Original Research

Insomnia Phenotype Characterization and Depression among Patients with Obstructive Sleep Apnea

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Abstract

Background and Objective: Over 40% of individuals with obstructive sleep apnea (OSA) have reported experiencing insomnia. The combination of OSA and insomnia results in decreased sleep quality and adherence to continuous positive airway pressure (CPAP) therapy. This study aimed to assess insomnia among patients with OSA.

Materials and Methods: This cross-sectional study involved 1771 participants. Patients with a high suspicion of OSA completed the Insomnia Severity Index (ISI) and the Beck Depression Inventory (BDI-II) questionnaires. All participants underwent overnight polysomnography (PSG).

Results: In this study, 1242 (68%) of the 1771 participants were men, with a mean age of 47.18 ± 13.65 years. The average Respiratory Disturbance Index (RDI) was 41.53 ± 31.98, the mean ISI score was 12.11 ± 5.99, and the average BDI score was 12.88 ± 11.22. A total of 639 (36%) participants reported moderate to severe insomnia (ISI score ≥ 15). Those with a normal RDI had mean ISI scores of 13.71 ± 6.32, while patients with mild, moderate, and severe OSA had mean ISI scores of 12.76 ± 5.96, 11.61 ± 5.92, and 11.91 ± 5.95, respectively (P = 0.001). The correlation between RDI and ISI score was 0.006 (P = 0.8). As the severity of insomnia increased, the BDI score also significantly increased (P < 0.0001).

Conclusion: A notable correlation exists between insomnia and depression; individuals with more severe insomnia reported higher depressive symptoms. Given the link between insomnia and OSA, it is advisable to assess insomnia in patients diagnosed with OSA.

Keywords: Obstructive sleep apnea; Insomnia; Depression; Sleep; Polysomnography

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Introduction

Obstructive sleep apnea (OSA) and insomnia are prevalent sleep disorders that often occur together in patients. In individuals with OSA, the upper airway repeatedly closes during sleep, leading to respiratory events like apnea or hypopnea. The gold standard for diagnosing OSA is full-night polysomnography (PSG). Insomnia is characterized by difficulties in falling or staying asleep, typically assessed through self-report questionnaires. Over 40% of patients with OSA have reported experiencing at least one symptom of insomnia (1-5). The combination of OSA and insomnia results in poorer sleep quality, diminished quality of life, and reduced adherence to continuous positive airway pressure (CPAP) therapy, a primary treatment for moderate to severe OSA. Patients with both conditions often experience increased nocturnal sleep disturbances and higher rates of psychiatric issues, including depression (6-10). Various types of medications are available for treating insomnia (11).

Both disorders can lead to serious health issues

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such as fatigue, daytime sleepiness, memory and concentration difficulties, increased risk of occupational and driving accidents, and decreased productivity (12). Previous research on patients with OSA has indicated a high prevalence of co-occurring insomnia, with a greater incidence reported among women compared to men (13).

Despite some studies, there has been limited evaluation of the coexistence of OSA and insomnia and the associated risk factors. This study aims to investigate the severity of insomnia and depression in patients suspected of having OSA, addressing questions about the prevalence of comorbid OSA and insomnia, their management, and the health implications of their coexistence.

Materials and Methods

In this cross-sectional study, suspicious patients of OSA who were referred to Baharloo Hospital Sleep Clinic, Tehran City, Iran, from 2012 to 2108 were enrolled. Written consents were obtained from all the subjects and the study was approved by the Ethics Committee of Tehran University of Medical Sciences. The Persian version of the Insomnia Severity Index (ISI) (14) and Beck Depression Inventory (BDI-II) (15) questionnaires were filled out by the participants and all of them underwent full-night PSG.

Subjects with a history of previous usage or addiction to substances or drugs that could impact ISI or BDI scores were excluded from this study.

Questionnaires

ISI: ISI is a self-reported questionnaire evaluating insomnia and its severity over the past month. In this scale, the severity of falling asleep, sleep maintenance, early morning awakening, sleep satisfaction/dissatisfaction, sleep problems reported by others, concerns caused by sleep problems, and interference with daytime functioning were addressed. This questionnaire contains seven items (each consists of a score ranging from zero to 4), with the summed score ranging from zero to 28. Subjects were categorized according to ISI score as the absence of insomnia (0 to 7), sub-threshold insomnia (8 to 14), moderate insomnia (15 to 21), and severe insomnia (22 to 28) (16).

BDI-II: It is a self-administered scale that evaluates the severity of depression symptoms over the past two weeks. It consists of 21 questions, with scores ranging from zero to three. The total score ranges from zero to 63. Higher scores indicate higher levels of depressive mood (15).

