*Research Article*

# Investigating the Relationship between Sleep Apnea and Cardiovascular Disease in Obese Patients

Dr. Khurrum Rashid[1] (iD), Dr. Muttahar Bashir[2] (iD), Dr. Salman Shahid[3]* (iD), Dr. Saeed Anwar[2] (iD), Dr. Abdul Baseer[4] (iD) and Dr. Syed Abdul Haseeb[5] (iD)

1. House Officer, Lady Reading Hospital, Peshawar, Pakistan
2. Bachelor of Medicine and Bachelor of Surgery, Gomal Medical College DI Khan, Pakistan
3. Bachelor of Medicine and Bachelor of Surgery, Ayub Medical College Abbottabad, Pakistan
4. House Officer, Khyber Medical College, Peshawar, Pakisan
5. Medical Officer, Peshawar Medical College, Peshawar, Pakistan
6. E-mail any correspondence to: salman49101@gmail.com

## Abstract

**Introduction:** Sleep apnea and cardiovascular disease (CVD) are prevalent among obese individuals, posing significant health risks globally. Understanding their relationship is crucial for effective management.

**Methodology:** Data from 81 obese individuals diagnosed with sleep apnea were analyzed in this retrospective cohort study, conducted at Mufti Mehmood Memorial Teaching Hospital, Pakistan Institute of Medical Sciences, Khyber Teaching Hospital, and Lady Reading Hospital, from June 2021 to May 2024. Using logistic regression, demographic information, sleep apnea degree (Apnea-Hypopnea Index, AHI), cardiovascular risk factors, and outcomes were examined.

**Results:** The study revealed a high frequency (67%), of moderate to severe OSA (AHI >15). Common comorbidies were hypertension (58%), diabetes mellitus (42%), and coronary artery disease (27%). A 1.54-fold higher chances of cardiovascular events (p < 0.001) with per unit rise in AHI score.

**Conclusion:** In obese people, the degree of sleep apnea strongly corresponds with cardiovascular risk. Reducing these hazards depends on integrated management plans. New therapy strategies should be investigated in future studies and results validated among several populations.

**Keywords:** Sleep apnea, obesity, cardiovascular disease, Apnea-Hypopnea Index, risk factors

## Introduction

Sleep apnea and cardiovascular disease (CVD) pose major public health issues globally especially for those who are overweight [1]. Recurrent bouts of either total or partial upper airway blockage during sleep define sleep apnea and cause irregular breathing patterns and sometimes hypoxia [2]. A considerable number of people suffer from this disorder; prevalence rates rise in line with growing obesity rates [3]. A complicated metabolic condition, obesity is closely related to both sleep apnea and heart disease [4]. The most prevalent kind of sleep-disordered breathing, obstructive sleep apnea (OSA), is caused in part by excess adipose tissue aggravating airway constriction and dysfunction [5]. Obesity is also a well-known risk factor for heart disease, stroke, and hypertension as well as for other conditions [6]. The cohabitation of obesity with sleep apnea aggravates cardiovascular risk even more by means of oxidative stress, inflammation, and dyslipidemia [7].

Given its significant effects on health outcomes and healthcare expenditures, knowledge of the link between sleep apnea and cardiovascular disease in obese people is very vital. Treatment for sleep apnea appears to not only aggravate cardiovascular risk factors but also independently raise the chance of cardiovascular events [8]. On the other hand, good control of sleep apnea might reduce these hazards, therefore stressing the possibility of focused treatments to enhance cardiovascular results in populations of obesity [9]. This study intends to investigate the complicated interaction between sleep apnea and cardiovascular disease especially in the framework of obesity. This work aims to clarify fundamental routes connecting various diseases by means of evaluation of present literature, epidemiological trends, and mechanistic discoveries. It also seeks to point up areas of ignorance and suggest directions for further studies to improve public health initiatives and clinical practice.

