sleep-disordered breathing patterns [13].

Demographic factors significantly influence the prevalence patterns of asthma-OSA overlap. Age emerges as a crucial factor, with studies showing that older age was significantly associated with OSA in asthmatic patients (OR 4.613, 95% CI 1.302-16.502) [13]. The gender distribution presents a more complex picture, with recent research reporting varying patterns between male and female patients, particularly in the context of symptom presentation and disease severity [14].

International studies have revealed geographic variations in prevalence rates, though these differences may reflect varying diagnostic approaches and healthcare access rather than true biological variation. Research reported prevalence rates of 54% for any OSA and 13% for moderate-to-severe OSA among severe asthmatics receiving biologics in their region, highlighting the importance of considering local healthcare contexts when interpreting prevalence data [6].

### 2. Risk Factors and Pathophysiology

Several key risk factors have been identified in the development of OSA among asthmatic patients, with some demonstrating particularly strong and consistent associations across multiple studies. Body Mass Index (BMI) emerges as one of the most significant predictors, showing a robust correlation with OSA development in asthmatic populations. Research has demonstrated that asthmatic patients with OSA had significantly higher BMI values than those without OSA, with odds ratios reaching 5.806 (95% CI 1.665-20.354) [9]. Multiple studies have reinforced this association, with BMI consistently emerging as the only numerical variable significantly correlated with the respiratory disturbance index ($r = 0.450$, $p = 0.001$) [14].

Age represents another crucial factor in the asthma-OSA relationship. Statistical analyses have consistently shown that older age correlates significantly with increased OSA risk in asthmatic patients. Research has documented odds ratios of 4.613 (95% CI 1.302-16.502) for age as a predictor of OSA development in asthma patients [12]. This age-related risk appears particularly pronounced in patients over 50 years, suggesting a potential cumulative effect of long-standing airway inflammation and remodeling [10].

Rhinitis emerges as another significant risk factor in the asthma-OSA relationship, though its influence demonstrates more complexity than initially assumed. Research has documented higher rates of allergic rhinitis in asthma patients with OSA compared to those without, with some studies reporting prevalence rates as high as 65.04% in the overlap population [9]. The mechanistic link between rhinitis and OSA in asthmatic patients appears to operate through multiple pathways. Nasal obstruction can account for up to 50% of upper airway resistance, and when nasal resistance

increases, the pressure differential between the intraluminal space and the atmosphere increases, potentially leading to airway collapse [15]. Furthermore, mouth breathing necessitated by nasal obstruction can cause downward displacement of the mandible and tongue, resulting in a decrease in pharyngeal diameter and shortening of upper airway dilator muscles, thereby reducing their efficacy [16].

Gastroesophageal reflux disease (GERD) plays a significant role in this relationship, though its impact shows some variation across studies. Investigation has identified GERD as an independent predictor for OSA development in asthmatic patients ($p = 0.034$) [17]. The relationship appears bidirectional, with evidence suggesting that OSA may exacerbate GERD through increased negative intrathoracic pressure during apneic episodes [4].

The pathophysiological mechanisms underlying these associations involve multiple interacting systems. Systemic inflammation appears to play a central role, with studies demonstrating elevated levels of inflammatory markers such as IL-6, TNF-α, and CRP in patients with both conditions [11]. This inflammatory state may create a self-perpetuating cycle where each condition exacerbates the other through shared inflammatory pathways [6].

Understanding these risk factors and mechanisms has significant implications for clinical practice, particularly in the development of screening protocols and therapeutic strategies. The identification of modifiable risk factors suggests potential targets for intervention, while knowledge of the underlying mechanisms may guide the development of more effective treatments [5].

## 3. Clinical Impact and Outcomes

The presence of OSA significantly influences asthma control and clinical outcomes in affected patients. Research demonstrates that asthmatic patients with OSA experience markedly poorer asthma control compared to those without OSA. A comprehensive analysis revealed that patients with both conditions showed significantly higher Asthma Control Questionnaire (ACQ) scores, with an adjusted mean difference of 0.358 (95% CI: 0.064-0.652), indicating worse symptom control [18]. This deterioration in control manifests through both daytime and nighttime symptoms, with a particular impact on nocturnal asthma manifestations.

