

Association Between Obstructive Sleep Apnea And Coronary Artery Disease: A Comparative Analysis Of Regional And Global Data

Shashwat Singh, Ratnesh Kumar Singh, Chandra Narain Saxena,
Suchit Swaroop

Research Scholar, Department Of Zoology, University Of Lucknow, Lucknow.

Associate Professor Department Of Zoology, University Of Lucknow, Lucknow.

Assistant Professor, Department Of Zoology, Khwaja Moinuddin Chishti Language University, Lucknow.

Assistant Professor, Department Of Zoology, Sri JNMPG (KKC) College, Lucknow.

Abstract:

Background: Obstructive sleep apnea (OSA) has emerged as an important non-traditional risk factor for coronary artery disease (CAD), contributing to cardiovascular morbidity through mechanisms such as intermittent hypoxia, oxidative stress, systemic inflammation, and endothelial dysfunction. Despite increasing evidence, regional variations in the prevalence of OSA among CAD patients remain insufficiently explored.

Objective: This study aims to evaluate the association between OSA and CAD and to compare the prevalence of OSA in CAD patients across Indian and international studies.

Methods: A comprehensive review of open-access studies examining the relationship between OSA and CAD was conducted. Data on prevalence were extracted and categorized into Indian and international groups. A comparative statistical analysis was performed using the Mann–Whitney U test to assess differences between the two groups. Effect size (r) was calculated to determine the magnitude of differences.

Results: The findings indicate a high prevalence of OSA among CAD patients across all studies, with a greater burden observed in Indian populations. Statistical analysis revealed higher mean ranks for Indian studies (4.00) compared to international studies (1.50). Although the difference did not reach statistical significance ($U = 0.000$, $Z = -1.732$, $p = 0.083$), the effect size was large ($r = 0.77$), indicating a substantial and clinically meaningful difference. The elevated prevalence in Indian cohorts may be attributed to a higher burden of metabolic risk factors and underdiagnosis of sleep disorders.

Conclusion: OSA is highly prevalent among patients with CAD and represents a significant, potentially modifiable cardiovascular risk factor. The observed regional differences, supported by a large effect size, highlight the importance of routine screening for OSA in CAD patients, particularly in high-risk populations. Further large-scale, standardized studies are needed to confirm these findings and to evaluate the impact of therapeutic interventions on cardiovascular outcomes.

Key Word: Obstructive sleep apnea, Coronary Artery Disease, Mann-Whitney U test

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I. Introduction

Coronary artery disease (CAD) remains one of the leading causes of morbidity and mortality worldwide. It is primarily characterized by the narrowing or blockage of coronary arteries due to atherosclerosis, which restricts blood supply to the myocardium and may lead to myocardial infarction, heart failure, or sudden cardiac death (Mahajan et al., 2022). Traditional risk factors for CAD include hypertension, diabetes mellitus, dyslipidemia, smoking, and obesity. However, in recent years, increasing attention has been directed toward non-traditional risk factors such as sleep disorders, particularly obstructive sleep apnea (OSA). Obstructive sleep apnea is a common sleep-related breathing disorder characterized by repetitive episodes of upper airway obstruction during sleep, resulting in intermittent hypoxia, sleep fragmentation, and increased sympathetic activity. The global prevalence of OSA has increased significantly, affecting millions of adults worldwide and posing a major public health concern. Studies have demonstrated that OSA is frequently associated with cardiovascular diseases including hypertension, heart failure, stroke, and coronary artery disease.