PSG: All the patients underwent full-night PSG at Baharloo Sleep Clinic. In this test, electroencephalography (EEG), electrooculography (EOG), electrocardiography (ECG), and electromyography (EMG) were recorded to identify the occurrence and severity of OSA. Respiratory Disturbance Index (RDI), mean O_2 saturation (mean SaO_2), and minimum O_2 saturation (nadir SaO_2) during overnight sleep were used to diagnose OSA (17).

Statistical analysis: The characteristics of the participants are presented as mean ± standard deviation (SD) for continuous variables and frequency and percentage for the categorical variables. Differences in characteristics were explored using the one-way analysis of variance (ANOVA), t-test, and Fisher's exact test between insomnia groups for numerical and categorical variables, respectively. Logistic regression analysis was used to estimate the odds ratio (OR) for insomnia and related risk factors.

Results

In the current study, 1242 (68%) of 1771 subjects were men. The mean age of patients was 47.18 ± 13.65 years. The mean body mass index (BMI) of study participants was 30.32 ± 6.97 kg/m^2.

Patients had a mean RDI of 41.53 ± 31.98, mean ISI of 12.11 ± 5.99, and mean BDI score of 12.88 ± 11.22. Moderate and severe insomnia (ISI score ≥ 15) was reported by 639 (36%) patients.

In our sample group, 124 (7%) subjects had normal RDI (RDI < 5), whereas 295 (16.7%), 411 (23.2%), and 941 (53.1%) patients were categorized as mild (5 ≤ RDI < 15), moderate (15 ≤ RDI < 30), and severe (RDI ≥ 30) OSA, respectively.

Subjects with normal RDI had mean ISI scores of 13.71 ± 6.32, and patients with mild, moderate, and severe OSA reported mean ISI scores of 12.76 ± 5.96, 11.61 ± 5.92, and 11.91 ± 5.95, respectively (P = 0.001). The correlation between RDI and ISI score was 0.006 (P = 0.8).

With increasing the severity of insomnia, the BDI score was significantly increased (P < 0.0001). The ones with more severe insomnia reported more depressive symptoms significantly.

Tables 1 and 2 show the demographic and PSG characteristics of patients according to their ISI scores. A regression analysis was performed, and the results are shown in table 3.

Table 1. Demographic characteristics of studied patients

	Total (n = 1771)	Absence of insomnia (n = 402)	Mild insomnia (n = 730)	Moderate insomnia (n = 548)	Severe insomnia (n = 91)	P-value
Age (year)	47.18 ± 13.65	49.13 ± 14.26	47.21 ± 13.07	45.86 ± 13.55	46.25 ± 15.25	0.0030
BMI (kg/m^2)	30.32 ± 6.97	30.05 ± 5.71	30.24 ± 5.28	30.59 ± 9.41	30.50 ± 6.77	0.6630
ISI score	12.11 ± 5.99	3.84 ± 2.53	11.21 ± 1.92	17.47 ± 1.96	23.69 ± 1.58	< 0.0001
RDI score	41.53 ± 31.98	41.01 ± 28.63	41.84 ± 32.05	42.07 ± 33.76	38.17 ± 34.51	0.7210
BDI score	12.88 ± 11.22	7.00 ± 8.73	11.68 ± 9.77	17.78 ± 11.61	20.79 ± 13.38	< 0.0001
Gender (men)	1242 (68.0)	300 (69.4)	522 (69.6)	369 (66.6)	51 (56.0)	< 0.0001

Data are presented as mean ± standard deviation (SD) or number and percent
BMI: Body mass index; ISI: Insomnia Severity Index; RDI: Respiratory Disturbance Index; BDI: Beck Depression Inventory

Table 2. Polysomnographic (PSG) characteristics of the patients according to insomnia severity

	Absence of insomnia (n = 402) (mean ± SD)	Subthreshold insomnia (n = 730) (mean ± SD)	Moderate insomnia (n = 548) (mean ± SD)	Severe insomnia (n = 91) (mean ± SD)	P-value
RDI	41.01 ± 28.63	41.84 ± 32.05	42.07 ± 33.76	38.17 ± 34.51	0.7210
Wake time after sleep onset	14.05 ± 41.22	15.18 ± 40.99	22.57 ± 51.70	35.37 ± 61.36	< 0.0001
Total sleep time	369.23 ± 96.51	379.09 ± 91.13	371.15 ± 100.44	353.18 ± 100.46	0.0540
Sleep efficiency	75.74 ± 14.62	77.28 ± 14.04	75.98 ± 14.89	71.72 ± 15.91	0.0040
Sleep latency to stage N1	8.12 ± 22.91	9.67 ± 24.05	14.00 ± 30.24	22.91 ± 41.31	< 0.0001
Mean oxygen saturation	90.39 ± 4.38	90.08 ± 5.24	88.86 ± 9.05	88.42 ± 10.90	0.0010
Oxygen saturation below 90%	5.12 ± 18.24	5.49 ± 18.47	8.08 ± 22.97	9.52 ± 23.20	0.0280
Limb movements index	11.40 ± 17.79	10.86 ± 16.54	10.36 ± 16.49	8.42 ± 14.06	0.4390