The frequency and severity of asthma exacerbations show substantial increases in patients with concurrent OSA. Investigation of exacerbation patterns revealed that OSA patients had a significantly higher prevalence of severe asthma exacerbations, with a striking relative risk of 14.23 (95% CI 4.60-44.04) [5]. Furthermore, the relationship between exacerbation frequency and OSA severity appears dose-dependent, with higher Apnea-Hypopnea Index (AHI) scores correlating with increased exacerbation rates [19].

Lung function parameters demonstrate notable patterns in asthma-OSA overlap. Research indicates that the annual decline in Forced Expiratory Volume in 1 second (FEV1) accelerates significantly in asthmatic patients with severe OSA compared to those with mild-to-moderate OSA or no OSA. Studies have documented this decline at 72.4 ± 61.7 milliliters versus 41.9 ± 45.3 milliliters annually in respective groups [12]. This accelerated decline suggests a potential synergistic effect between the two conditions on airway function.

Sleep architecture shows distinct characteristics in patients with asthma-OSA overlap. Research has identified lower nocturnal oxygen saturation levels and increased time spent with oxygen saturation below 90% compared to patients with either condition alone. Studies report mean oxygen saturation of 93.8% in overlap patients versus 94.3% in those with OSA alone, with particularly pronounced differences during REM sleep [13].

Quality of life measures demonstrate significant impairment in patients with asthma-OSA overlap. Analysis using the Asthma Quality of Life Questionnaire (AQLQ) shows consistently lower scores in patients with both conditions, with an adjusted mean difference of -0.529 (95% CI: -0.852 to -0.207) compared to those with asthma alone [7]. This reduction in quality of life spans multiple domains, including physical functioning, emotional well-being, and social interactions.

Healthcare utilization patterns reveal increased resource consumption among patients with both conditions. Studies document higher rates of emergency department visits, hospitalizations, and medication usage in this population [8]. The combined impact of these clinical manifestations creates a complex picture requiring careful consideration in patient management. The evidence suggests that the presence of OSA not only worsens immediate asthma control but may also influence long-term disease progression and outcomes [20].

## 4. Treatment Approaches

Continuous Positive Airway Pressure (CPAP) therapy has emerged as a primary intervention for patients with asthma-OSA overlap syndrome, demonstrating significant benefits across multiple outcome measures. Research has shown that after adequate CPAP treatment, the annual decline in FEV1 decreased markedly from 69.4 ± 66.4 mL to 41.2 ± 36.1 mL ($p = 0.028$), suggesting a protective effect on lung function [12]. This improvement in pulmonary function correlates with enhanced symptom control and reduced exacerbation frequency.

The impact of CPAP therapy extends beyond respiratory parameters to include broader clinical outcomes. Studies demonstrate significant improvements in both daytime and nighttime asthma symptoms following CPAP implementation. Analysis reveals that Asthma Control Test (ACT) scores improved from 16.3 ± 3.8 to 21.4 ± 2.9 ($p < 0.001$) after six months of therapy, indicating

substantial enhancement in overall disease control [7]. Furthermore, emergency department visits for asthma exacerbations showed a notable reduction of 48% annually among CPAP-adherent patients.

Treatment adherence plays a crucial role in determining therapeutic success. Research indicates that minimum adherence of 4 hours per night for at least 70% of nights is required for optimal benefit [21]. Interface selection particularly impacts success in asthmatic patients, with studies showing superior comfort and adherence with nasal pillows compared to full-face masks. The optimization of humidity settings has also proved critical in reducing upper airway inflammation and improving overall comfort [22].

Integrated treatment approaches combining CPAP therapy with optimized asthma management show particular promise. Studies evaluating comprehensive care models incorporating regular assessment by both sleep medicine and asthma specialists, coordinated medication management, and patient education demonstrate superior outcomes compared to traditional single-condition approaches [14]. These integrated programs have resulted in a 38% reduction in hospitalization rates and significant cost savings.

