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RESEARCH ARTICLE
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"UNRAVELING THE IMPACT OF SLEEP DISTURBANCES ON MENTAL HEALTH IN TYPE 2 DIABETIC PATIENTS: EXPLORING THE LINKS AND IMPLICATIONS"

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ABSTRACT

Background. Type 2 diabetes melitus is linked to sleep disorders, which can worsen glucose metabolism and contribute to anxiety and depression. This study aimed to investigate the association between insomnia and anxiety and depression in T2DM patients. **Objective:** This study aimed to assess the association between insomnia and anxiety and depression in patients with Type 2 diabetes melitus, examining the relationship between sleep quality and mental health outcomes to inform strategies for improving patient care. **Methodology** A cross-sectional study was conducted among 376 patients with decompensated Type 2 diabetes melitus to investigate the relationship between insomnia, anxiety, and depression. The study utilized standardized assessment tools, including the Pittsburgh Sleep Quality Index (PSQI) ,Insomnia Severity Index (ISI) to evaluate insomnia, Hospital Anxiety and Depression Scale (HADS) to assess anxiety and depression symptoms. Multivariable logistic regression analysis was employed to examine the association between insomnia and the presence of anxiety and depression, controlling for potential confounding variables. This comprehensive approach enabled the researchers to gain a deeper understanding of the complex interplay between sleep disturbances, anxiety and depression in patients with T2DM. **Study place and duration** The study was conducted at Abbasi shaheed Hospital between January 2024 to December 2024. **Results**: The study found a significant association between sleep disturbances and anxiety/depression, with 12.80% of patients experiencing anxiety and 12.20% experiencing depression. Poor sleep quality and insomnia severity increased the risk of both conditions, highlighting the importance of addressing sleep disturbances to mitigate anxiety and depression risk. . In terms of anxiety, the adjusted odds ratio for PSQI and ISI scores were 1.09 (P=0.08) and

1.07 (P=0.01) respectively. These for depression were 1.10 (P=0.06) and 1.07 (P=0.01), respectively. **Conclusions** The study concluded that the severity of insomnia is a key indicator of psychological health in T2DM patients, especially those with anxiety and depression. Timely evaluation and further research are necessary to understand the underlying mechanisms and develop effective assessment techniques to improve diagnosis and treatment in clinical settings.

Key Words: Type 2 Diabetes Mellitus, Insomnia, Anxiety, Depression, Sleep Quality, Mental Health

INTRODUCTION

Type 2 diabetes melitus has a complex relationship with sleep disorders, which can have a profound impact on mental health. Specifically, sleep disturbances can contribute to the development of anxiety and depression in individuals with T2DM[1,2]. Furthermore, sleep deprivation can disrupt glucose metabolism, leading to decreased insulin sensitivity and impaired glucose tolerance[3]. This can create a vicious cycle, where poor sleep quality exacerbates diabetes symptoms and diabetes-related stress and anxiety further worsen sleep quality. The present study sought to investigate the association between insomnia and anxiety and depression in patients with T2DM, aiming to shed light on the intricate relationships between sleep, mental health and diabetes management[4,5]. By exploring this association, the study aims to inform strategies for improving sleep quality, mental health outcomes, and overall diabetes care.