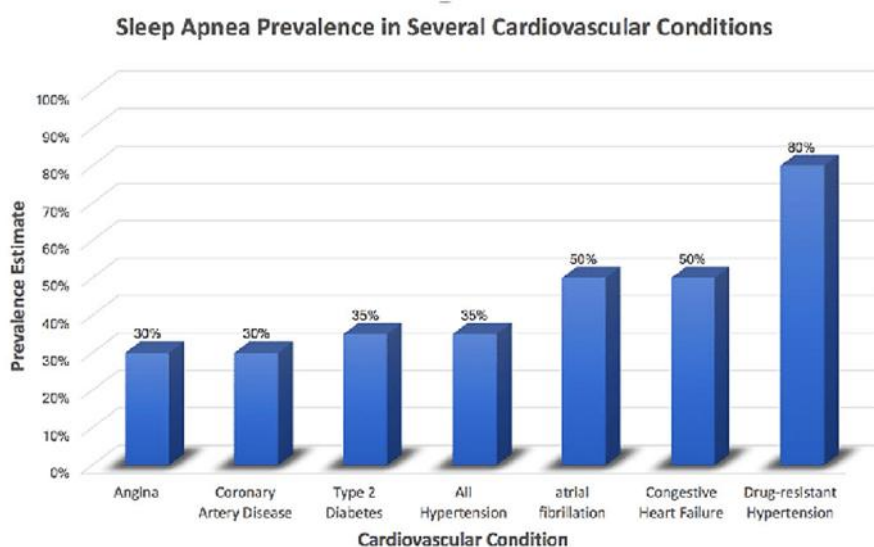
The pathophysiological link between OSA and CAD is complex and multifactorial. Intermittent hypoxia associated with OSA leads to oxidative stress, systemic inflammation, endothelial dysfunction, and metabolic dysregulation, all of which contribute to the development and progression of atherosclerosis. These mechanisms may accelerate coronary plaque formation and increase the risk of myocardial ischemia and

adverse cardiovascular events (De Torres-Alba et al., 2013). Epidemiological studies have shown that OSA is highly prevalent among patients with cardiovascular diseases. Approximately 40–80% of individuals with cardiovascular disorders such as hypertension, heart failure, and CAD have been reported to suffer from OSA, although the condition often remains underdiagnosed in clinical practice.

Similarly, several clinical studies conducted across different populations have shown that the prevalence of OSA in patients with CAD ranges from 30% to more than 60%, depending on the severity of disease and diagnostic methods used. In patients with acute coronary syndrome (ACS), the prevalence of OSA may reach as high as 63%, suggesting a strong association between sleep-disordered breathing and coronary pathology (Mahajan et al., 2022).

In India, limited but growing research has highlighted the high burden of OSA among patients with CAD. Studies conducted in Indian tertiary care centres have demonstrated a high prevalence of OSA among patients admitted with acute coronary syndrome, with obesity, hypertension, and diabetes emerging as important associated risk factors.

Given the increasing recognition of the interaction between sleep disorders and cardiovascular diseases, understanding the correlation between OSA and CAD is essential for improving early diagnosis, risk stratification, and therapeutic strategies.



Reference: Cardiovascular Disease Risk in Obstructive Sleep apnea: An Update - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/Prevalence-estimates-of-sleep-apnea-in-several-cardiovascular-conditions_fig2_323773960.

II. Material And Methods

The study aimed to examine the correlation between obstructive sleep apnea and coronary artery disease by analyzing findings from published studies conducted in India and abroad. The objective was to evaluate the prevalence, pathophysiological mechanisms, and clinical implications of OSA in patients with CAD. This study also seeks to highlight the importance of early diagnosis and management of OSA in reducing cardiovascular complications. Literature search of open-access research articles and reviews related to obstructive sleep apnea and coronary artery disease was carried out. Relevant studies were identified through online databases including PubMed and other open-access repositories. Articles focusing on epidemiology, pathophysiology, and clinical associations between OSA and CAD were included.

III. Result

Findings from India

Several studies conducted in India have demonstrated a significant association between obstructive sleep apnea and coronary artery disease. Research involving patients admitted with acute coronary syndrome in northern India reported a prevalence of OSA as high as 78.8% when assessed using polysomnography. The study also found that obesity, diabetes mellitus, and hypertension were strongly associated with increased severity of sleep apnea.

Another clinical investigation reported that a considerable proportion of CAD patients exhibited symptoms of sleep-disordered breathing, indicating that OSA may be an important but frequently overlooked cardiovascular risk factor in Indian populations. The findings suggested that patients with CAD should routinely be screened for OSA to improve cardiovascular outcomes.

Overall, Indian studies highlight the high prevalence of OSA among CAD patients and emphasize the role of metabolic risk factors such as obesity and diabetes in the development of both conditions.

Table 1. Findings from Indian Studies on CAD and OSA

Author	Year	Study Population	Study Design	Key Findings	Prevalence of OSA
Mahajan et al.	2022	CAD/ACS patients	Review	OSA contributes to endothelial dysfunction, inflammation, and atherosclerosis in CAD patients	Not specified
Singh et al.	2020	Young CAD patients (<40 years)	Prospective study	High burden of OSA in young CAD patients; strong association with BMI and obesity	~80%
Bhalla et al.	2020	CAD and heart failure patients	Observational study	OSA commonly present in cardiovascular patients; associated with disease severity	~64.9%
Malavika et al.	2024	Female CAD patients	Hospital-based study	High prevalence of OSA in women with CAD; highlights gender-specific risk factors	Not specified
Northern India ACS Study	2022	ACS patients	Cross-sectional	High prevalence of OSA; associated with diabetes, hypertension, and obesity	~78.8%

Findings from Abroad

International research has also consistently demonstrated a strong association between OSA and coronary artery disease. A clinical study involving 156 CAD patients found that approximately 56.4% of participants had obstructive sleep apnea, with the majority of cases categorized as moderate to severe.

