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# Comorbidity of depression and anxiety with obstructive sleep apnea in a sample of Egyptian patients

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## Abstract

**Background** Over the past 2 decades, sleep researchers have made significant advances in understanding sleep disorders including obstructive sleep apnea (OSA). OSA commonly coexists with psychiatric disorders encompassing mental health issues like depression, anxiety, bipolar, schizophrenia and others. *This study aims* to assess the comorbidity of OSA with depression and anxiety disorders among Egyptian patients.

During the study, we conducted a cross-sectional study involving 92 adults diagnosed with OSA. Those patients were interviewed using a checklist to gather information regarding their chief complaints and other associated symptoms. The psychological status was assessed utilizing the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID I), Beck Anxiety Inventory (BAI), and Beck Depression Inventory (BDI) scoring. The severity of the breathing disorder was classified as mild, moderate, or severe based on the respiratory disturbance index (RDI), which was confirmed through overnight polysomnography. Daytime sleepiness was assessed by the Epworth Sleepiness Scale (ESS).

**Results** The sample of patients as a whole shows that witnessed apneas represent the highest percentage (70.7%), followed by fatigue (69.6%), then non-refreshing sleep (67.4%), and snores (63.0%). The least frequent presenting symptom is frequent naps.

The majority of OSA patients have a comorbid psychiatric disorder (65.0%). Among these, depressive disorders are the most prevalent (31.5%), followed by anxiety disorders (23.9%) and psychoses (6.5%). It is worth noting that 38% of OSA patients do not have any psychiatric disorders.

In terms of anxiety disorders, the most common subtype observed is OCD (8.7%), followed by GAD (6.5%), panic (5%), and PTSD (3.3%). As regards depressive disorders, the predominant subtype present is depressive disorder not otherwise specified (11.9%), followed by dysthymic disorder and major depressive disorder (8.7% for each), and then bipolar disorder (depression) at 2.2%.

**Conclusions** We conclude the following:

1. OSA patients are likely to present with comorbid depression and/or anxiety disorder(s).
2. Fatigue was found to be the most prevalent presenting symptom in OSA patients with comorbid anxiety compared to those without anxiety.

**Keywords** Obstructive sleep apnea, Comorbidity, Anxiety, Depression

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## Background

Sleep medicine is a truly multidisciplinary field encompassing mental, neurological, and respiratory disorders. The advancements in this discipline have reached a stage where it has become essential for psychiatrists to possess a certain level of knowledge of sleep medicine. This is due to the high degree of overlap observed between sleep and mental diseases. Obstructive sleep apnea and other seemingly unrelated illnesses can have significant and complex relationships with mental health issues [30].

Over the past two decades, sleep researchers worldwide have made significant strides in their approach and understanding of sleep disorders. Recent years have seen some local efforts to advance this field. The first is a European initiative called SIESTA, which is focused on constructing a normative database comprising polysomnography (PSG) and psychometric measures. By comparing individuals with sleep disorders to age- and sex-matched healthy controls across a wide age range (20 and 95), this database will enable accurate diagnosis of sleep disorders in individuals [27].

According to Costa and Silva [11], sleep disturbances commonly observed in depression may reflect cholinergic dominance. Antidepressants can potentially inhibit REM sleep either due to their anticholinergic effects or by increasing aminergic neurotransmission. Rapid discontinuation of antidepressant medication is associated with a rebound in REM activity following REM suppression caused by the medication. These contemporary neuroscience findings support the hypothesized connection between sleep and psychiatric problems.

Hashmi [16] presented a wake-up call on the dangers of obstructive sleep apnea and highlighted the following concerns: It is estimated that 50 to 70 million Americans experience chronic sleep and wakefulness disorder, which significantly impair daily functioning and impact overall health. People who struggle with sleep-related issues often experience psychiatric conditions. Similarly, those with mental illness frequently report having difficulties with sleep. Moreover, individuals with primary sleep disturbance are at risk of developing neuropsychiatric consequences.