Poor glycemic control in patients with Type 2 diabetes melitus can lead to severe and debilitating complications. To achieve optimal blood glucose levels and prevent these complications, patients with T2DM must adhere to a lifelong regimen that includes a strict diet, regular physical activity, medication adherence and frequent blood glucose monitoring[6,7]. However, this demanding regimen can take a toll on patients' mental health, leading to chronic stress and emotional problems such as anxiety, fear and poor sleep quality. Sleep disturbances are a common comorbidity in patients with T2DM, affecting approximately 30-50% of individuals.[8] Furthermore, sleep disturbances can have a profound impact on blood glucose regulation and diabetes-related quality of life, regardless of factors such as age of onset, disease duration, comorbidities, complications, insulin use and depressive symptoms[9,10]. The complex interplay between sleep quality, glycemic control and emotional well-being highlights the need for a comprehensive approach to managing T2DM that addresses not only physical but also psychological and emotional aspects of the disease. Research has shown that insomnia is linked to an increased risk of developing psychiatric disorders, including depression and anxiety[11]. The development of Type 2 diabetes melitus and depression/anxiety may share common biological pathways, with anxiety activating the autonomic and hypothalamic-pituitary-adrenal (HPA) axis leading to immuno-inflammatory dysregulation. The hypothalamus plays a crucial role in regulating the sleep-wake cycle and anxiety is a common comorbidity in individuals with T2DM. Studies have demonstrated that diabetic patients with comorbid anxiety are more likely to experience increased complications, blood glucose dysregulation and poor treatment adherence[12,13]. Depression is also prevalent in individuals with T2DM with a prevalence approximately two times higher than in the general population. According to the Diagnostic and Statistical Manual of Mental Disorders, a major depressive episode is characterized by symptoms such as sadness, pessimistic thinking, suicidal tendencies and changes in energy, appetite, and sleep patterns, which can occur individually or in combination and are associated with a poorer clinical profile, including glycemic control, dietary habits, and adherence to physical activity. Current evidence highlighted a strong interconnection between emotional disorders and sleep disturbances, suggesting that these conditions often co-occur[14]. For instance, individuals experiencing insomnia are at a heightened risk of developing mental health disorders, particularly depression[15,16]. Research has shown that persistent sleep disturbances can increase the likelihood of recurrent depressive episodes, underscoring the complex relationship between sleep quality and mental health. Moreover, insomnia has been identified as a significant risk factor for suicidal behavior, emphasizing the critical need for addressing sleep disturbances in mental health interventions. In the context of

Type 2 diabetes melitus, the combination of poor sleep quality and anxiety can have a profoundly negative impact on patients' quality of life (QoL)[17-19]. Studies have estimated that approximately 29% of the decline in QoL in individuals with T2DM can be attributed to the interaction between poor sleep quality and anxiety symptoms, highlighting the importance of addressing both sleep disturbances and emotional well-being in the management of T2DM to improve overall patient outcomes.

The study highlighted the severity of insomnia can serve as a crucial indicator of psychological health in patients with Type 2 diabetes melitus, particularly those experiencing sleep disorders accompanied by anxiety and depression. Early evaluation and assessment of these patients are essential to provide timely interventions. Further research is needed to elucidate the underlying mechanisms linking anxiety, depression and sleep disorders in T2DM patients. Moreover, investigating the feasibility and effectiveness of assessment techniques in clinical settings can help improve diagnosis and treatment of affective and sleep disorders, ultimately enhancing patient outcomes and quality of life.

OBJECTIVES

The study aimed to assess the association between insomnia and anxiety and depression in patients with Type 2 diabetes melitus. Specifically, the study aimed to examine the relationship between sleep quality, insomnia severity and the presence of anxiety and depression symptoms in patients with decompensated T2DM. By exploring this association, the study sought to provide insights into the complex interplay between sleep disturbances and mental health outcomes in patients with T2DM, ultimately informing strategies for improving sleep quality, mental health and overall diabetes management.

METHODOLOGY

A cross-sectional study was conducted at Abbasi shaheed Hospital between January 2024 to December 2024. The study targeted patients with confirmed Type 2 diabetes melitus diagnoses, calculating a sample size of 376 participants based on statistical power analysis to ensure a 95% confidence interval with a 5% error margin. Inclusion criteria included a disease duration of at least one year with hemoglobin glycation index (HbA1C) of ≥6.5%. Patients were excluded if they had severe or unstable concomitant somatic pathology, a history of stroke or transient ischemic attack, craniocerebral trauma, central nervous system disorders, severe psychiatric disorders, dementia, or drug addiction.

