Factors predicting the presence of depression in obstructive sleep apnea

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ABSTRACT

Background: Obstructive sleep apnea (OSA) is a sleep-related breathing disorder and is associated with a myriad of neurocognitive dysfunctions and cardiac and metabolic diseases. Several studies have shown the relation of depressive symptom in patients with OSA. Keeping this in view, we planned to study various factors predicting the presence of depression in OSA. Aim: The aim of the study was to study various factors predicting the presence of depression in OSA. Methods: We performed polysomnography (PSG) studies on patients that were referred from various subspecialty clinics from July 2011 to August 2013. Psychiatric diagnosis was done using the Mini International Neuropsychiatric Interview (plus) scale. This was followed by the application of the Hamilton Depression Rating Scale. Standard methods of statistical analysis were used for data analysis. All statistical analyses were performed using SPSS software version 11.0 (SPSS, Chicago, Illinois, USA) and tests of statistical significance were two-sided and differences were taken as significant when P-value was less than 0.05. Results: Of 182 patients who underwent PSG, 47 were suffering from depression with a mean age of 58.60 years. Age, gender, snoring, body mass index, hypertension, witnessed apnea, nocturia, disturbed sleep, and daytime sleepiness were significantly correlated with depression. Diabetes and cardiovascular disease were also significantly correlated, but the correlation was statistically significant at the 0.05 level. Conclusion: This study demonstrates a significant overlap between sleep apnea and depression. Health specialists need more information about screening for patients with OSA to ensure proper diagnosis and treatment of those with the condition.

Keywords: Depression, obstructive sleep apnea, psychiatric disorders

Obstructive sleep apnea (OSA) is a common sleep-related breathing disorder. It is characterized by repetitive airway restriction due to upper airway instability during sleep and results in markedly reduced (hypopnea) or absent (apnea) airflow during sleep. The end result is sleep fragmentation and arterial hypoxemia. The sleep changes and hypoxemia may provoke the depressive symptoms. Several possible causal mechanisms linking OSA and depression have been proposed but not established. Despite our limited understanding of the underlying mechanism of how sleep apnea is linked to depressed mood, patients with comorbid OSA have impaired neurocognitive functioning and impaired quality of life. Prevalence of depression in OSA, particularly with respect to patients with other chronic diseases, is a debatable issue. OSA and depression cases comprise two interacting epidemics, both with high prevalence and morbidity. Various researchers have reported a high prevalence of depression among people with OSA in both communities and clinical populations. Symptoms common to OSA and depression, such as daytime sleepiness and fatigue, are huge obstacles to determining the presence and severity of one condition in the presence of the other, in a research setup as well as in the clinical setting. Given the high prevalence of OSA in patients with depression, there are insufficient data on whether the presence and severity of OSA affects the severity of depression, presence of depression adds to treatment complexity, is frequently associated with chronicity, and negatively affects the course of OSA.

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In the past few years, the relationship between OSA and depression has become evident, and each of these two conditions can affect the patient’s overall health and course of the disease. The data regarding the factors predicting the presence of depression in OSA are scarce. To the best of our knowledge, not much has been reported regarding the presence of depression in OSA. Keeping this in view, we planned to study various factors predicting the presence of depression in OSA.

**METHODS**

**Participants**
We did a retrospective study of data from 182 patients with ages ranging from 22 to 90 years referred to our sleep laboratory from various subspecialty clinics from July 2011 to August 2013 for an evaluation of OSA. A total of 201 patients were included in the study and 19 patients were excluded from the study after checking inclusive and exclusive criteria. We performed sleep studies on patients that were referred to us and had been subjected to an overnight polysomnography (PSG).

**Exclusion criteria**
1. Patients on nocturnal oxygen supplementation
2. Unstable cardiopulmonary, neurological, or psychiatric disease
3. Upper airway surgery
4. Using positive airway pressure therapy or oral appliances
5. Patients using psychotropic drugs or diagnosed as having mental illness including depression.

All participants gave written informed consent before undergoing PSG. All patients underwent overnight PSG for the assessment of sleep-disordered breathing by means of a computer-based system. Demographic data, general medical history, clinical information from the initial visit for sleep-related complaints, as well as PSG results for cases, were recorded. Height, weight, and neck circumferences were measured in all patients.

