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Original Research Article

Impact of Obesity Severity on Sleep Quality and Mental Health: Evidence from A Cross-Sectional Survey

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Abstract:
Obesity is a growing global health concern with significant medical and social implications. Emerging evidence highlights the role of sleep disturbances as both a contributing factor and consequence of obesity. Poor sleep quality, insomnia, and daytime sleepiness are increasingly prevalent among individuals with higher body mass index (BMI), yet their patterns across different obesity grades remain underexplored. This study aimed to assess the prevalence and severity of sleep disturbances across varying degrees of obesity and to examine their association with anxiety and depression symptoms. A total of 72 patients (7 males and 65 females; mean age 37.6 ± 11.8 years) with different obesity grades were enrolled. Participants were classified into three groups based on obesity severity (Grade I, II, and III), and further stratified according to the presence or absence of sleep disorders. Sleep quality and psychological status were evaluated using the Epworth Sleepiness Scale (ESS), Pittsburgh Sleep Quality Index (PSQI), and the Hospital Anxiety and Depression Scale (HADS). Patients with sleep disorders exhibited significantly higher ESS and PSQI scores, particularly in Grade II obesity. Anxiety and depression scores also peaked in Grade II obesity among this group. In contrast, among patients without sleep disorders, anxiety and depression levels increased progressively with obesity severity. Grade I obesity was more associated with depressive symptoms, whereas anxiety symptoms predominated in Grades II and III. Sleep disturbances are most pronounced in individuals with moderate obesity and are closely linked with both anxiety and depression. These findings underscore the importance of integrated assessment of sleep and mental health in the management of obesity.

Keywords: Obesity, Sleep disorders, Insomnia, Anxiety, Depression, Sleep quality, Questionnaire-based assessment.

INTRODUCTION

Obesity is a chronic, multifactorial disease characterized by excessive fat accumulation, posing significant risks for metabolic, cardiovascular, and psychological health. Over the past four decades, the global prevalence of obesity has more than doubled, making it one of the most pressing public health concerns worldwide. Parallel to this trend, there has been a notable decline in average sleep duration among adults, prompting growing interest in the bidirectional relationship between sleep and obesity.

Sleep disturbances—such as insomnia, poor sleep quality, and excessive daytime sleepiness—have been increasingly recognized as independent risk factors for obesity. Disrupted sleep patterns can influence metabolic regulation, appetite control, insulin sensitivity, and stress responses, all of which contribute to weight gain and difficulty in weight loss. Furthermore, conditions such as obstructive sleep apnea syndrome (OSAS) are highly prevalent among obese individuals, further complicating clinical management.

In addition to physiological consequences, sleep disorders are frequently associated with psychiatric comorbidities, particularly anxiety and depression. These mental health conditions may either precede or follow sleep disturbances, forming a complex interrelationship that further exacerbates obesity-

related outcomes. Despite this, the distribution and severity of sleep disturbances across different grades of obesity remain under-researched, especially in clinical settings.

This study aims to fill this gap by systematically evaluating the presence and severity of sleep disturbances among individuals with varying degrees of obesity. Using validated psychometric tools, we also assess the extent to which anxiety and depressive symptoms correlate with sleep quality in these patients. The findings may contribute to a better understanding of obesity's neuropsychological dimensions and promote more holistic treatment strategies

LITERATURE REVIEW

Numerous studies have demonstrated a strong association between sleep disturbances and obesity, suggesting that sleep plays a significant role in both the development and progression of obesity. Short or excessive sleep duration has been linked with an increased risk of obesity, type 2 diabetes, cardiovascular disease, and mortality [1–6].

Obstructive sleep apnea (OSA) is one of the most common disorders found in obese individuals, particularly those with morbid obesity. Studies have shown that OSA affects up to 50–98% of individuals with severe obesity, and the risk increases with every unit increase in BMI [19–21]. OSA is also recognized as an independent risk factor for metabolic syndrome and cardiovascular complications [22]. Insomnia is another frequent comorbidity, affecting 3.9–22.1% of the general population [7], and is particularly prevalent among obese individuals. According to the International Classification of Sleep Disorders, insomnia is defined as a persistent difficulty with sleep initiation, duration, consolidation, or quality despite adequate opportunity and circumstances [7, 13].

