

Prevalence of comorbidities in obstructive sleep apnea patients in comparison with general population

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Abstract

Background: Obstructive sleep apnea (OSA) is a breathing disorder that occurs in sleep, which poses many threats more than disturbed sleep. It is associated with major comorbidities. There are insufficient studies in India regarding multiple comorbidities and OSA syndrome. The objective of this study is to compare the incidence of comorbidities in documented OSA patients with subjects without OSA.

Methods: The study was carried out with a total of 274 patients in tertiary-care hospital for a period of 6 months. The study design used was retrospective case-control study. Patient history was taken from the documented records. SPSS package was used for estimating results.

Results: Mean age of patients was 55.53 ± 11.37 years. Average apnea-hypopnea index was 45.50 ± 24.51 . A total of 110 men and 27 women were seen. The age group of 45–65 years recorded the highest number of OSA patients with a greater severity. The prevalence of hypertension (HT) in case group was 38.4%. When the correlation coefficient was calculated, HT correlated the most with OSA ($r=0.513$, $P=0.01$) followed by stroke, hypothyroidism, and coronary artery disease. The least correlation was with diabetes mellitus ($r=0.172$, $P=0.01$) with prevalence of 40.15% in case group.

Conclusions: The study showed that prevalence of comorbidities is more in patients with OSA than without OSA.

Keywords: OSA, comorbidities, apnea hypopnea index, case-control study, odds ratio, hypertension.

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Introduction

The incidence of obstructive sleep apnea (OSA) is increasing in India. The derangements caused by recurrent failure of the upper airway are directly related to the signs and symptoms and consequences of OSA, which include sleep fragmentation, hypoxia, hypercapnia, notice able

variations in intrathoracic pressure, and enhanced sympathetic activity.

OSA is a recognized risk factor for systemic hypertension¹. OSA is generally related tonighttime hypertension and toa reversed 24-hour arterial pressure profile². Enhanced after load at the time of obstructive happening, nighttime hypoxemia, and subsequent increased sympathoadrenal activity damageleft ventricular function³.

It is well known that causes a worst scenario of insulin resistance, leading too obvious compensatory hyperinsulinemia and, thereby, elevating the necessity for overdoses of exogenous insulin⁴. Thedamage in glucose tolerance is associated with oxygen desaturation. A 4% reduction in saturation results in the associated odds ratio for deteriorating glucose tolerance of 1.99⁵.

Severe OSA is associated with an increased incidence of coronary vascular disease independent of insulin resistance and obesity. OSA is also associated with increased risk of stroke and other cardiovascular diseases,with mechanisms being increased sympathetic activity, endothelial dysfunction, elevated fibrinogen levels, increased in vivo platelet activation during sleep, alteration of in vitro platelet agreeability, hypercoagulability, and decreased cerebral blood flow in sleep apnea patients⁶.

The mechanisms suggestive of clarifying how hypothyroidism results in OSA comprise mucoprotein deposition in the upper airway, reduced neural output to the upper airway musculature, obesity, and aberrations in ventilatory control⁷.

Most of the people are undiagnosed, especially malesubjects. There are insufficient studies in India regarding multiple comorbidities and OSA syndrome. All the studies have focused on a single comorbid condition. This study aims at including five comorbid conditions and to determine which among these carries the most significant correlation with OSA.

Material and Methods

A retrospective case-control observational study was carried out in Department of Pulmonology of a 1000-bedded tertiary-care hospital. This study was conducted for 6 months after taking permission from Institutional Ethics Committee.

The type of sleep study performed was split-night or whole-night polysomnography (PSG), with 55-channel ALICE-5 PSG system. Enrolment of the patient was from the Outpatient Department of Pulmonology. Patients who were diagnosed as OSA in whole-or split-night polysomnography were included in case group, whereas patients whose sleep study was negative for OSA were included in control group.

The information regarding comorbidities, body mass index (BMI), other baseline data, and apnea-hypopnea index (AHI) value was collected from the patient's medical records and polysomnography reports.

With estimated proportion of incidence of OSA being 14%, confidence interval (CI) of 95%, power of 85%, sample size was calculated as 137 in case group and 137 in control group. A total of 274 patients were involved in the study.