A detailed history of complaints including snoring, witnessed apneas, nocturia, disturbed nocturnal sleep, and morning headaches was taken. Daytime sleepiness was assessed by the Epworth Sleepiness Scale (ESS).

An overnight laboratory PSG was then performed to diagnose the presence and severity of OSA. PSG recordings were started based on the patient’s usual domestic sleeping habits, and each patient was recorded for a minimum of 7 h.

**Polysomnographic recordings included**
Polysomnographic recordings included recordings of airflow by the nasal pressure transducer and oronasal thermocouples, chest and abdominal wall motion by piece electrodes, oxygen saturation by a pulse oximeter, electrocardiogram, six electroencephalogram channels, bilateral electrooculogram, and chin and tibialis electromyogram. The data were analyzed on a visual basis by an experienced investigator. Recordings were scored visually in 30 s in non-rapid eye movement (REM) sleep stages 1–4 sleep and in REM sleep according to standard criteria. Similarly, respiratory events and microarousals were scored according to established criteria. Daytime sleepiness was measured by the ESS. A score of >9 points was considered excessive daytime sleepiness (EDS). We defined the obstructive sleep apnea syndrome as a combination of apnea–hypopnea index >5 and an ESS Score >9.

Psychiatric diagnosis was done using the Mini-International Neuropsychiatric Interview (plus) scale. This was followed by the application of the Hamilton Depression Rating Scale (HAM-D) in patients suffering from OSA referred for PSG.

**Ethical committee**
The study was performed in accordance with the Declaration of Helsinki and was approved by a local ethics committee.

**Statistical analysis**
Normality of data in each group was tested with Kolmogorov–Smirnov test. Data were expressed in terms of mean and standard deviation for continuous variables, and a number of cases were used for categorical variables. Differences between the groups were analyzed by Kruskal–Wallis or Chi-square test as appropriate. Correlational analyses were calculated according to Pearson’s correlation.

**RESULTS**
Of 182 patients who underwent PSG, we found that 47 were suffering from depression with a mean age of 58.60 years. The basic characteristics and PSG finding of the study population are given in Table 1.

Variables that significantly correlated with the presence of depression in OSA include age ($r = 0.193$, $P = 0.009$), gender ($r = 0.045$, $P = 0.001$), snoring ($r = 0.277$, $P = 0.00$), body mass index (BMI) ($r = 0.300$, $P = 0.00$), hypertension ($r = 0.292$, $P = 0.00$), witnessed apnea ($r = 0.327$, $P = 0.00$), nocturia ($r = 0.255$, $P = 0.001$), disturbed sleep ($r = 0.0224$, $P = 0.002$), and daytime sleepiness ($r = 0.350$, $P = 0.000$). Diabetes ($r = 0.186$, $P = 0.012$) and cardiovascular disease ($r = 0.170$, $P = 0.022$) were also significantly correlated but correlation was statistically significant at the 0.05 level (two-tailed) [Table 2].
The prevalence of depression was more in moderate and severe OSA patients as compared to mild OSA ($P \leq 0.034$) [Table 3].

Of 182 patients who underwent PSG, 47 were suffering from depression, 121 patients had hypertension, 61 patients were suffering from diabetes, 28 from cardiovascular diseases, and 26 from other comorbidities [Table 4].

**DISCUSSION**

**Main findings**

OSA is a common breathing disorder associated with considerable morbidity. OSA is being recognized and diagnosed with increasing frequency as well and has become an increasingly important part of the respiratory practice. This study investigated the presence of depression and predictors of depression among individuals with OSA. In our study, age, gender, snoring, BMI, witnessed apnea, nocturia, disturbed sleep, and daytime sleepiness were significant predictors of depression in this sample of patients with OSA. Among the systemic conditions, hypertension was more significantly correlated with depression than diabetes and cardiovascular disease. This suggests that sleep specialists should evaluate OSA patients who present with mood disturbances, sleep disturbances, and comorbid systemic disorders for the possibility depression, particularly in patients of the female gender, older age, and those with high BMI.