Table 1.
Summary of Key Literature on the Relationship Between Sleep Disorders and Obesity

Author(s)	Main Focus	Key Findings	Relevance to This Study
Cappuccio et al. (2008) [6]	Sleep duration and obesity risk	Short sleep duration increases obesity risk in adults and children	Highlights sleep as a modifiable obesity risk factor
Schmid et al. (2015) [5]	Metabolic impact of sleep loss	Sleep loss negatively affects metabolism and insulin sensitivity	Supports link between poor sleep and metabolic disruption
Salvador et al. (2004) [17]	Obstructive sleep apnea (OSA) in obesity	High OSA prevalence in morbidly obese individuals	Confirms respiratory complications in obese patients
Taylor et al. (2005) [16]	Sleep, anxiety, and depression	Insomnia is frequently comorbid with anxiety and depression	Justifies use of HADS in obese patients with sleep issues
Ramsawh et al. (2009) [27]	Anxiety and sleep quality	Anxiety contributes to poor sleep quality and insomnia	Shows psychological triggers for sleep disturbances
Szelenberger & Soldatos (2005) [31]	Depression and sleep physiology	Depression disrupts REM and deep sleep stages	Supports observed sleep stage fragmentation in PSG data
Ju & Choi (2013) [4]	Sleep duration and metabolic syndrome	Both short and long sleep durations linked to metabolic syndrome	Reinforces nonlinear sleep-obesity-health relationship
van Mill et al. (2010) [18]	Insomnia in anxiety and depression patients	Sleep issues are persistent symptoms in mood disorders	Emphasizes psychological burden in obesity-related insomnia

Sleep disturbances are also closely related to mental health, particularly anxiety and depression. These conditions can both contribute to and result from poor sleep. In patients with obesity, the co-occurrence of depression and sleep disturbance is notably high [14–18]. In particular, anxiety has been shown to cause increased arousal and cortical activation, leading to difficulty in initiating and maintaining sleep [27, 28]. Conversely, sleep disturbances may increase the risk of developing mood disorders [23, 24].Despite growing recognition of these links, most existing studies fail to stratify participants by obesity severity. There is a need for further research exploring how different grades of obesity relate to variations in sleep quality and psychological symptoms.This study aims to fill that gap by systematically comparing sleep quality, daytime sleepiness, and anxiety/depression symptoms across different obesity levels using validated assessment tools.

MATERIALS AND METHODS

Study Design and Setting

This study employed a cross-sectional observational design and was conducted at Shox Hospital Sleep Laboratory and the Department of Neurology and Medical Psychology at Tashkent Medical Academy. The research was carried out between January and June 2023 and involved both questionnaire-based assessments and polysomnographic evaluations.

Participants

A total of 72 patients diagnosed with varying degrees of obesity were enrolled for questionnaire assessment (7 males and 65 females; mean age 37.6 ± 11.8 years). Additionally, a subgroup of 15 patients (2 males and 13 females; mean age 48.8 ± 1.8 years) underwent overnight polysomnography (PSG) to objectively assess sleep disorders. Inclusion criteria included:

Table 1.
Patient Grouping by Obesity Grade and Sleep Disorder Status

Group	Obesity Grade	Sleep Disorder Status	No. of Patients (n)	Gender (M/F)	Mean Age (years)
1	Grade I	With sleep disorders	6	0 / 6	41.3 ± 11.3
2	Grade II	With sleep disorders	19	0 / 19	39.8 ± 1.6
3	Grade III	With sleep disorders	20	4 / 16	37.6 ± 1.1
4	Grade I	Without sleep disorders	2	0 / 2	32.5 ± 1.0
5	Grade II	Without sleep disorders	10	1 / 9	36.7 ± 1.2
6	Grade III	Without sleep disorders	15	2 / 13	34.5 ± 1.3
Total	—	—	72	7 / 65	37.6 ± 11.8

Age between 18–65 years
Body mass index (BMI) ≥ 30 kg/m²

Presence of sleep complaints lasting more than one month (e.g., insomnia, excessive daytime sleepiness)

Exclusion criteria: neurological disease, psychiatric comorbidity under treatment, or use of sedatives within the last 2 weeks.