The study utilized three questionnaires to assess insomnia, sleep quality, and anxiety and depression symptoms in patients with Type 2 diabetes melitus. The Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI) and Hospital Anxiety and Depression Scale (HADS) were administered during interviews with the help of the first author. The PSQI is a 19-item self-rated questionnaire that evaluates overall sleep quality by assessing seven components, including subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction. Scores range from 0 to 21, with a score higher than five indicating poor sleep quality. The Insomnia Severity Index (ISI) is a seven-item questionnaire that assesses current sleep problems over the preceding two weeks, with scores ranging from 0 to 28, and categorizing insomnia severity as normal, mild, moderate, or severe. The Hospital Anxiety and Depression Scale (HADS) is a 14-item questionnaire that assesses anxiety and depression symptoms, with scores ranging from 0 to 21 for each subscale, and a cutoff score of ≥8 indicating significant anxiety or depression. The validity and reliability of the HADS have been confirmed in numerous studies. These questionnaires provided a comprehensive assessment of sleep quality, insomnia, anxiety and depression symptoms in the study population.

STATISTICAL ANALYSIS

The study used SPSS 22.0 for statistical analysis. Descriptive data presented as frequencies and percentages while continuous data were reported as means with standard deviations (mean ± SD). To

determine the differences between groups, the non-parametric Mann-Whitney U test was employed. Spearman's correlation analysis was used to assess the relationships between variables. Furthermore, binary logistic regression analysis, adjusted for age and sex, was utilized to evaluate the association between insomnia and anxiety/depression, providing a more nuanced understanding of the relationships between these variables

RESULTS

In the study,the respondents comprised of a total of 376 patients with decompensated Type 2 diabetes melitus, comprising 232 females and 144 males, with a mean age of 51.73 ± 6.63 years (range: 45-59 years). The assessment of affective disorders revealed that the majority of patients (87%) did not exhibit symptoms of anxiety or depression.

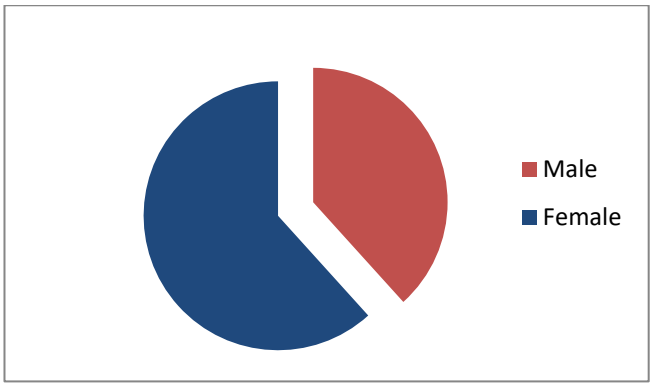

Fig 1:Gender distribution

Table 1: showed the demography and clinical characterstics of the patient

Variables	**Results**
Age	51.73 ±6.63
Sex	
Male	232(61.70)
Female	144(38.30)
BMI	29±6.30
HbA1C	113.05
Co-morbidities Atrial hypertension Ischemic Heart disease	204(54,3) 12(3,2) 24(6,4)
Anxiety Without anxiety (HADS<8) Abnormal anxiety score(HADS>8)	 328(87.20) 48(12.80)
Depression Without depression(HADS<8) Abnormal depression score(HADS>8)	 330(87.80) 46(12.20)
Insomnia Sleep quality(PSQI) Insomnia(ISI)	 7.9±3.99 9±7.14

Data are expressed as mean±SD or number (%), BMI: Body mass index; HbA1C: Hemoglobin glycation; HADS: Hospital anxiety and depression scale; PSQI: Pittsburgh sleep quality index; ISI: Insomnia severity index

However, notably, all patients in the study demonstrated signs of sleep disturbances. A comparative analysis between patients with and without anxiety/depression (presented in Table 2) showed significant differences in insomnia indicators. Specifically, patients with anxiety and depression had significantly poorer sleep quality and greater insomnia severity compared to those without these

conditions, highlighting the complex interplay between sleep disturbances, anxiety, and depression in patients with T2DM.