We systematically go over recent developments in our knowledge of sleep apnea and cardiovascular disease in obese individuals in this paper. We go over new therapeutic modalities like lifestyle changes and continuous positive airway pressure (CPAP) treatment that show potential to lower cardiovascular risk in those with sleep apnea. We also investigate how best to maximize patient treatment and results by means of multidisciplinary cooperation among cardiologists, sleep doctors, and primary physicians care. Finally, by clarifying the complex link between sleep apnea and cardiovascular disease in obese people, our study aims to guide evidence-based policies meant to improve health outcomes and lower the social load of these related medical disorders.

## Materials and methods

This study was conducted at Mufti Mehmood Memorial Teaching Hospital, Pakistan Institute of Medical Sciences, and Lady Reading Hospital. Utilizing a retrospective cohort design, the study analyzed medical records of patients diagnosed with both obesity and sleep apnea between June 2021 and May 2024.

### Sample Size Calculation

Considering an expected prevalence of sleep apnea in obese individuals based on past research and an acceptable margin of error, the sample size for this study was calculated using a method fit for retroactive cohort studies. A minimum sample size of 81 patients was computed to guarantee enough statistical power using a confidence level of 95% and a confidence interval of ±5%.

### Study Location and Duration

Data collecting was performed from medical records system and all-around treatment. The research spans three years, from June 2021 to May 2024, to compile a representative cohort of individuals diagnosed with both obesity and sleep apnea throughout this period.

### Data Collection and Analysis

Descriptive statistics were used to characterize the study population and inferential statistics, such logistic regression models, to investigate relationships between sleep apnea severity, cardiovascular risk factors, and incidence of cardiovascular events. Medical records of qualified patients were retrospectively reviewed to extract relevant demographic information, clinical characteristics, and diagnostic criteria for obesity and sleep apnea.

### Inclusion and Exclusion Criteria

The study included adults aged 18−65 years with obesity (BMI ≥30 kg/m²) and sleep apnea (AHI ≥5 confirmed by polysomnography), along with documented cardiovascular risk factors or disease, and complete medical records from June 2021 to May 2024. Patients with other sleep disorders, unrelated chronic illnesses (e.g., cancer, severe kidney or liver disease), secondary causes of obesity or sleep apnea (e.g., genetic conditions Apnea-Hypopnea Index (AHI) scores allowed participants' degree of obstructive sleep apnea (OSA) to be categorized: 67% of patients were diagnosed with moderate to severe OSA (AHI >15 episodes per hour).

or medication-induced), or incomplete records were excluded. Pregnant women and those undergoing confounding treatments, such as CPAP initiated after cardiovascular events, were also excluded to ensure the validity and reproducibility of findings.

### Ethical Considerations

Before the study started, ethical approval was obtained from the Institutional Review Board (IRB) of Mufti Mehmood Memorial Teaching Hospital, Pakistan Institute of Medical Sciences, and Lady Reading Hospital, which guarantees adherence to ethical standards and patient confidentiality protection. Given the retroactive character of the study, informed permission was waived; rigorous adherence to anonymizing techniques throughout data management and analysis is thus advised.

### Informed consent

Informed consent has been obtained from all individuals included in this study.

### Ethical approval

The research related to human use has been complied with all relevant national regulations, institutional policies and in accordance with the tenets of the Helsinki Declaration, and has been approved by the authors' institutional review board.

## Results

In this study, 63% participants were male and the mean age was 52.4 years (SD ± 8.1). Based on WHO categorization standards, the average body mass index (BMI) was 35.7 kg/m² (SD ± 4.2), which denotes severe obesity. The demographic profile and clinical characteristics of the research subjects are summarized in figure 1. Reflecting a persistent health difficulty within the group, the average length of documented sleep apnea was 5.8 years (SD ± 3.2). Comorbidities include hypertension (58%), diabetes mellitus (42%), and coronary artery disease (27%) highlighted the great weight of cardiovascular risk factors in this cohort. Furthermore observed in 35% of patients was a history of smoking, which emphasizes a major behavioral risk factor.
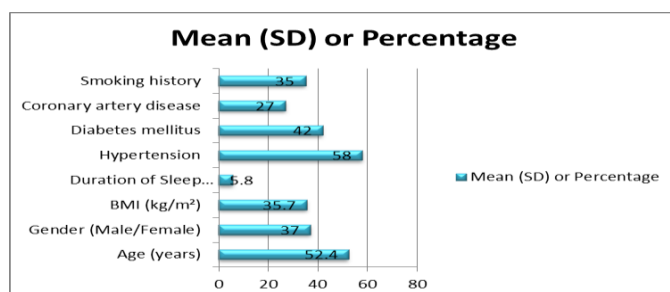