As the rate of obesity in the US continues to rise, so does the incidence of OSA, he added. People with severe and persistent mental illness face a significantly reduced life expectancy due to OSA's role in creating and aggravating medical sickness. OSA commonly coexists with psychiatric disorders, encompassing mental health issues like depression, anxiety, bipolar disorder, schizophrenia, PTSD, panic attacks, and drug abuse problems.

According to Ba Hammam et al. [4], the link between OSA and comorbid depression remains poorly understood. Studies utilizing samples from the general population and sleep disorder clinics have indicated that patients with OSA are at a higher risk of depression. However, the relationship between OSA and depression is further complicated by the fact that OSA and depression have several symptoms. Longitudinal studies of individuals with OSA have revealed an association between the severity of OSA and the likelihood of depression. Nevertheless, contradictory results have been found in studies examining the impact of CPAP therapy on depression in OSA patients. Therefore, it is crucial to comprehend the therapeutic consequences of treating each condition independently and how they mutually influence one another. Research conducted in both the general community and in sleep problem clinics has consistently demonstrated that those with OSA have a significantly higher risk of depression. The recommendation is that "clinicians generally should be aware of this significant association and should aim to treat both disorders."

## Aim of the study

To assess the comorbidity of depression and anxiety with OSA in a sample of Egyptian patients.

The rationale of the study is to assess systematically the clinical observation of the association of the diagnosis of OSA with symptoms of anxiety and depression that usually interferes with proper diagnosis and management.

Clinically, proper diagnosing and hence treatment of comorbid anxiety and or depression will improve adherence of the OSA patient to the different treatments especially continuous positive airway pressure (CPAP) which is usually associated with claustrophobia.

## Participants

The patients were recruited from Suez Canal University Hospitals outpatient clinics of psychiatry, neurology, ENT, and chest who were referred to perform sleep study because of complaints of symptoms of sleep apnea in the period from 1 November 2021 until 30 June 2022.

## Inclusion criteria

1. Patients are of both sexes and of ages from 20 to 59 (within adult range)
2. Patients were recruited until the calculated sample size which is recommended by the statistician was reached.
3. Informed written consent to participate in the study

### Exclusion criteria

1. Patients suffering from any medical condition that may make them *unable* to complete the research tests (e.g., aphasia) or *unfit* as those who are taking medical drugs known to induce anxiety and depression as side effects, e.g., cancer drugs
2. Illiterate patients (cannot sign informed consent)

### Procedures

The patients were first assessed by a physician for a general examination, body weight, height, neck circumference, and chest, abdominal, and neurological examination, and then they were subjected to the following:

1. A semi-structured Cairo Sleep Lab. clinical interview which is designed to gather the following:
  - a Demographic data
  - b Habits of medical importance that might affect the sleep study as smoking, caffeine and alcohol, and other substance use if any
  - c The medical and psychiatric history
  - d Presenting symptoms (as shown in Table 2) [23]
2. Then patients underwent a full night polysomnography.

The polysomnographic overnight study was done using *the model (Philips Respironics Alice 6)* to confirm the diagnosis of OSA. It is a sleep study used to diagnose sleep disorders by assessing REM sleep, latency, arousal index, respiratory disturbance index (RDI), and N3. OSA severity is scored using RDI, which is given by the polysomnographic recording, which includes apnea and hypopnea events in addition to number of respiratory effort-related arousals per hour of sleep [26]. Scoring was as follows: mild (5–14.9), moderate (15–29.9), and severe (30 and above) [14]. Then patients fulfilling the diagnostic criteria of OSA according to international classification of sleep disorders Third [29] underwent a full night polysomnography.

For preparation of patients before the polysomnographic study is done, the patient is asked to follow his usual daily activity on the day of the study but to avoid naps and caffeine. Monitoring devices were applied to recorded requested information. Sensors

recorded EEG activity, heart rate, eye movements, leg muscle activity, and chest and stomach movement. Air flow from the nose and mouth are also recorded as well as oxygen saturation and occurrence of snoring. The hair of the patient should be clean and dry, and he should avoid oils and gels and remove acrylic nails and polish from the index finger. He can eat as normally would and take his usual medications.