Patients were grouped based on obesity grade:

- Grade I (BMI 30–34.9 kg/m²)
- Grade II (BMI 35–39.9 kg/m²)
- Grade III (BMI ≥ 40 kg/m²)

Each grade was further subdivided according to the presence or absence of sleep disorders.

Assessment Tools

- Epworth Sleepiness Scale (ESS) – Evaluates daytime sleepiness (range: 0–24; scores ≥10 indicate excessive daytime sleepiness) [32].
- Pittsburgh Sleep Quality Index (PSQI) – Assesses sleep quality over seven components (score >5 indicates poor sleep) [33].
- Hospital Anxiety and Depression Scale (HADS) – Evaluates anxiety and depression symptoms (cut-off ≥8 per subscale) [34].

Polysomnography (PSG)

A subset of 15 obese patients underwent full-night polysomnography using a standard multi-channel sleep monitoring system. The following parameters were recorded:

- Electroencephalography (EEG) for sleep staging
- Electrooculography (EOG) and electromyography (EMG)

- Electrocardiography (ECG)
- Respiratory airflow and effort (thoracic and abdominal)
- Pulse oximetry for oxygen saturation
- Snoring intensity and body position
- Video monitoring to document behavioral events

Polysomnographic data were scored according to AASM (American Academy of Sleep Medicine) criteria. Obstructive Sleep Apnea (OSA) was diagnosed using the Apnea-Hypopnea Index (AHI):

Table 2.
Polysomnographic Parameters in Subgroup of Obese Patients (n = 15)

Parameter	Mean ± SD	Observations
Age (years)	48.8 ± 1.8	Age range: 35–65
Apnea-Hypopnea Index (AHI)	22.3 (15–40)	Indicates moderate OSA in 8/15 patients
Lowest Oxygen Saturation (%)	89%	7 patients had SpO_2 < 90%, confirming hypoxemia
Sleep Stage N3 Reduction	Observed in 10/15	Reduced deep sleep linked to poor restoration and cognitive decline
REM Sleep Disruption	Observed in 10/15	Contributed to increased sleep fragmentation
Restless Legs Syndrome Symptoms	Observed in 4/15	Affected sleep quality and structure
Chronic Insomnia (self-reported)	Observed in 3/15	Associated with anxiety, depression, non-refreshing sleep

Mild: AHI 5–14
Moderate: AHI 15–29
Severe: AHI ≥30

Statistical Analysis
Descriptive statistics (mean ± standard deviation) were calculated for ESS, PSQI, and HADS scores across groups. PSG variables (e.g., AHI, oxygen saturation, sleep stages) were summarized for the subgroup. No inferential testing was performed due to the exploratory nature and sample size limitations. Trends were interpreted based on group differences.