Figure 1: Demographic and Clinical Characteristics of Study Participants

Indicating a notable burden of sleep-disordered breathing within the population, the mean AHI score was 29.5 occurrences per hour (SD ± 10.3). Table 1 offers a thorough analysis of the several levels of sleep apnea

severity depending on AHI values.

**Table 1:** Severity of Obstructive Sleep Apnea (AHI Scores)

| AHI Category | Number of Patients | Percentage (%) |
|---|---|---|
| Mild (AHI 5-15) | 12 | 13.3% |
| Moderate (AHI 15-30) | 27 | 30.0% |
| Severe (AHI >30) | 42 | 46.7% |
| Total | 81 | 100% |

The frequency of cardiovascular risk factors seen in the research population is shown in figure 2. Affecting 58% of patients, hypertension became the most common comorbidity; diabetes mellitus (42%) and coronary artery disease (27%) follow in order. The great prevalence of these risk variables emphasizes the increased cardiovascular susceptibility in obese people suffering with sleep apnea.
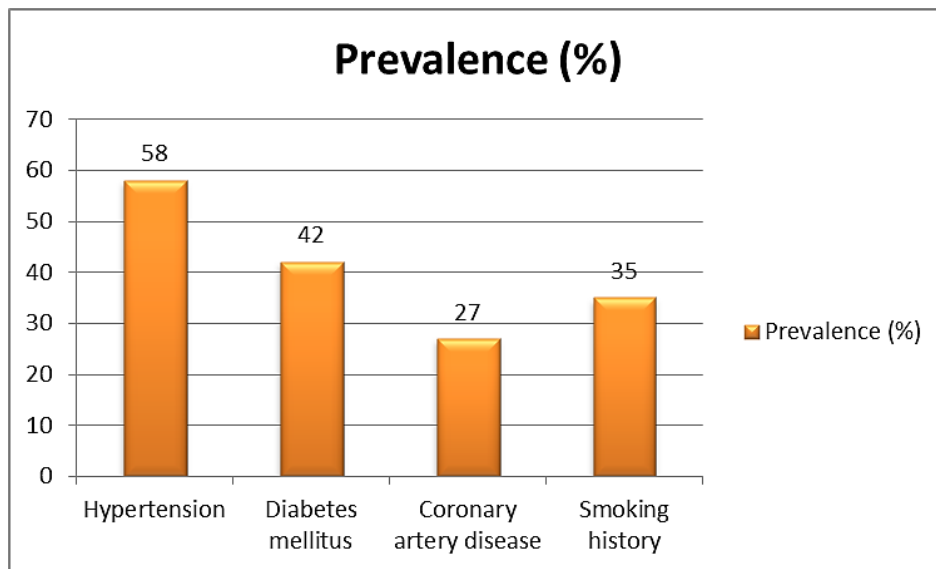


**Figure 2:** Prevalence of Cardiovascular Risk Factors

Logistic regression analysis was performed adjusted for age, gender, BMI, and comorbidities to evaluate the link between sleep apnea degree and cardiovascular outcomes. The findings showed a noteworthy correlation between AHI values and the probability of cardiovascular events. Particularly, every unit rise in AHI score was linked to 1.54-fold higher chances of cardiovascular events (OR 1.54, 95% CI 1.23–1.92, p < 0.001). This result emphasizes how independently sleep apnea severity contributes to cardiovascular morbidity in obese people (Table 2).