Table 2: Sleep disturbance indicators based on cut off & core off hospital anxiety and depression scale

Indicators		Anxiety			Depression	
	HADS≤7 (n=328)	HADS>8 (n=48)	P value*	HADS≤7 (n=330)	HADS>8 (n=46)	P value**
Sleep quality PSQI	7.53 (4, 10)	10.26 (7, 13)	0.34 (<0.001)	7.53 (4, 10)	10.26 (7, 13)	0.37 (<0.001)
Severity of insomnia ISI	8.23 (2,13)	13.42(9.5,9)	0.48 (<0.001)	8.26 (2, 11)	13.43 (9, 9)	0.33 (<0.001)

*Mann-Whitney U test; **Spearman's correlation; HADS: Hospital anxiety and depression scale; PSQI: Pittsburgh sleep quality index; ISI: Insomnia severity index. Higher PSQI and ISI scores indicate poorer sleep quality and more severe insomnia, respectively.

Logistic regression analysis was employed to investigate the association between insomnia and anxiety and depression. The results revealed moderate correlations between anxiety scores and both the Pittsburgh Sleep Quality Index (PSQI) ($r = 0.34$, $p < 0.0001$) and the Insomnia Severity Index (ISI) ($r = 0.48$, $p < 0.0001$). Similarly, depression scores were correlated with PSQI ($r = 0.37$, $p < 0.0001$) and ISI ($r = 0.33$, $p < 0.0001$). The adjusted logistic regression analysis demonstrated a significant association between PSQI and ISI scores with both anxiety and depression, as presented in Table 3. These findings suggest that poorer sleep quality and greater insomnia severity are significantly associated with increased symptoms of anxiety and depression in patients with Type 2 Diabetes Mellitus.

Table 3:showed the anxiety and depression association of anxiety and depression with demographic parameters and sleep indicators

Variables		Adjusted*		Crude	
		OR (95% CI)	P value	OR (95% CI)	P value
Anxiety	Sex	0.98	0.01	n/a	
	Age	0.00	0.89	n/a	n/a
	PSQI	1.09 (0.99-1.20)	0.08	1.13 (1.02-1.25)	0.01
	ISI	1.07 (1.02-1.13)	0.01	1.07 (1.02-1.13)	0.01
Depression	Sex	1.16	0	n/a	n/a
	Age	0.00	0.76	n/a	n/a
	PSQI	1.10 (1.00-1.21)	0.06	1.14 (1.04-1.26)	0.01
	ISI	1.07 (1.01-1.13)	0.01	1.07 (1.02-1.13)	0.01

The multivariate model was adjusted for both age and sex rather than each variable; n/a: Not available; PSQI: Pittsburgh sleep quality index; ISI: Insomnia severity index

DISCUSSION

Type 2 diabetes is a chronic metabolic disorder characterized by insulin resistance and impaired insulin secretion leading to hyperglycemia. The condition is often accompanied by a range of psychological comorbidities, including anxiety and depression, which can significantly impact an individual's quality of life and disease management[20-21]. Anxiety and depression in patients with type 2 diabetes can exacerbate symptoms, worsen glycemic control, and increase the risk of diabetes-related complications[22]. The complex interplay between type 2 diabetes, anxiety, and depression is thought to be influenced by a range of factors, including biological mechanisms, such as inflammation and oxidative stress, as well as psychological and social factors, such as the emotional burden of managing a chronic condition, social support, and coping mechanisms[23-24]. Effective management

of type 2 diabetes therefore requires a comprehensive approach that addresses not only the physical aspects of the condition but also the psychological and emotional needs of patients[25].