Epidemiological studies have reported that the prevalence of OSA in CAD patients ranges between 14% and 65%, indicating that sleep apnea is significantly overrepresented among individuals with coronary artery disease.

In addition, large observational studies have shown that severe sleep-disordered breathing is associated with increased coronary artery calcification and greater risk of cardiovascular complications. Multivariate analysis revealed that severe OSA was an independent predictor of coronary artery calcification with an adjusted odds ratio of 3.30.

These findings collectively indicate that OSA plays a crucial role in the development and progression of coronary artery disease across diverse populations.

Table 2. Findings from International Studies on CAD and OSA

Author	Year	Study Population	Study Design	Key Findings	Prevalence of OSA
Wali et al.	2015	CAD patients	Cross-sectional	Majority of CAD patients had moderate-to-severe OSA	~56.4%
Mandal et al.	2018	CAD patients	Review	Severe OSA associated with increased coronary artery calcification (CAC)	30–60%
De Torres-Alba et al.	2013	CAD patients	Review	OSA leads to oxidative stress, inflammation, and endothelial dysfunction	Not specified
Jean-Louis et al.	2008	General population	Epidemiological study	OSA increases risk of coronary heart disease and cardiovascular events	~30% increased risk
Andreas et al.	1996	Cardiovascular patients	Clinical study	High prevalence of OSA in patients with cardiovascular diseases including CAD	Not specified

Statistical Comparison of OSA Prevalence in CAD Patients

1. Data Used for Calculation

- Indian Studies (with prevalence reported)

Singh et al., 2020 → 80%

Bhalla et al., 2020 → 64.9%

Northern India ACS Study, 2022 → 78.8%

- International Studies (with prevalence reported)

Wali et al., 2015 → 56.4%

Mandal et al., 2018 → ~45% (midpoint of 30–60% range)

2. Mean Prevalence Calculation

- Indian Studies

Mean prevalence = $(80 + 64.9 + 78.8) / 3 = 74.56\%$ (~74.6%)

- International Studies

Mean prevalence = $(56.4 + 45) / 2 = 50.7\%$

Data Interpretation (Mann-Whitney U Test):

		Ranks		
	Study Region	N	Mean Rank	Sum of Ranks
OSA Prevalence (%)	India	3	4.00	12.00
	International	2	1.50	3.00
	Total	5		

Test Statistics ^a	
	OSA Prevalence (%)
Mann-Whitney U	.000
Wilcoxon W	3.000
Z	-1.732
Asymp. Sig. (2-tailed)	.083
Exact Sig. [2*(1-tailed Sig.)]	.200 ^b
a. Grouping Variable: Study Region	
b. Not corrected for ties.	

Effect Size Calculation (r):

Formula:

$$r = \frac{Z}{\sqrt{N}}$$

From SPSS output:

- Z = -1.732

- N = 5

$$r = \frac{-1.732}{\sqrt{5}} = \frac{-1.732}{2.236} \approx -0.77$$

Effect size (r) ≈ 0.77

A Mann–Whitney U test was conducted to compare the prevalence of obstructive sleep apnea between Indian and international studies. The analysis revealed that Indian studies exhibited a higher mean rank (4.00) compared to international studies (1.50), indicating a greater burden of OSA among CAD patients in Indian populations. Although the difference did not reach statistical significance (U = 0.000, Z = -1.732, p = 0.083), the calculated effect size was large (r = 0.77). This suggests that the observed difference is not only meaningful but also potentially clinically significant. The lack of statistical significance is likely attributable to the small sample size rather than the absence of a true effect. These findings support the presence of a substantial difference in OSA prevalence between Indian and international cohorts and highlight the importance of larger studies to confirm this association.