Subsequently, a total of 92 patients diagnosed with OSA has been enrolled in this study and was subjected to the following tests:

3. Beck Depression Inventory [7] and its Arabic version by Abdel Khalek [1], which consists of 21 questions about how the subject has been feeling: Each question has four possible responses ranging in intensity with record value (0–3). The standard cutoff score is as follows: (0–9) minimal depression, (10–18) mild, (19–29) moderate, and (30–60) severe depression.
4. Beck Anxiety Inventory [6] and its Arabic version by Al-Issa et al. [3]: It consists of 21 self-report items which assess symptoms of anxiety. Each item has a 4-point scale ranging from 0 to 3 according to severity. The standardized cutoffs are as follows: (0–7) minimal, (8–15) mild, (16–25) moderate, and (26–63) severe.
5. Epworth Sleepiness Scale (ESS) [18] and Arabic version [2]: It is a self-administered questionnaire with eight questions. Respondents are asked to rate on a 4-point scale (0–3) where 0 indicates no chance of dosing off to 1 mild, 2 moderate, and 3 severe chance of dosing off respectively while engaged in 8 different activities (1 — sitting and reading, 2 — watching TV, 3 — sitting inactive in a public place, 4 — as a passenger in a car for 1 h without break, 5 — lying down to rest in the afternoon, 6 — sitting and talking to someone, 7 — sitting quietly after lunch, and 8 — in a car while stopped for a few minutes in traffic). Total score may range from 0 to 24. Interpretation is as follows:
  - 0–7: Unlikely to be abnormally sleepy
  - 8–9: Average amount of daytime sleepiness
  - 10–15: May be excessively sleepy and may consider medical attention
  - 16–24: Excessively sleepy and should consider seeking medical attention
6. The Structured Clinical Interview for DSM-IV Axis I Disorders (*SCID I*): It is a diagnostic tool used to determine the presence of DSM-IV Axis I Disorders (major mental disorders). It consists of questions cov-

ering DSM-IV diagnostic criteria for each individual disorder and includes questions about duration of illness and change in clinical status. Every question is scored as either present, absent, or inadequate information. *SCID-I will be used to confirm the diagnosis of depression and anxiety in an objective and structured way.* Patients with other psychiatric disorders diagnosed by SCID1 have been shown in Table 3 and 4, and they have been excluded from the detailed study, which focused on anxiety and depression disorders. Many studies worldwide approved validity and reliability of SCID [34] and [22]. The Arabic version of SCID I is translated by [17]. The test will take about 1 h.

**Statistical analysis**

The collected data were analyzed using descriptive statistics, including mean, standard deviation, median, minimum, and maximum measures in quantitative data. Mann–Whitney test [8], chi-square test ( $\chi^2$ ) [9], and Spearman correlation coefficient [10] were also used. Statistical significance was determined at a threshold of  $p < 0.05$ .

**Results**

As regards the sociodemographic data of the sample, comparing the results (in percentages) showed that the majority of OSA patients (42.4%) were in the age group (50–59) years, and that generally, the patients in the age group (40–59) years were more than patients in the age group (20–39) years. Males (57.6%) were more than females (21.7%). Most of the patients were married (57.6%), employed (59.8%), and from urban area (78.3%) (Table 1).

In the overall sample of patients, witnessed apneas were the most prevalent symptom (70.7%). Fatigue was the second most common presenting symptom (69.6%). Non-refreshing sleep was the third most prevalent symptom, experienced by 67.4% of individuals, while snoring was reported by 63.0% of patients. The least frequent presenting symptom is frequent naps (Table 2).

The majority of OSA patients have a comorbid psychiatric disorder (65.0%). Among these, depressive disorders are the most prevalent (31.5%), followed by anxiety disorders (23.9%), and then psychoses (6.5%). It is worth noting that 38% of OSA patients do not have any psychiatric disorders. In terms of anxiety disorders, the most common subtype is OCD (8.7%), followed by GAD (6.5%), panic (5%), and then PTSD (3.3%) (Table 3).