The severity of OSA is based on AHI: mild, 5-14; moderate, 15-29; and severe ≥ 30 .

Clinically, OSA is defined by the incidence of daytime sleepiness, loud snoring, observed breathing interludes or arousals owing to gasping or choking in the presence of at least five obstructive respiratory events (apneas, hypopneas, or respiratory efforts-related arousals) per hour of sleep⁸.

Selection Criteria for Case Group

Following were the criteria for inclusion in the study.

- Patients diagnosed as mild, moderate, or severe OSA by either whole-night or split-night polysomnography.
- Patients from age group of 18 to 80 years.

Exclusion Criteria

- Pregnant women.
- Inconclusive sleep study.

Selection Criteria for Control Group

Inclusion Criteria

- Control group is selected so as to match the case in terms of age and sex.
- Subjects must not have OSA.

Tools Used

- Data collection form (patient history) designed for OSA patient.
- Data entry was done in Microsoft Excel.
- SPSS package was used for estimating results.

Statistical Analysis

Odds ratio was calculated to estimate the level of comorbidities in case and control groups. Correlation coefficient was estimated for different comorbidities and OSA. *P* value of $d > 0.05$ was considered as statistically significant.

Results

After retrieving all the data and analyzing, the descriptive statistics of the study population was calculated.

The total number of male and female patients in the case group was 110 and 27, respectively. The same number of subjects was taken in control group. The mean age of population without OSA was close to population with OSA, indicating that both the groups were matched in terms of age and gender.

The age group of 45-65 years recorded the highest number of OSA patients in both male and female population: 60 and 19 patients respectively. The 25-35 years age group and 75-86 years age group recorded least number of patients in both the genders. The detailed information is provided in (Table 1).

Table 1: Age- and gender-wise categorization of the study population

Age (years)	Male		Female		Total patients	Cumulative percentage
	<i>n</i>	%	<i>n</i>	%		
25-35	9	1.18	0	0.00	9	1.18
35-45	16	14.55	1	3.70	17	12.40
45-55	33	30	6	22.22	39	28.46
55-65	33	30	13	48.15	46	33.58
65-75	17	15.45	7	25.92	24	17.51
75-86	2	1.82	0	0.00	2	1.46
Total	110	100	27	100	137	100

The age group of 45-65 years recorded more number of overweight and obese patients, with a percentage of 61.73%. Interestingly, there were two patients in the normal weight category in the age group of 55-65 years with OSA as shown in Table 2 and Figure 1.

Table 2: Categorization of the study population by age and body mass index

Age group (years)	Body mass index						Total	Total %
	Normal weight	%	Over weight	%	Obese	%		
25-35	0	0	7	5.10	2	1.45	9	6.55
35-45	0	0	5	3.64	12	8.75	17	12.39
45-55	0	0	14	10.2	25	18.24	39	28.44
55-65	2	1.45	13	9.48	31	22.36	46	33.29
65-75	0	0	6	4.37	18	13.14	24	17.51
75-86	0	0	1	0.72	1	0.72	2	1.44
Total	2	1.45	32	33.51	93	64.66	137	100

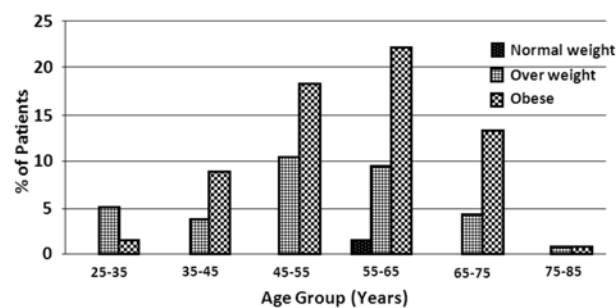


Figure 1: BMI categorization according to age of population

Table 3: Severity of obstructive sleep apnea

Severity	<i>N</i>	Percentage
Mild	13	9.48
Moderate	31	22.63

Mild form of OSA was found to be least prevalence with 9.48% and severe form of OSA in most patients with 67.89%. The details are shown in Table 3.