The relationship between insomnia and the intensity of affective disorders, such as anxiety and depression, in our patient population has not been previously reported in the literature. However, several studies have explored the association between insomnia and anxiety and depression in different contexts[26]. Studies have reported strong associations between poor sleep quality and affective disorders in patients with cardiovascular disease particularly in older adults, smokers, those with low physical activity levels, obesity and type 2 diabetes[27-28]. These findings suggest that poor sleep quality is a significant risk factor for anxiety and depression, highlight the importance of addressing sleep disturbances in the prevention and management of affective disorders[29].This study is the first to investigate the association between insomnia and the risk of anxiety and depression symptoms in patients with Type 2 diabetes melitus. The findings revealed that despite only a small proportion (less than 15%) of patients exhibiting signs of subclinical or clinical depression and anxiety, these individuals had significantly poorer quality of life and more severe insomnia compared to their counterparts without anxiety and depression. Notably, anxiety and depression scores were moderately correlated with sleep quality and insomnia severity, suggesting a strong link between sleep disturbances and mental health outcomes in this population. Furthermore, logistic regression analysis confirmed a significant association between insomnia severity and the degree of anxiety and depression, highlighting the potential role of insomnia in exacerbating mental health symptoms[30-32]. Interestingly, the study also found that anxiety and depression scores were negatively associated with the severity of daytime sleepiness, suggesting a complex relationship between sleep, anxiety, and depression in patients with T2DM. In this study, we employed both the Pittsburgh Sleep Quality Index (PSQI) and the Insomnia Severity Index (ISI) questionnaires to comprehensively assess sleep quality and insomnia severity in patients with Type 2 diabetes melitus. The rationale behind using both tools was to capture the multifaceted nature of sleep disturbances, which can lead to physiological changes, such as activation of the sympathetic nervous system and impaired glucose tolerance, as well as behavioral disorders, including inattention, anxiety and depression. Understanding the exact mechanisms underlying the relationship between sleep quality, insomnia and affective disorders is crucial for developing targeted interventions. A recent meta-analysis reported a 39% prevalence of insomnia in individuals with T2DM, which was associated with poorer glycemic control, as evidenced by higher HbA1c and fasting glucose levels. In contrast, our study found a significantly higher prevalence of insomnia, potentially due to the larger proportion of patients with decompensated T2DM and elevated HbA1c levels, highlighting the complex interplay between sleep disturbances, glycemic control, and affective disorders in this population[33]. A previous study utilizing the International Prevalence and Treatment of Diabetes and Depression protocol found an overall prevalence of anxiety disorders of 18% among 3,170 individuals with Type 2 diabetes melitus across multiple countries. In our study, we identified specific variables significantly associated with anxiety disorders, including female sex, presence of diabetic complications and poorer glycemic control, as indicated by higher HbA1c levels[34-35]. These findings highlighted the importance of considering the complex interplay between demographic, clinical and psychological factors in understanding anxiety disorders in patients with T2DM.

Our study's findings have significant implications for clinical practice, highlighting the importance of timely diagnosis and management of sleep disorders in patients with Type 2 diabetes melitus. Healthcare practitioners should prioritize screening for poor sleep quality in these patients, given the potential psychological effects on their overall well-being. By identifying and addressing sleep disorders, practitioners can mitigate the emotional burden of the disease and improve patient outcomes. However, our study's limitations should be acknowledged, including the fact that all participants had decompensated T2DM, which may limit the generalizability of our findings to patients with well-controlled T2DM. Furthermore, while our cross-sectional design allowed us to explore the temporal relationship between insomnia and anxiety and depression, a longitudinal study would provide more comprehensive insights into the complex dynamics between sleep quality,

anxiety, and depression in patients with T2DM. Future research should consider longitudinal designs to further elucidate these relationships.

CONFLICT OF INTEREST Nil

CONCLUSIONS

The study concluded that sleep quality plays a crucial role in maintaining psychological health in individuals with Type 2 diabetes melitus, particularly those who are prone to anxiety and depression. As a vital indicator of overall well-being, sleep quality can significantly impact mental health outcomes in T2DM patients. Poor sleep quality can exacerbate symptoms of anxiety and depression while good sleep quality can help mitigate these conditions. Monitoring and addressing sleep quality can provide valuable insights into the psychological health of T2DM patients, enabling healthcare providers to develop targeted interventions that address both sleep and mental health concerns. By prioritizing sleep quality, healthcare providers can potentially improve mental health outcomes and overall quality of life for individuals with T2DM. By exploring these areas, healthcare providers can develop more effective strategies to address the complex interplay between sleep, mental health, and diabetes management.

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