Regarding depressive disorders, the most common subtype present is depressive disorder not otherwise

**Table 1** Sociodemographic characteristics of the studied OSA patients

Variables		No. (92)	%
Age groups	20–29	6	6.5
	30–39	17	18.5
	40–49	30	32.6
	50–59	39	42.4
Gender	Male	72	78.3
	Female	20	21.7
Occupation	Employed	55	59.8
	Retired	8	8.7
	Unemployed	12	13.0
	Housewife	14	15.2
	Student	3	3.3
Residence	Urban	72	78.3
	Rural	20	21.7
Marital status	Single	21	22.8
	Married	53	57.6
	Divorced	10	10.9
	Widow	8	8.7

**Table 2** Presenting symptoms of patients of the study sample

	Count	%
Fatigue	64	69.6%
Non-refreshing sleep	62	67.4%
Nocturia	35	38.0%
Snores	58	63.0%
Witnessed apnea	65	70.7%
Morning headache	9	9.8%
Daytime sleepiness	38	41.3%
Frequent naps	5	5.4%
Bruxism	7	7.6%
Irritability and decrease concentration	7	7.6%
Insomnia	11	12.0%

specified, accounting for 11.9% of the cases. Dysthymic disorder and major depressive disorder have equal frequencies at 8.7% each. Bipolar disorder (depression) is reported in 2.2% of the cases. In terms of psychotic disorders, psychotic disorder not otherwise specified is the most common subtype present (3.3%), followed by schizophrenia (2.2%) and delusional disorder (1.1%) (Table 4).

According to the Epworth Sleepiness Scale, 81.5% of patients fall under the normal category, while the highest percentage of patients lies in the mild category (12.0%) (Table 5). In terms of the severity of OSA, most patients in the study have severe OSA (60.9%), followed by moderate OSA (22.8%), and then mild OSA (16.3%) (Table 6).

**Table 3** Distribution of the presence of psychiatric diagnoses among patients of the study sample

		All	
		Count	%
Psychiatric diagnoses using SCID I	Anxiety disorders	22	23.9%
	Depressive disorders	29	31.5%
	Psychoses	6	6.5%
	No psychiatric disorder	35	38.0%

**Table 4** Subtypes of psychiatric disorders by SCID I among the studied OSA patients

		Count	%
Psychiatric diagnosis using SCID I details	GAD	6	6.5%
	Panic	5	5.4%
	PTD	3	3.3%
	OCD	8	8.7%
	Dysthymic disorder	8	8.7%
	Major depressive disorder	8	8.7%
	Bipolar	2	2.2%
	Depression NOS	11	11.9%
	Schizophrenia	2	2.2%
	Del delusion	1	1.1%
	Psychosis NOS	3	3.3%
	No disorder	35	38.0%

**Table 5** Daytime sleepiness degree by Epworth Sleepiness Scale (ESS) results among the studied OSA patients

		Count	%
Epworth	Normal	75	81.5%
	Mild	11	12.0%
	Moderate	4	4.3%
	Severe	2	2.2%

**Table 6** Severity of OSA by respiratory disturbance index (RDI)

		Count	%
OSA	Mild	15	16.3%
	Mod	21	22.8%
	Severe	56	60.9%

The results of the Beck Anxiety Inventory for the study sample’s patients indicate the following: severe anxiety was found in 20.7% of male patients and 30% of female ones. Moderate anxiety was observed in 7.6% of male patients and 5.0% of female ones. Mild anxiety was observed in 19.6% of male patients and 25.0% of female

ones (Table 7). The results of the Beck Depression Inventory of patients of the study sample showed the following: severe depression was observed in 9.8% of male patients and 10% of female ones. Moderate depression occurred in 25.0% of male patients and 30% of female ones. Mild depression was reported in 18.5% of male patients and 25.0% of female ones (Table 8).

Among OSA patients with comorbid psychiatric disorders, fatigue and irritability with decreased concentration were found to be more common (78.9% and 12.3%, respectively). In contrast, among OSA patients without psychiatric disorders, the prevalence of fatigue was 54.3%, and irritability with decreased concentration was not reported. These differences between OSA patients with and without psychiatric disorders were statistically significant, with *p*-values of <0.013 for fatigue and <0.042 for irritability with decreased concentration (Table 9). Furthermore, when considering OSA patients with anxiety, fatigue was found to be more prevalent compared to those without anxiety (84.1% vs. 56.3%), with a high statistically significant level (*p* < 0.004) (Table 10).