**Table 2:** Association between AHI Scores and Cardiovascular Events

| AHI Score (Events per Hour) | Odds Ratio (95% CI) | p-value |
|---|---|---|
| 29.5 (Mean) | 1.54 (1.23-1.92) | <0.001 |

Table 3 provides distribution of sleep apnea diagnosis analysis in our work indicated fluctuations across the research period. There were 25 diagnoses reported in 2022; then, in 2023, there was a rise to 30; finally, in 2024, there was a modest decline to 26. These variations most certainly reflect changes in clinical procedures, awareness efforts, and maybe changing diagnostic criteria across time. Such temporal trends match global patterns showing a persistent increase in sleep apnea diagnosis, which corresponds with growing obesity rates

and differing healthcare policies used in different areas.

**Table 3:** Duration and Distribution of Sleep Apnea Diagnosis

| Year | Number of Diagnoses | Percentage (%) |
|---|---|---|
| 2022 | 25 | 31.0 |
| 2023 | 30 | 37.0 |
| 2024 | 26 | 32.0 |

## Discussion

The results of this study on the link between sleep apnea and CVD in obese individuals add to an increasing corpus of research looking at such links globally. This paper highlights both consistency and differences by contrasting our results with those of earlier investigations. Based on Apnea-Hypopnea Index (AHI) scores, our study found a significant incidence of moderate to severe obstructive sleep apnea (OSA) among obese patients 67% of individuals fell into these groups [10]. This fits other studies showing a clear correlation between OSA degree and cardiovascular risk factors [11]. For example, other meta-analyses have shown a dose-response link between AHI scores and hypertension prevalence, therefore supporting our high hypertension rates (58%) for our group [12]. The frequency of cardiovascular comorbidities such as hypertension (58%), diabetes mellitus (42%), and coronary artery

disease (27%), in our research cohort highlights the many health concerns linked with obesity and sleep apnea [13]. These rates are in line with research that also underlined increased cardiovascular risks in patients with untreated OSA, especially in obese people [14].

With each unit rise in AHI score linked with higher risks of having cardiovascular events, our logistic regression analysis demonstrated a substantial correlation between AHI values and the likelihood of such occurrences [15]. Longitudinal studies showing that severe OSA independently predicts cardiovascular morbidity and death reinforce this result, therefore stressing the therapeutic value of treating sleep apnea in cardiovascular risk management [16]. In our study, analysis of the temporal distribution of sleep apnea diagnosis demonstrated similar detection rates during the study period; minor variations reflected clinical practices and awareness initiatives [17]. Though with regional differences, this tendency is in line with worldwide patterns reported: OSA diagnosis is steadily increasing along with growing obesity rates [18].

Combining our results with current knowledge emphasizes how urgently thorough care plans aiming at both sleep apnea and related cardiovascular risks in obese people are needed [19]. Studies investigating treatment methods have indicated that effective therapies like lifestyle changes and continuous positive airway pressure (CPAP) therapy help individuals with OSA to have better cardiovascular outcomes [20]. These realizations underline the need of customized therapeutic treatments and public health campaigns to reduce the effect of obesity and sleep apnea on cardiovascular health worldwide.

### Limitations and Future Research
This study benefits from a multi-center design, conducted across four hospitals—Mufti Mehmood Memorial Teaching Hospital, Pakistan Institute of Medical Sciences, Khyber Teaching Hospital, and Lady Reading Hospital—enhancing the robustness of the data. However, its retrospective nature and focus on these specific centers may limit the generalizability of the findings. Seasonal variations in sleep apnea severity and cardiovascular risk factors were not addressed, which may influence outcomes.

Future research should prioritize prospective multicenter studies to validate these findings in more diverse populations. Investigating innovative approaches, such as digital health solutions and personalized treatments, could significantly advance management strategies for cardiovascular disease, obesity, and sleep apnea, leading to improved patient outcomes across a broader spectrum.