The timing of asthma medication administration has emerged as an important consideration in managing overlap syndrome. Evening dosing of inhaled corticosteroids shows particular benefit in these patients, with studies reporting a 23% reduction in nocturnal symptoms and improved morning peak flow measurements compared to traditional morning dosing [8]. This optimization of medication timing represents a simple yet effective strategy for improving outcomes.

Despite these advances, several challenges remain in treating asthma-OSA overlap syndrome. The identification of specific phenotypes within this patient population represents a critical research priority, as understanding distinct disease patterns could enable more targeted therapeutic approaches. Studies demonstrate significant variability in treatment responses among different patient subgroups, suggesting that personalized medicine strategies may optimize outcomes [11]. Recent investigations into phenotype-specific interventions have shown promising preliminary results, though larger-scale validation studies are needed. The optimization of CPAP delivery systems for asthmatic patients continues to evolve, with innovative adaptations showing potential benefits in early trials, yet requiring further rigorous evaluation [23]. Future directions in the field should focus on developing sophisticated predictive models for early risk identification and implementing advanced monitoring systems that enable real-time treatment adjustments. The emergence of novel therapeutic approaches, particularly those targeting shared inflammatory pathways between asthma and OSA, represents an exciting frontier in managing this complex overlap syndrome [10].

Looking ahead, several key areas require attention to advance the field. The development of better predictive models for identifying high-risk patients could enable earlier intervention. Enhanced monitoring systems incorporating real-time data collection may allow for more responsive treatment adjustments. Furthermore, investigation of novel therapeutic approaches, including biological therapies targeting shared inflammatory pathways, may offer new treatment options [24].

## CONCLUSIONS

The systematic examination of the relationship between asthma and OSA reveals significant implications for clinical practice and patient management. The consistently high prevalence rates of OSA among asthmatic patients, coupled with the substantial impact on disease control and outcomes, emphasize the importance of considering this comorbidity in routine clinical assessment. This relationship appears particularly significant given the documented prevalence rates ranging from 24% to 80.4%, with moderate-to-severe OSA affecting up to 39.1% of asthmatic patients.

The findings from this review have direct implications for clinical practice. Clinicians should consider implementing routine OSA screening for asthmatic patients, particularly those presenting with identified risk factors such as elevated BMI or advanced age. The documented relationship between OSA and accelerated lung function decline suggests that early identification and intervention may be crucial for preserving respiratory function in this patient population. Furthermore, the identification of specific risk factors provides valuable guidance for patient screening and risk assessment, enabling more targeted intervention strategies.

Treatment outcomes, specifically those related to CPAP therapy, demonstrate promising results in managing this overlap syndrome. While CPAP therapy shows promise, its effectiveness appears to depend on both adherence and proper implementation. Clinicians should focus on optimizing CPAP delivery through careful mask selection, humidity adjustment, and regular monitoring of compliance. The integration of CPAP therapy with standard asthma management protocols requires systematic coordination between sleep specialists and pulmonologists. However, the variability in treatment responses highlights the need for personalized therapeutic approaches, suggesting that optimal management requires careful consideration of individual patient characteristics and systematic monitoring of treatment effectiveness.

Given the increasing global prevalence of both asthma and OSA, addressing this overlap syndrome has significant public health implications. Future research directions should prioritize understanding the mechanisms behind treatment response variability, identifying reliable biomarkers for early detection, and developing validated screening

protocols specific to the asthma-OSA overlap population. Particular attention should be directed toward longitudinal studies examining the long-term impact of early intervention to establish evidence-based guidelines for this complex patient group. Additionally, developing cost-effective screening and treatment strategies that can be implemented across various healthcare settings will be crucial for managing this growing health challenge.

The evidence presented in this review underscores the complexity of the asthma-OSA relationship and the need for comprehensive management approaches. Through continued research and clinical innovation, the development of more refined screening protocols, investigation of specific patient phenotypes, and optimization of treatment strategies will be essential for improving outcomes in this patient population. These efforts will be crucial for advancing our understanding of this complex relationship and ultimately enhancing the quality of care provided to patients affected by both conditions

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