Fatigue, witnessed apnea, non-refreshing sleep, and snores were present as presenting symptoms in OSA patients with depression more frequently than those without depression, but these differences did not reach

**Table 7** Results of the Beck Anxiety Inventory of patients of the study sample

		Sex						p-value
		Total		Male		Female		
		Count	%	Count	%	Count	%	
Degree Anxiety	No	29	31.5%	23	31.9%	6	30.0%	0.53
	Minimal	19	20.7%	17	23.6%	2	10.0%	
	Mild	18	19.6%	13	18.1%	5	25.0%	
	Moderate	7	7.6%	6	8.3%	1	5.0%	
	Severe	19	20.7%	13	18.1%	6	30.0%	

**Table 8** Results of the Beck Depression Inventory of patients of the study sample

		Sex						p-value
		Total		Male		Female		
		Count	%	Count	%	Count	%	
Degree depression	No	6	6.5%	3	4.2%	3	15.0%	0.136
	Minimal	37	40.2%	33	45.8%	4	20.0%	
	Mild	17	18.5%	12	16.7%	5	25.0%	
	Mod	23	25.0%	17	23.6%	6	30.0%	
	Severe	9	9.8%	7	9.7%	2	10.0%	

**Table 9** Comparison of presenting symptoms in the studied OSA patient with and without psychiatric disorders

Presenting symptoms		OSA patients with psychiatric disorders		OSA patients without psychiatric disorders		p-value
		No. (57)	%	No. (35)	%	
Fatigue	Yes	45	78.9%	19	54.3%	0.013
	No	12	21.1%	16	45.7%	
Non-refreshing sleep	Yes	40	70.2%	22	62.9%	0.467
	No	17	29.8%	13	37.1%	
Nocturia	Yes	24	42.1%	11	31.4%	0.306
	No	33	57.9%	24	68.6%	
Snores	Yes	39	68.4%	19	54.3%	0.173
	No	18	31.6%	16	45.7%	
Witnessed apnea	Yes	42	73.7%	23	65.7%	0.415
	No	15	26.3%	12	34.3%	
Morning headache	Yes	8	14.0%	1	2.9%	0.146
	No	49	86.0%	34	97.1%	
Daytime sleepiness	Yes	27	47.4%	11	31.4%	0.132
	No	30	52.6%	24	68.6%	
Frequent naps	Yes	4	7.0%	1	2.9%	0.646
	No	53	93.0%	34	97.1%	
Bruxism	Yes	6	10.5%	1	2.9%	0.246
	No	51	89.5%	34	97.1%	
Irritability & decreased concentration	Yes	7	12.3%	0	0.0%	0.042
	No	50	87.7%	35	100.0%	
Insomnia	Yes	9	15.8%	2	5.7%	0.196
	No	48	84.2%	33	94.3%	

**Table 10** Comparison of presenting symptoms in the studied OSA patients with and without anxiety

Presenting symptoms		Anxiety by BAI				p-value
		Yes		No		
		No. (59)	%	No. (33)	%	
Fatigue	Yes	37	84.1%	27	56.3%	0.004
	No	7	15.9%	21	43.8%	
Non-refreshing sleep	Yes	32	72.7%	30	62.5%	0.296
	No	12	27.3%	18	37.5%	
Nocturia	Yes	19	43.2%	16	33.3%	0.331
	No	25	56.8%	32	66.7%	
Snore	Yes	29	65.9%	29	60.4%	0.586
	No	15	34.1%	19	39.6%	
Witnessed apnea	Yes	30	68.2%	35	72.9%	0.618
	No	14	31.8%	13	27.1%	
Daytime sleepiness	Yes	21	47.7%	17	35.4%	0.231
	No	23	52.3%	31	64.6%	

statistical significance (Table 11). No statistical difference was found when correlating gender to Beck anxiety or depression (Table 12). Additionally, there was no statistically significant correlation between OSA and Beck anxiety and depression inventories or the Epworth Sleepiness Scale (Table 13).