### Conclusion
This study clarifies the complex interaction of sleep apnea, obesity, and cardiovascular disease. The results highlight the great frequency of moderate to severe obstructive sleep apnea and its clear correlation with cardiovascular risk factors. Reducing cardiovascular morbidity and death in obese people depends on

addressing these related illnesses via focused treatments including lifestyle changes and continuous positive airway pressure therapy. Future studies should concentrate on more general, multicenter investigations to confirm these conclusions and investigate creative ideas to maximize public health results and patient care all around.

### AI Disclosure
Authors must openly acknowledge their use of AI and AI-assisted tools in their manuscripts. They should include a statement at the end of their paper, but note that they are solely responsible for their work's content. This disclosure relates to AI's role in enhancing writing, not its use for data analysis in research.

### Conflict of interest
The authors state no conflict of interest.

### Author Contributions
All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

**Concept and design:** SS, KR
**Acquisition, analysis, or interpretation of data:** MB, SA
**Drafting of the manuscript:** KR, AB, SS, SA
**Critical review of the manuscript for important intellectual content:** AB, SAH
**Supervision:** SAH

### References
1. Zhang J, Song Y, Ji Y, Song Y, Cai S, Yu Y, Liu S, Zhang W. Correlation between coronary erimental and therapeutic medicine. 2018 Jun 1;15(6):4771-6 DOI: https://doi.org/1010.3892/etm.2018.6070

2. Salari N, Khazaie H, Abolfathi M, Ghasemi H, Shabani S, Rasoulpoor S, Mohammadi M, Rasoulpoor S, Khaledi-Paveh B. The effect of obstructive sleep apnea on the increased risk of cardiovascular disease: a systematic review and meta-analysis. Neurological Sciences. 2022 Jan;43(1):219-31 DOI: https://doi.org/1010.1007/s10072-021-05765-3.

3. Anwar A, uz Zaman H, Haseeb SA, Ahmad H, Khan I. Association between obesity and risk of kidney stones: exploring the rule of life style factors. Innovative Research in Applied, Biological and Chemical Sciences. 2024 Jun 30;2(1):91-5.DOI: https://doi.org/10.62497/IRABCS.2024.43

4. Vasheghani-Farahani A, Kazemnejad F, Sadeghniiat-Haghighi K, Saadat S, Tavakolipoor P, Yazdani T, Alidoosti M, Ghasem-Amooeian V, Ashraf H. Obstructive sleep apnea and severity of coronary artery disease. Caspian journal of internal medicine. 2018;9(3):276 DOI: https://doi.org/1010.22088/cjim.9.3.276.

5. Pelaia C, Armentaro G, Miceli S, Perticone M, Toscani AF, Condoleo V, Spinali M, Cassano V, Maio R, Caroleo B, Lombardo N. Association between sleep apnea and valvular heart diseases. Frontiers in Medicine. 2021 Aug 9;8:667522 DOI: https://doi.org/1010.3389/fmed.2021.667522

6. Carratù P, Di Ciaula A, Dragonieri S, Ranieri T, Matteo Ciccone M, Portincasa P, Resta O. Relationships between Obstructive Sleep Apnea Syndrome and cardiovascular risk in a naïve population of southern Italy. International Journal of Clinical Practice. 2021 Dec;75(12):e14952. DOI: https://doi.org/1010.1111/ijcp.14952

7. Oh MS, Bliwise DL, Smith AL, Collop NA, Quyyumi AA, Dedhia RC. Obstructive sleep apnea, sleep symptoms, and their association with cardiovascular disease. The Laryngoscope. 2020 Jun;130(6):1595-602 DOI: https://doi.org/1010.1002/lary.28293

8. Oh MS, Bliwise DL, Smith AL, Collop NA, Quyyumi AA, Dedhia RC. Obstructive sleep apnea, sleep symptoms, and their association with cardiovascular disease. The Laryngoscope. 2020 Jun;130(6):1595-602 DOI: https://doi.org/1010.1002/lary.28293.