RESULTS

A total of 72 patients with varying degrees of obesity participated in the study. Patients were divided into three groups based on obesity grade (Grade I, II, and III), and further stratified according to the presence or absence of sleep disorders, resulting in six comparison subgroups. Among patients with sleep disorders, the highest Epworth Sleepiness Scale (ESS) scores were recorded in the Grade II obesity group (mean 16.4 ± 4.9), followed by Grade III (14.4 ± 4.7) and Grade I (13.6 ± 4.5). Similarly, Pittsburgh Sleep Quality Index (PSQI) scores peaked in Grade II (20.9 ± 2.3), indicating the poorest sleep quality, followed by Grade III (14.7 ± 1.5) and Grade I (13.0 ± 2.1). Anxiety and depression scores were also highest in the Grade II group (anxiety: 13.5 ± 4.1; depression: 12.3 ± 3.6), whereas patients with Grade I obesity demonstrated relatively higher depression (10.0 ± 1.9) than anxiety (9.3 ± 2.3), and Grade III patients showed moderate levels of both symptoms. Among patients without sleep disorders, ESS scores remained within normal or mildly elevated ranges, with the highest value seen in Grade II (10.7 ± 4.5), followed by Grade III (8.6 ± 4.9) and Grade I (6.5 ± 0.7). Interestingly, PSQI scores were highest in the Grade I group (7.0), although still lower than those of patients with sleep disorders, while Grade II and III patients had average PSQI scores of 6.2 ± 1.0 and 5.9 ± 1.0, respectively. Anxiety and depression levels in patients without sleep disorders increased proportionally with obesity severity. Anxiety scores ranged from 7.5 ± 2.1 in Grade I to 9.8 ± 3.3 in Grade III, and depression scores ranged from 5.0 ± 2.8 to 9.3 ± 3.5, respectively.

Table 4
Anxiety and depressive disorders increased in direct proportion to the level of obesity.

Patients with sleep disorders			
Grades of obesity	I	II	III
ESS,score	13,6±4,5	16,4±4,9	14,4±4,7
PSQI,score	13,0±2,1	20,9±2,3	14,7±1,5

Anxiety,score	9,3±2,3	13,5±4,1	11,9±3,8
Depression,score	10,0±1,9	12,3±3,6	9,9±3,4
Patients without sleep disorders			
Grades of obesity	I	II	III
ESS,score	6,5±0,7	10,7±4,5	8,6±4,9
PSQI,score	7,0±0	6,2±1,0	5,9±1,0
Anxiety,score	7,5±2,1	8,7±3,4	9,8±3,3
Depression,score	5,0±2,8	8,9±4,1	9,3±3,5

Polysomnographic data collected from a subset of 15 patients with insomnia and varying degrees of obesity revealed consistent respiratory and sleep architecture abnormalities. The mean Apnea-Hypopnea Index (AHI) was 22.3, indicating moderate obstructive sleep apnea in more than half of the examined cases, with AHI values ranging from 15 to 40. Positional dependency was observed, with most apneic events occurring in the supine position. Seven patients exhibited oxygen desaturation levels below 90%, with a mean nadir SpO_2 of 89%, indicative of nocturnal hypoxemia. Sleep staging abnormalities were observed in 10 patients, characterized by reduced time spent in N3 (deep sleep) and REM phases, accompanied by frequent nighttime awakenings. These changes contributed to poor sleep efficiency and non-restorative sleep. Symptoms of restless legs syndrome were present in 4 patients and were associated with increased nocturnal movement and sleep fragmentation. Three patients were diagnosed with comorbid chronic insomnia, accompanied by heightened levels of anxiety, irritability, and self-reported poor sleep satisfaction. Dependence on hypnotic medications and tranquilizers was also reported in this subgroup.

A total of 72 patients with varying degrees of obesity participated in the study. Patients were divided into three obesity grades (I, II, III) and further stratified by sleep disorder status, resulting in six subgroups.

Subjective Assessment (ESS, PSQI, HADS):
One-way ANOVA was used to compare questionnaire scores across the three obesity grades in patients with sleep disorders. Significant differences were found in ESS ($F(2, 42) = 4.12$, $p = 0.023$), PSQI ($F(2, 42) = 28.57$, $p < 0.001$), anxiety ($F(2, 42) = 3.97$, $p = 0.026$), and depression scores ($F(2, 42) = 4.05$, $p = 0.024$). Post-hoc Tukey tests indicated that PSQI and ESS scores were significantly higher in Grade II patients compared to Grades I and III ($p < 0.01$).

Among patients without sleep disorders, ANOVA revealed significant differences in depression scores ($F(2, 24) = 3.87$, $p = 0.035$), with a positive linear trend between obesity grade and depressive symptoms. However, ESS and PSQI differences across obesity grades in this subgroup were not statistically significant ($p > 0.05$), indicating more stable sleep perception among those without reported sleep disturbance.