The prevalence of all forms of OSA (mild, moderate, and severe) was on a higher side in the age group of 45-65 years, recording 62.05% as shown in Table 4 and (Figure 2).

When odds ratio and coefficient of correlation was done for comorbidities with OSA, it was seen that hypertension was closely correlated to OSA. Detailed information is given in (Table 5).

Table 6 and Figure 3 clearly show that patients with hypertension showed the highest percentage of OSA prevalence with a total of 97 patients, and the least was with hypothyroidism, which accounted for only 28 patients.

Table 4: Categorization of obstructive sleep apnea severity with age

Age group (years)	Severity						Total	Total %
	Mild	%	Moderate	%	Severe	%		
25-35	0	0	0	0	9	6.57	9	6.57
35-45	4	2.92	2	1.45	11	8.02	17	12.41
45-55	4	2.92	11	8.02	24	17.52	39	28.47
55-65	4	2.92	10	7.30	32	23.36	46	33.58
75-86	0	0	2	1.45	0	0	2	1.45
Total	13	9.49	32	23.36	93	67.88	137	100

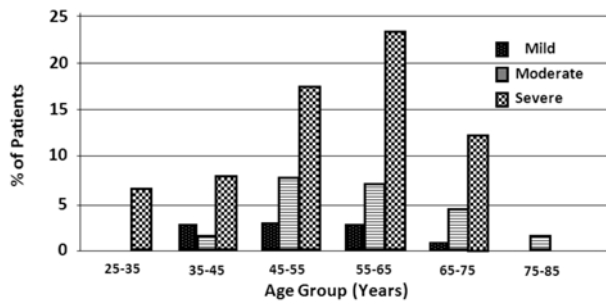


Figure 2: Distribution of severity of OSA according to age

Table 5: Odds ratio and coefficient correlation of comorbidities with OSA

Comorbidity	Obstructive sleep apnea patients (%)	Nonobstructive sleep apnea patients (%)	Odds ratio (confidence interval)	Coefficient of correlation (P)
Hypertension	70.8	19.71	9.88 (5.647, 17.284)	0.513 (0.01)
Diabetes mellitus	40.15	24.09	2.11 (1.257, 3.554)	0.172 (0.01)
Hypothyroidism	20.44	2.92	8.54 (2.90, 25.09)	0.276 (0.01)
Coronary artery disease	28.47	9.49	3.84 (1.94, 7.52)	0.244 (0.01)
Stroke	26.28	1.46	24.05 (5.6, 102.2)	0.359 (0.01)

Table 6: Categorization of comorbidities based on severity of obstructive sleep apnea

Comorbidity	Mild	%	Moderate	%	Severe	%
Hypertension	4	2.92	25	18.25	68	49.64
Hypothyroidism	2	1.46	7	5.11	19	13.87
Coronary artery disease	3	2.19	11	8.03	25	18.25
Stroke	2	1.46	8	5.84	26	18.98

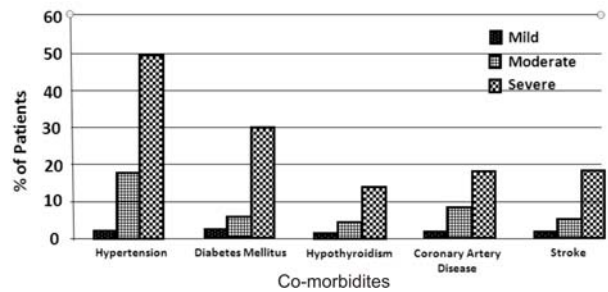


Figure 3: Categorization of severity of OSA in different comorbidities

Table 7: Demographic data of patients without comorbidities

	With OSA	
	Male	Female
Number	14	3
Age (years)	50.07 ± 13.42	57.0 ± 4.36
BMI (kg/m ²)	31.39 ± 6.31	30.7 ± 1.14
AHI	45.19 ± 18.80	19.97 ± 12.48