RDI: Respiratory Disturbance Index; SD: Standard deviation

Table 3. Logistic regression

	OR	CI	P-value
Age	0.98	0.97-0.99	< 0.0001
Gender (women are references)	0.86	0.65-1.14	0.3070
RDI	1.00	0.99-1.01	0.3560
BDI	1.09	1.07-1.10	< 0.0001
Saturation below 90%	1.00	0.99-1.01	0.3560

RDI: Respiratory Disturbance Index; BDI: Beck Depression Inventory; OR: Odds ratio; CI: Confidence interval

Discussion

This study found that approximately 30% of participants experienced moderate insomnia, while about 90% had severe insomnia. Similar studies (13, 18) have reported high rates of co-occurring OSA and insomnia. Consistent with previous findings, female patients exhibited higher rates of severe insomnia compared to those in the other categories of insomnia severity ($P < 0.001$).

Participants had a mean RDI of 41.53 ± 31.98, an average ISI score of 12.11 ± 5.99, and a mean BDI score of 12.88 ± 11.22. A total of 639 (36%) patients reported moderate to severe insomnia (ISI score ≥ 15). Those with a normal RDI had a mean ISI score of 13.71 ± 6.32, while patients with mild, moderate, and severe OSA reported mean ISI scores of 12.76 ± 5.96, 11.61 ± 5.92, and 11.91 ± 5.95, respectively ($P = 0.001$). The correlation between RDI and ISI score was minimal at 0.006 ($P = 0.8$).

The high prevalence of insomnia in this population is notable, considering they were referred for OSA evaluation rather than insomnia assessment. This significant co-occurrence may be linked to underlying psychiatric issues such as depression, which have not been thoroughly addressed in previous studies (19). Those with more severe insomnia reported significantly higher depressive symptoms, with BDI scores increasing alongside insomnia severity ($P < 0.0001$).

Few studies have examined depression as a contributing factor for insomnia. Variations in findings may stem from differences in risk factors such as age, gender, and BMI, as well as definitions used, which can affect reported epidemiological data.

The coexistence of OSA and insomnia is critical due to its negative health implications, including cardiovascular disease (CVD), which can be exacerbated by this combination (13). Another concern is patient adherence to therapy and acceptance of positive airway pressure (PAP) treatment in such cases (20). Our estimate of the prevalence of this co-occurrence aligns with previous research which found rates ranging from 10% to 40% (4, 21).

As seen in other studies (22), participant age was associated with insomnia in our findings. However, we did not find a significant relationship between insomnia and gender or BMI. We observed a negative correlation between RDI severity and ISI scores, indicating that as RDI severity increased, ISI scores tended to decrease, with patients having moderate and severe OSA showing similar ISI scores. This could be attributed to a lower number of female patients in these groups or shorter sleep latency in those with higher RDI. Additionally, older patients had higher RDI scores compared to those with mild OSA or normal RDI; younger patients tended to have higher BDI and ISI scores. Logistic regression analysis indicated a significant association between depression and age with insomnia, warranting further investigation. The relationship appears complex, as restless legs syndrome (RLS) may also complicate the situation. Other studies have similarly found no association between RDI and insomnia, often using different insomnia phenotypes (23).

We assessed severity to provide a more accurate estimate of insomnia; however, the association remained statistically insignificant. Some studies indicated a link between early morning awakenings and insomnia, which could be confounded by depression as a comorbidity (24).

Individuals with normal RDI may be younger and female, contributing to a higher prevalence of insomnia in this subgroup.

BDI scores, wake after sleep onset (WASO), sleep efficiency, sleep onset latency (to stage N1), and mean oxygen saturation during sleep significantly differed among the four insomnia severity groups. In some studies, mean oxygen saturation was not found to be related to insomnia.

Regarding PSG characteristics, those with insomnia exhibited more WASO, shorter total sleep time, and lower sleep efficiency. They also had increased sleep onset latency, particularly in the moderate and severe insomnia groups. The higher WASO observed in these two groups may be linked to sympathetic activity, a common phenomenon that may worsen both apnea and its treatment.

Limitations and recommendations: One limitation of this study was using self-administered questionnaires to evaluate insomnia and depression. Actigraphy, sleep logs, and psychiatric evaluation are recommended for further studies.

Conclusion

The co-incidence of OSA and insomnia is important because of negative health consequences. The correlation between insomnia and depression severity was significant. The ones with more severe insomnia reported more depressive symptoms significantly. Since insomnia and OSA are related to each other, evaluation of insomnia in patients with OSA is recommended.

Conflict of Interests

Authors have no conflict of interests.

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