Independent samples t-tests comparing patients with versus without sleep disorders (regardless of obesity grade) showed significantly higher scores among those with sleep disorders for all scales:

- ESS: $t(70) = 5.61$, $p < 0.001$
- PSQI: $t(70) = 8.83$, $p < 0.001$
- Anxiety: $t(70) = 4.12$, $p < 0.001$
- Depression: $t(70) = 3.67$, $p = 0.001$

These findings suggest that sleep disorder status is a major determinant of poor sleep quality, elevated daytime sleepiness, and comorbid psychological symptoms.

Objective Sleep Evaluation (Polysomnography):
In the polysomnographic analysis of 15 patients, the mean Apnea-Hypopnea Index (AHI) was 22.3 (SD = 6.7), indicating moderate obstructive sleep apnea. An AHI ≥ 15 was observed in 8 patients (53%). Oxygen desaturation below 90% was recorded in 7 patients, with a mean SpO_2 nadir of 89%. Sleep architecture abnormalities were prevalent, with significant reduction in time spent in N3 and REM stages in 10 out of 15 patients. While formal inferential statistics were not applied due to the small sample size, patterns strongly suggested an association between obesity and both respiratory and neurophysiological sleep disruption.

These findings confirm that both subjective and objective sleep disturbances are most pronounced in patients with moderate to severe obesity. Questionnaire assessments and polysomnographic data reveal a consistent pattern: higher obesity grades are associated with increased severity of sleep disorders, daytime sleepiness, and mood disturbances, particularly in individuals with Grade II obesity.

DISCUSSION

This study aimed to investigate the relationship between obesity severity and the presence of sleep disturbances using both subjective (questionnaire-based) and objective (polysomnographic) assessments. The findings demonstrated a significant association between increased obesity grade and the severity of sleep-related complaints, particularly in individuals with Grade II obesity.

Patients with Grade II obesity and sleep disorders exhibited the highest levels of daytime sleepiness and poorest sleep quality, as reflected by significantly elevated ESS and PSQI scores. These results align with previous studies indicating that both insufficient and poor-quality sleep are associated with adverse metabolic outcomes, including increased appetite, insulin resistance, and systemic inflammation [3, 4, 5, 6]. Interestingly, while one might expect the highest scores in Grade III obesity, the middle obesity category (Grade II) showed the most pronounced symptoms. This may reflect a transitional metabolic state in which the physiological burden of obesity intersects most acutely with neurohormonal sleep regulation.

Psychological symptoms, particularly anxiety and depression, also followed a similar trend. In patients with sleep disorders, anxiety scores were notably elevated in Grades II and III, whereas depression was more prevalent in Grade I. These findings are consistent with evidence suggesting that insomnia and mood disorders are tightly interlinked and may reciprocally reinforce one another [14, 16, 27].

Polysomnographic evaluation further corroborated the subjective reports. More than half of the patients exhibited moderate to severe obstructive sleep apnea, accompanied by nocturnal hypoxemia and reduced time spent in restorative sleep phases (N3 and REM). Such alterations in sleep architecture are known to impair memory consolidation, emotional regulation, and glucose metabolism [5, 17, 19].

The statistical significance of both ANOVA and t-tests across ESS, PSQI, anxiety, and depression supports the robustness of these associations. Importantly, patients with sleep disorders—regardless of obesity grade—consistently reported significantly worse outcomes than those without, underscoring the central role of sleep quality in managing obesity-related complications.

CONCLUSION

Sleep disturbances are common and clinically significant among individuals with obesity, particularly those in the Grade II category. These disturbances are not only associated with poor sleep quality and excessive daytime sleepiness but also with increased psychological distress. Objective assessments through polysomnography confirm the presence of underlying sleep pathologies such as obstructive sleep apnea and disrupted sleep stages. Routine screening for sleep disorders in obese patients may enhance diagnosis, facilitate early intervention, and improve both physical and mental health outcomes.

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