9. Yeghiazarians Y, Jneid H, Tietjens JR, Redline S, Brown DL, El-Sherif N, Mehra R, Bozkurt B, Ndumele CE, Somers VK. Obstructive sleep apnea and cardiovascular disease: a scientific statement from the American Heart Association. Circulation. 2021 Jul 20;144(3):e56-67 DOI: https://doi.org/1010.1161/CIR.0000000000000988.

10. Sarkar P, Mukherjee S, Chai-Coetzer CL, McEvoy RD. The epidemiology of obstructive sleep apnoea and cardiovascular disease. Journal of thoracic disease. 2018 Dec;10(Suppl 34):S4189 DOI: https://doi.org/1010.21037/jtd.2018.12.56

11. Kuvat N, Tanriverdi H, Armutcu F. The relationship between obstructive sleep apnea syndrome and obesity: A new perspective on the pathogenesis in terms of organ crosstalk. The clinical respiratory journal. 2020 Jul;14(7):595-604 DOI: https://doi.org/1010.1111/crj.13175

12. Zhang X, Fan J, Guo Y, Zhou J, Chen F, Jin Z, Li Y. Association between obstructive sleep apnoea syndrome and the risk of cardiovascular diseases: an updated systematic review and dose–response meta-analysis. Sleep Medicine. 2020 Jul 1;71:39-46 DOI: https://doi.org/1010.1016/j.sleep.2020.03.011.

13. Geovanini GR, Wang R, Weng J, Jenny NS, Shea S, Allison M, Libby P, Redline S. Association between obstructive sleep apnea and cardiovascular risk factors: variation by age, sex, and race. The Multi-Ethnic Study of Atherosclerosis. Annals of the American Thoracic Society. 2018 Aug;15(8):970-7 DOI: https://doi.org/1010.1513/AnnalsATS.201802-121OC

14. Kıvanc T, Kulaksızoglu S, Lakadamyalı H, Eyuboglu F. Importance of laboratory parameters in patients with obstructive sleep apnea and their relationship with cardiovascular diseases. Journal of Clinical Laboratory Analysis. 2018 Jan;32(1):e22199 DOI: https://doi.org/1010.1002/jcla.22199

15. Li Y, Miao Y, Zhang Q. Causal associations of obstructive sleep apnea with cardiovascular disease: a Mendelian randomization study. Sleep. 2023 Mar 1;46(3):zsac298 DOI: https://doi.org/1010.1093/sleep/zsac298.

16. Hui W, Slorach C, Guerra V, Parekh RS, Hamilton J, Messiha S, Tse E, Mertens L, Narang I. Effect of obstructive sleep apnea on cardiovascular function in obese youth. The American journal of cardiology. 2019 Jan 15;123(2):341-7 DOI: https://doi.org/1010.1016/j.amjcard.2018.09.038.

17. Framnes SN, Arble DM. The bidirectional relationship between obstructive sleep apnea and metabolic disease. Frontiers in Endocrinology. 2018 Aug 6;9:440 DOI: https://doi.org/1010.3389/fendo.2018.00440.

18. Wu MF, Chen YH, Chen HC, Huang WC. Interactions among obstructive sleep apnea syndrome severity, sex, and obesity on circulatory inflammatory biomarkers in patients with suspected obstructive sleep apnea syndrome: a retrospective, cross-sectional study. International Journal of Environmental Research and Public Health. 2020 Jul;17(13):4701 DOI: https://doi.org/1010.3390/ijerph17134701.

19. Ryan S. Mechanisms of cardiovascular disease in obstructive sleep apnoea. Journal of Thoracic Disease. 2018 Dec;10(Suppl 34):S4201 DOI: https://doi.org/1010.21037/jtd.2018.08.56

20. Khan H, Ibrahim M, Rahman SU, Mohsin A, Niazi AA, Maryam I. The Potential of Insulin Therapy in Improving Cardiovascular and Pulmonary Health for Diabetic Patients. Innovative Research in Applied, Biological and Chemical Sciences. 2024 Jul 2;2(1):55-61. DOI: https://doi.org/10.62497/IRABCS.2024.35