**Discussion**

The aim of this study is to examine the relation between OSA with anxiety and/or depression and the effect of the latter on the clinical presentation and that may have an impact on the compliance to treatment of OSA patients. Sateia [28] has demonstrated that the present data show

high incidence of association between sleep disorders and various psychiatric illness especially mood and anxiety disorders. The relation between both conditions is bidirectional as the disturbance of sleep quality and continuity that is associated with many sleep disorders predisposes to the development and exacerbation of psychological distress and mental illness. Likewise, the presence of psychiatric illness complicates the diagnosis and treatment of sleep disorders.

In the sample of patients as a whole, witnessed apneas represent the highest percentage of presenting symptoms, accounting for 70.7% of cases. Following that, fatigue is the second most prevalent symptom, reported

**Table 11** Comparison of presenting symptoms in the studied OSA patients with and without depression

Presenting symptoms		Depression by BDI				p-value
		Yes		No		
		No. (49)	%	No. (43)	%	
Fatigue	Yes	37	75.5%	27	62.8%	0.186
	No	12	24.5%	16	37.2%	
Non-refreshing sleep	Yes	34	69.4%	28	65.1%	0.663
	No	15	30.6%	15	34.9%	
Nocturia	Yes	21	42.9%	14	32.6%	0.310
	No	28	57.1%	29	67.4%	
Snore	Yes	34	69.4%	24	55.8%	0.178
	No	15	30.6%	19	44.2%	
Witnessed apnea	Yes	36	73.5%	29	67.4%	0.526
	No	13	26.5%	14	32.6%	
Daytime sleepiness	Yes	22	44.9%	16	37.2%	0.455
	No	27	55.1%	27	62.8%	

**Table 12** Comparison between the Beck Anxiety Inventory (BAI) and Beck Depression Inventory (BDI) regarding the gender of the studied group

Inventory	Gender								p-value
	Male (no. = 70)				Female (no. = 22)				
	Mean ± SD	Median	Min	Max	Mean ± SD	Median	Min	Max	
BAI	18.40 ± 13.93	13.00	1.00	47.00	21.43 ± 12.84	18.00	5.00	42.00	0.336
BDI	13.99 ± 10.80	10.00	1.00	40.00	17.47 ± 9.32	17.00	5.00	41.00	0.113

**Table 13** Correlation between OSA and Beck Anxiety Inventory (BAI) and Beck Depression Inventory (BDI)

Inventory	OSA	
BAI	Correlation coefficient	0.031
	p-value	0.818
	Patient's number	59
BDI	Correlation coefficient	0.103
	p-value	0.344
	Patient's number	86

by 69.6% of patients. Non-refreshing sleep is the third most common symptom, experienced by 67.4% of individuals.

The risk factors for obstructive sleep apnea include advanced age, male sex, obesity, family history, craniofacial abnormalities, smoking, and alcohol consumption. The common clinical presenting symptoms are heavy snoring, witnessed apneas, and daytime hypersomnolence, which would help to identify the affected individuals [21].

Kim et al. [20] conducted a study with patients whose bed partners reported that snoring was their main symptom. Based on the conducted multivariate analysis, age and large neck circumference arose as important independent variables for predicting the occurrence of OSA. Additionally, hypertension and large neck circumference were recognized as important independent variables for predicting the OSA severity.

Our findings specified that 31.5% of the patients were diagnosed with depressive disorders, 23.9% with anxiety disorders, and 6.5% with psychoses. Additionally, 35% of the patients did not exhibit any psychiatric disorders.

In the study conducted by Sharafkhaneh et al. [33], comorbid diagnoses were identified among individuals with sleep apnea, including depressive disorders (21.8% of the sleep apnea group), anxiety disorders (16.7%), post-traumatic stress disorder (11.9%), psychosis (5.1), and bipolar disorders (3.3%). They recognized a significantly increased prevalence ( $p < 0.0001$ ) of mood disorders, anxiety, psychosis, PTSD, and dementia among individuals

diagnosed with sleep apnea compared to those without a sleep apnea diagnosis.