Table 8: The general demographic data of both case and control groups

Parameter	Case group (mean ± SD)	Control group (mean ± SD)
Age (years)	55.53 ± 11.374	55 ± 11.68
BMI (kg/m ²)	33.02 ± 5.75	28.07 ± 5.30
AHI	45.50 ± 24.51	—
Duration of hypertension (years)	6.21 ± 6.82	1.74 ± 4.43
Duration of diabetes mellitus (years)	2.78 ± 4.91	1.99 ± 4.71
Duration of hypothyroidism (years)	1.00 ± 2.51	0.13 ± 0.84
Duration of coronary artery disease (years)	2.17 ± 4.59	0.87 ± 3.37
Event of stroke (years)	1.80 ± 3.83	0.04 ± 0.42

Table 7 shows the demographics of case group without comorbidities, in which the mean AHI in the men was 45.19 ± 18.80 and in women 19.97 ± 12.48 .

The mean duration of various comorbidities and demographics of case and control groups is shown in (Table 8).

Discussion

This study shows the ratio of OSA prevalence in men and women as 4:1. As seen in the study done by Bixler et al.⁹ where the ratio was found to be 3.3:1, it can be interpreted that hormonal influences are also likely to have an important role in pathogenesis of OSA.

It was noted that maximum prevalence of OSA was in middle age group in both men and women as seen in (Table 2). The studies by BaHammamet al^{10,11}. have shown that 1 in 3 middle-aged Saudi male subjects is at risk for OSA and almost 4 of 10 middle-aged Saudi women are at risk for OSA^{10,11}. There is almost 2:1 ratio in the prevalence of increased BMI in middle age group when compared with lower age group. As the BMI is on the higher side in the middle-aged population, there is greater prevalence of severe OSA in this age group. According to Bixler et al., the average BMI did increase with age for subjects with OSA¹². When odds ratio was calculated to check the prevalence of comorbidities in OSA group in comparison with those without OSA, it was found that stroke showed a maximum odds ratio of 26.28 (95% CI: 5.66, 102.26); but, the width of CI was very high. Hypertension showed an odds ratio of 9.88 (95% CI: 5.647, 17.28). Hypothyroidism was next with an odds ratio of 8.54 (95% CI: 2.907, 25.09). Coronary artery disease showed an estimated odds ratio of 3.84 (95% CI: 1.94, 7.58). Finally, diabetes revealed an odds ratio of 2.11 (95% CI: 1.25, 3.55).

According to the study done by Goncalves et al¹³. OSA was present in 45 patients with OSA (71%) and in 4 patients without OSA (38%). In a logistic regression model, OSA was strongly and independently associated with resistant hypertension (odds ratio, 4.8; 95% CI: 2.0, 11.7). The study results by Mahmood et al. showed the prevalence of type 2 diabetes to be 30.1% in the group with OSA compared with 18.6% in those without OSA. The subjects with OSA showed significantly increased odds of type 2 diabetes compared with those without OSA (odds ratio, 1.8, 95% CI: 1.3, 2.6); but, this

association became non significant when subjects without OSA were adjusted for confounding variables and covariates (odds ratio, 1.3, 95% CI: 0.9, 2.0)¹⁴. A study done by Kapur et al. gave an estimate of the risk of OSA in individuals with treated hypothyroidism that was modestly higher (1.47 times) than in individuals who revealed no history of hypothyroidism. The summary odds ratio after stratification for age and gender was 1.47¹⁵. Peker et al¹⁶. conducted a study and created a multiple logistic regression model, and the significant predictors of coronary artery disease incidence were OSA at baseline (odds ratio, 4.9; 95% CI: 1.8, 13.6). In the OSA group, coronary artery disease incidence was observed in 21 of 37 (56.8%)¹⁶. According to study conducted by Davies et al¹⁷. the odds ratio was found to be 1.44 (95% CI: 0.88, 2.41)¹⁷. The patients without comorbidities showed a slightly overweight status, and the AHI was on a lower side. This shows that, as the weight and obstructive events reduce, there is lower incidence of comorbidities.

Conclusion

The study showed that prevalence of comorbidities is more in patients with OSA when compared with subjects without OSA. The most correlated comorbidity was found to be hypertension and least was diabetes mellitus. For patients with long-standing hypertension, screening for OSA may be considered. In patients with uncontrolled hypertension even on multiple drugs, referral to a sleep laboratory may be considered to diagnose previously undetected OSA.

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