IV. Discussion

The study demonstrates a strong association between obstructive sleep apnea (OSA) and coronary artery disease (CAD), supported by both Indian and international studies. A consistently higher prevalence of OSA was observed among CAD patients, with Indian studies reporting a greater burden compared to global data. This observation aligns with the growing recognition of OSA as an important non-traditional cardiovascular risk factor contributing to the development and progression of coronary atherosclerosis (Mahajan et al., 2022; Mandal et al., 2018).

To quantitatively compare regional differences, a Mann–Whitney U test was conducted to evaluate the prevalence of OSA between Indian and international studies. The analysis revealed that Indian studies exhibited a higher mean rank (4.00) compared to international studies (1.50), indicating a greater burden of OSA among CAD patients in Indian populations. Although the difference did not reach statistical significance (U = 0.000, Z = -1.732, p = 0.083), the calculated effect size was large (r = 0.77). This suggests that the observed difference is not only meaningful but also potentially clinically significant. The lack of statistical significance is likely attributable to the small sample size rather than the absence of a true effect. These findings support the presence of a substantial difference in OSA prevalence between Indian and international cohorts and highlight the importance of larger studies to confirm this association.

The biological plausibility of this association is well established. Intermittent hypoxia, a hallmark feature of OSA, leads to oxidative stress, systemic inflammation, and endothelial dysfunction, all of which are central to the pathogenesis of CAD (De Torres-Alba et al., 2013). Repeated hypoxia–reoxygenation cycles promote the generation of reactive oxygen species, contributing to vascular injury and atherosclerotic plaque formation. Additionally, OSA-induced sympathetic overactivity results in increased blood pressure and myocardial oxygen demand, further exacerbating coronary ischemia (Mandal et al., 2018).

Inflammatory pathways also play a crucial role in linking OSA with CAD. Elevated levels of inflammatory mediators such as C-reactive protein, interleukins, and tumor necrosis factor-alpha have been reported in OSA patients, contributing to plaque instability and increased risk of acute coronary events. This may explain the particularly high prevalence of OSA observed in patients with acute coronary syndrome in Indian studies.

The higher burden of OSA in Indian populations may be attributed to multiple factors. These include a higher prevalence of metabolic risk factors such as obesity, diabetes mellitus, and hypertension, as well as potential underdiagnosis of sleep disorders in routine clinical practice. Differences in study design, diagnostic modalities, and population characteristics further contribute to the heterogeneity observed across studies.

The substantial heterogeneity in prevalence estimates across studies underscores the complexity of the OSA–CAD relationship. Variability in diagnostic criteria, study populations, and disease severity limits direct comparability and highlights the need for standardized methodologies. Although a formal meta-analysis was not performed, the observed trends and effect size analysis provide meaningful insights into regional differences.

Despite these limitations, the findings of the study emphasize that OSA is not merely a comorbid condition but an independent and potentially modifiable risk factor for CAD. Early identification and management of OSA, particularly through interventions such as continuous positive airway pressure (CPAP), may improve cardiovascular outcomes, although further large-scale studies are required to confirm long-term benefits.

V. Conclusion

This study highlights a significant and clinically relevant association between obstructive sleep apnea and coronary artery disease. Evidence from both Indian and international studies indicates that OSA is highly prevalent among patients with CAD and contributes to disease progression through mechanisms such as intermittent hypoxia, oxidative stress, systemic inflammation, and endothelial dysfunction (De Torres-Alba et al., 2013; Mandal et al., 2018).

Comparative statistical analysis revealed a higher burden of OSA in Indian populations compared to international cohorts. Although the difference did not achieve statistical significance, the large effect size suggests a meaningful and potentially clinically important difference. This emphasizes the limitation of relying solely on p-values, particularly in studies with small sample sizes, and highlights the importance of considering effect size in interpreting results.

The findings underscore the need for increased awareness and routine screening of OSA in patients with coronary artery disease, especially in high-risk populations such as those with obesity, diabetes, and hypertension. Early diagnosis and appropriate management of OSA may play a crucial role in reducing cardiovascular morbidity and improving patient outcomes.

However, the current evidence is limited by heterogeneity in study design, diagnostic approaches, and sample size. Future research should focus on large, multicentre, prospective studies using standardized diagnostic criteria to better define the relationship between OSA and CAD. Additionally, further investigation into the impact of therapeutic interventions such as CPAP on cardiovascular outcomes is warranted.

In conclusion, obstructive sleep apnea represents a significant yet underrecognized contributor to coronary artery disease. Addressing this comorbidity through early detection and targeted intervention may offer a valuable strategy for improving cardiovascular health and reducing the global burden of CAD.

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