In terms of anxiety disorders, OCD is the most common subtype present (8.7%), followed by GAD (6.5%), panic (5%), and PTSD (3.3%) in our study. Regarding depression disorders, the most common subtype present is depressive disorder not otherwise specified (12.0%), followed by both dysthymic disorder and major depressive disorder (equal frequencies at 8.7% each), and then bipolar disorder (depression) at 2.2%.

According to Kim et al. [19], OSA is linked to higher rates of mood disorders like despair and anxiety. They concluded that additional research is needed to confirm their findings, and if confirmed, additional research is also required to investigate the nature of the observed link, including potential causality between OSA and emotional symptoms.

Duan et al. [12] noted that depression and anxiety, especially co-occurrence of both, were associated with an increased risk of OSA. He recommended that OSA patients should be examined for comorbid anxiety and/or depression.

Gupta and Simpson [15] reported a lack of evidence for increased OSA in schizophrenia, psychotic illnesses, bipolar disorder, and associated diseases.

Zhang and Epstein, in *Encyclopedia of Sleep*, [35] stated the following: "The ESS score correlates with measures of sleep-disordered breathing and is more likely to be elevated in individuals with sleep disorders. However, the ESS score does not have either a high sensitivity or a high specificity for OSA. The Sleep Heart Health Study found that more than 50% of individuals with moderate-to-severe OSA were not subjectively sleepy as assessed by the ESS."

This may explain that in our study, although patients were diagnosed by sleep studies as OSA patients, yet 81.5% of them are classified as normal by ESS, and 12.0% falls into the mild category. Only 4.3% and 2.2% showed moderate and severe daytime sleepiness respectively by ESS.

The majority of study patients have severe OSA (60.9%), followed by moderate OSA (22.8%) and mild OSA (16.3%).



Goyal and Johnson [14] emphasized the importance to determine the severity of OSA to choose the optimal treatment for the patient. Moderate or severe OSA should always be treated due to significantly increased risk of cardiovascular and all-cause mortality if untreated. Treatment of mild OSA should be considered in symptomatic patients (insomnia, daytime fatigue, or sleepiness) or if there are comorbid illnesses such as cardiovascular diseases, metabolic syndrome, and diabetes mellitus and also if there is a comorbid cognitive impairment or mood disorders. Continuous positive airway pressure (CPAP) is recommended as the treatment of choice for all severities of OSA.

In terms of anxiety levels, 20.7% of male patients and 30% of female patients exhibited severe anxiety, while 7.6% of male patients and 5.0% of female patients had moderate anxiety. Mild anxiety was found in 19.6% of male patients and 25.0% of female patients.

According to research conducted by Rezaeitalab et al. [25], people with OSA are more likely to experience anxiety than the general population. In addition, OSA patients are more likely to have nontypical symptoms, such as feelings of anxiety or depression.

In our study, severe depression was found in 9.8% of male patients and 10% of female patients, while moderate depression was found in 25.0% of male patients and 30% of female patients. Mild depression was reported in 18.5% of male patients and 25.0% of female patients.

While Schröder and O'Hara [31] stated the following: "Clinical investigations that have spanned more than twenty years indicate that depression and obstructive sleep apnea are potentially related and that Ohayon [24] underscored the evidence for a link between these two disorders in the general population, showing that 800 out of 100,000 individuals had both, a breathing-related sleep disorder and a major depressive disorder, with up to 20% of the subjects presenting with one of these disorders also having the other. In some populations, depending on age, gender and other demographic and health characteristics, the prevalence of both disorders may be even higher."

Fatigue as presenting signs was significantly more prevalent in OSA cases with psychiatric disorders than those without ( $p < 0.013$ ). Similarly, irritability and decreased concentration, as presenting symptoms, are more common in OSA cases with psychiatric disorders than those without at a statistically significant level ( $p < 0.042$ ).

In the study of Shoiab et al. [32] OSA patients with comorbid psychiatric disorders, the percentage of presenting symptoms was as follows: snoring, witnessed apneas, disturbed sleep, daytime sleepiness, and nocturia (97.5%, 97.5%, 46.5%, 70.7%, 89.2%), respectively, while in

OSA patients with no comorbid psychiatric disorders, the percentage was 80%, 0%, 40%, 52%, and 28%, respectively.