A substantial proportion of patients with depression suffer from unrecognized OSA, and conversely, depression is more prevalent among OSA patients compared to those without OSA. Some studies suggest that a strong bidirectional relationship exists between OSA and depression, with each disease influencing the development of the other. Thus, interdisciplinary cooperation is recommended for both OSA patients with symptoms of depression and depressed patients with treatment resistance. Thus, the role of OSA in the management of depression needs urgent and rigorous assessment. The question of whether OSA represents an independent risk for the development of depression needs further exploration.

**Limitations**

The major limitation of our study was relatively small sample size. Another limitation of our study was due to retrospective design, which did not allow us to determine the direction of causality in this relationship between the two. To clarify, more research is needed to examine the association between OSA and depression and the clinical relevance of this comorbidity. Further, the severity of depression on HAM-D for risk factors was not analyzed.

**Implications**

Our findings add to the emerging literature on the relationship between OSA and depression with several important clinical implications. This study demonstrates a significant overlap between sleep apnea and depression. Sleep specialists need more information and guidelines about screening patients with OSA to ensure proper diagnosis and treatment of those with this condition. Most of the clinicians do not suspect this important comorbidity (depression) of OSA early, resulting in delayed

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**Table 1: Basic characteristics and polysomnography findings of the study population**

| Variable          | Mean±SD Depression | Mean±SD Without depression |
|-------------------|--------------------|---------------------------|
| Age (years)       | 58.6±14.75         | 54.3±12.6                 |
| BMI               | 31.86±4.53         | 30.8±4.2                  |
| Neck circumference (cm) | 39.85±3.14   | 40.2±3.4                  |
| AHI               | 26.04±10.54        | 21.9±12.4                 |
| ESS               | 15.70±3.29         | 10.9±3.8                  |
| HAM-D             | 17.35±5.45         | 10.1±5.8                  |
| Sleep efficiency  | 68.55±9.42         | 78.0±18.6                 |
| Awake SpO2        | 92.51±4.02         | 92.9±0.8                  |
| Nocturnal SpO2    | 84.66±6.46         | 87.7±21.1                 |
| ODI               | 24.81±14.53        | 25.74±2.2                 |

BMI – Body mass index; AHI – Apnea–Hypopnea Index; ESS – Epworth Sleepiness Scale; HAM-D – Hamilton Depression Rating Scale; ODI – Oxygen desaturation index; SD – Standard deviation

**Table 2: Severity of obstructive sleep apnea analyzed for depression**

| Severity of OSA | Prevalence of depression | $P$  |
|-----------------|--------------------------|------|
| Mild            | 3 (6.8)                  | 0.034 (S) |
| Moderate        | 18 (40.9)                |      |
| Severe          | 23 (52.3)                |      |

OSA – Obstructive sleep apnea

**Table 3: Variables significantly correlating with the presence of depression in obstructive sleep apnea**

| Variable*          | r (Correlation coefficient) | $P$  |
|--------------------|-----------------------------|------|
| Gender             | 0.193**                     | 0.009|
| Age                | 0.245**                     | 0.001|
| BMI                | 0.300**                     | 0.000|
| Hypertension       | 0.292**                     | 0.000|
| Diabetes           | 0.186*                      | 0.012|
| Cardiovascular disease | 0.170*                  | 0.022|
| Snoring            | 0.277**                     | 0.000|
| Witnessed apneas   | 0.327**                     | 0.000|
| Nocturia           | 0.255**                     | 0.001|
| Disturbed sleep    | 0.274**                     | 0.002|
| Daytime sleepiness | 0.350**                     | 0.000|

**Pearson correlation is significant at the 0.01 level (two-tailed), *Pearson correlation is significant at the 0.05 level (two-tailed). BMI – Body mass index**
diagnosis. Thus, sleep specialist should screen symptoms of depression and consider referral to a psychiatrist when indicated. Usually, depression remains underdiagnosed in OSA and hampering the treatment response. On the other hand, it is also possible that detection and appropriate treatment of OSA can aid in the treatment of depression.[1]

## CONCLUSION

The results of this study confirm the risks of depression in OSA. This study also provides evidence that EDS, BMI, and age independently predict depressive symptoms in OSA. Health specialists need more information about screening for patients with OSA to ensure proper diagnosis and treatment of those with the condition.

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## Conflicts of interest
There are no conflicts of interest.

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