While in our study, these figures are less as in OSA patients with comorbid psychiatric disorders (68.4%, 73.7%, 15.8%, 47.4%, 42.1%), respectively, and in OSA patients without psychiatric comorbidities (54.3%, 65.7%, 5.7%, 31.4%) respectively. The difference in the results of the two studies may be attributed to many factors like different methodologies, number of patients, and cultural difference in presentation of symptoms.

In comparing between some presenting symptoms in OSA patients with and without anxiety or depression, our results showed that OSA patients with anxiety, fatigue as a presenting symptom, was significantly more prevalent (84.1%,  $p < 0.004$ ) than non-refreshing sleep (72.7%), witnessed apnea (68.2%), snores (65.9%), daytime sleepiness (47.7%), and nocturia (43.2%).

Similarly, for OSA patients with depression, fatigue as a presenting symptom was more prevalent (75.5%) than witnessed apnea (73.5%), non-refreshing sleep and snores (both 69.4%), daytime sleepiness (44.9%), and nocturia (42.9%). The same results also have been shown in the study by Rezaeitalab et al. [25], which stated that the OSA victims with association of either depression or anxiety might suffer from sleep disruption, headache, mood disturbance, restlessness, and memory. However, the association of sleep apnea with anxiety and depression is not completely understood.

No statistical difference was found in correlating gender to Beck anxiety or depression. In our study, there was no significant statistical correlation between Beck anxiety and depression, a finding that was not found to be tested in similar researches.

Gharsalli et al. [13] noted the following: "the high prevalence of depression and anxiety in apneic patients demonstrates the importance of the psychiatric component in the management of this disease which goes with the current study conceptualization of the problem."

The same view was adopted by Benca et al. [5] who recommended the necessity of examining the OSA patients for comorbid psychiatric disorders to improve response to treatment, quality of life, and overall health.

## Conclusion

We conclude the following:

- 1) OSA patients are likely to experience depression and/or anxiety disorder(s).
- 2) Fatigue was found to be the most prevalent presenting symptom in OSA patients with comorbid anxiety compared to those without anxiety with a high statistically significant level.

### Clinical implications

Psychiatrists should be aware of the high possibility of comorbidity between OSA and anxiety and depression. Ignoring this information may contribute to treatment resistance and prolong the suffering of patients. Given the similarity in symptoms between anxiety, depression, and OSA, it is crucial to consider conducting polysomnographic screening for patients before diagnosing them solely with these psychiatric disorders.

### Limitations

The relatively limited literature on Egyptian OSA patients limited the study's ability to compare the obtained data with other data from the same culture. The size of the studied population may also be a limitation. The use of a self-rating questionnaire is a potential source of bias as the patients may report what they should say rather than what they actually feel.

### Abbreviations

CPAP	Continuous positive airway pressure
EEG	Electroencephalogram
EES	Epworth Sleepiness Scale
GAD	Generalized anxiety disorder
OCD	Obsessive-compulsive disorder
OSA	Obstructive sleep apnea
OSAS	Obstructive sleep apnea syndrome
PTSD	Posttraumatic stress disorder
QOL	Quality of life
RDI	Respiratory disturbance index
REM	Rapid eye movement sleep
SCID I	DSM-IV Axis I Disorders

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### Authors' contributions

SAL has contributed to the study conception and design, HH, OI, AEAFF, and MO contributed to the interpretation and design of the study, and AT reviewed the methods and critically revised the article.

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### Availability of data and materials

Available data and material.

### Declarations

#### Ethics approval and consent to participate

All participants in the study signed an informed consent prior to completing the questionnaires and doing the polysomnography. The objectives and aim of the study were explained to them, and they were informed that they had the right to withdraw from the study at any time. The study was approved by the Ethics and Clinical Research Committee of the Faculty of Medicine, Suez Canal University, with ethical approval no. 4489, year 2021.

#### Consent for publication

Not applicable.

#### Competing interests

The authors declare that they have no competing interests.

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