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RESEARCH PAPER

Relationship between Seasonal Affective Disorder and Fibromyalgia among Type 2 Diabetics: Moderating Role of Sleep Quality

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ABSTRACT

Type 2 diabetes is generally associated with depression and seasonal affective disorder. This study examined sleep quality, seasonal affective disorder, and fibromyalgia in demographic variables. Purposive sampling of 200 patients with type 2 diabetes was recruited from clinics and hospitals. Using the Pittsburgh Sleep Quality Index, the Seasonal Pattern Assessment Questionnaire, and the Fibromyalgia Rapid Screening Tool, researchers found that poor sleep quality is predictive of fibromyalgia and seasonal affective disorder, and that sleep quality moderates the effect of fibromyalgia on seasonal affective disorder, with higher levels of fibromyalgia related to higher levels of seasonal affective disorder among those with poor sleep quality. Additionally, sleep quality, fibromyalgia symptoms, and seasonal affective disorder differed significantly by gender, climatic zone, and vitamin D levels, suggesting that clinicians should consider focusing treatment strategies on sleep quality in patients with type 2 diabetes, fibromyalgia, and seasonal affective disorder.

| **Keywords:** | Diabetes, Fibromyalgia Relationship, Treatment Strategies |

Introduction

Diabetes, particularly T2DM, is a long-lasting metabolic ailment characterized by inadequate regulation of blood glucose, which may lead to cardiovascular, kidney, and eye complications (CDC, 2022). T2DM is influenced by numerous lifestyle and biological factors and is linked to poor sleep quality, which can further impair blood glucose control and metabolic health (Marcotte-Chénard et al., 2025). Type 2 diabetes mellitus is due to insulin resistance resulting from insufficient insulin secretion. Whereas peripheral insulin resistance lessens glucose uptake in tissues, hepatic insulin resistance thwarts the suppression of hepatic glucose synthesis.

Post-meal hyperglycemia and fasting are the outcomes of this dual impact. Early in the course of the disease, insulin levels are often high, but as the condition worsens, insulin production may decrease, exacerbating the high blood sugar levels. Insulin resistance is largely caused by obesity and weight increase, which are impacted by lifestyle variables like nutrition and exercise as well as genetic susceptibility. Increased blood levels of free fatty acids are caused by increased lipolysis in adipose tissue, which disrupts insulin-stimulated glucose transport. It also inhibits the activity of muscle glycogen synthase. Furthermore, adipose tissue secretes a variety of substances that can either favorably or unfavorably impact glucose metabolism, functioning as an endocrine organ.

Sleep is essential for physical and psychological well-being, governed by circadian rhythms and influenced by environmental, emotional, and physiological factors (Darraj, 2023). Poor sleep quality—common in T2DM—is bidirectionally linked to worsened

glycemic control, elevated appetite due to hormonal imbalances, reduced physical activity, and increased psychological distress (Marcotte-Chénard et al., 2025). Additionally, disrupted sleep patterns are strongly associated with mood disorders such as depression and anxiety, potentially leading to suicidal ideation (Darraj, 2023). The risk of mental health disorders is greatly increased by inadequate or poor quality sleep. Even though insomnia is sometimes considered a sign of mental health disorders like anxiety and depression, new research indicates that sleep disturbances may actually cause or worsen these diseases, possibly even resulting in suicidal thoughts. According to studies on sleep deprivation, people who don't currently have any mental health issues can nonetheless feel more stressed and anxious after getting too little sleep.

Sleep issues and type 2 diabetes are closely related. According to research, blood sugar fluctuations and other diabetes-related symptoms cause up to half of people with type 2 diabetes to have trouble sleeping. Insomnia and daytime weariness are frequently caused by changes in blood sugar levels during the night. Frequent urination, headaches, thirst, and exhaustion are all symptoms of high blood sugar that can interfere with sleep. On the other hand, nighttime hypoglycemia brought on by an extended period of fasting or an incorrect dosage of diabetic medication can cause dreams, perspiration, or confusion when you wake up.

Literature Review

Seasonal Affective Disorder (SAD), a subtype of major depressive disorder recognized in the DSM-5 as having a seasonal pattern, also involves significant disruptions in sleep, mood, and energy, particularly during winter months. Reduced sunlight in winter interferes with melatonin and serotonin regulation, leading to symptoms like hypersomnia, low energy, carbohydrate cravings, and social withdrawal (Modzelewski et al., 2025). Individuals with T2DM may experience worsening self-care and disease management during these periods due to SAD symptoms (Sanyal et al., 2020). SAD is also linked to delayed sleep timing, excessive sleepiness, and frequent, unrefreshing naps (Tomatsu et al., 2025).

Fibromyalgia (FM), a chronic condition with widespread pain, fatigue, cognitive impairment ("fibro fog"), and mood alterations, occurs in about 4 million U.S. adults (CDC, 2020). Like T2DM and SAD, FM is strongly linked to disrupted sleep and emotional disorders. Approximately 92.9% of individuals with FM report significant sleep disturbances, which are directly correlated with symptom severity (Andrade et al., 2025; Gómez-Olivé&Fatusi, 2023). FM patients often experience insomnia, non-restorative sleep, and conditions such as sleep apnea and restless legs syndrome, contributing to a vicious cycle of pain, fatigue, and emotional distress.

Current evidence suggests a significant comorbidity between FM and T2DM, with fibromyalgia occurring in 15% of patients with T2DM. This relationship could be due to common pathophysiologic mechanisms like chronic low-grade inflammation, metabolic derangement, and dysregulation of the nervous system, such as insulin resistance and high HbA1c (Ren et al., 2025). All these cross-over biological pathways are responsible for an aggregate disease burden, exacerbating both body and mind symptoms.

Depression and Seasonal Affective disorder (SAD), a condition characterized by mood changes that occur during the winter, are two of the mental illnesses that type 2 diabetes has long been associated with an increased risk for. The American Diabetes Association (Davies et al., 2022) highlights increasing evidence that Type 2 diabetes is linked with mental illnesses, especially during winter when reduced daylight hours and shorter days may exacerbate symptoms. Furthermore, studies have confirmed that Type 2 diabetes significantly affects the risk of developing both fibromyalgia and SAD, and that individuals with poor metabolic control tend to develop both in tandem.

SAD (Seasonal Affective Disorder) often happens alongside fibromyalgia (FM), and many people with FM notice their symptoms get worse during the winter months (Minier et al., 2025). Both conditions seem to involve imbalances in serotonin and melatonin, which can cause mood swings and make people more sensitive to environmental changes, especially in colder, darker seasons. Women are more susceptible than men, and individuals who reside at higher elevations or areas with reduced sunlight have a higher risk (Bazzichi et al., 2024). Both low levels of vitamin D, prevalent in areas where there is little sun, are also linked to FM and SAD. A lack of sufficient vitamin D will exacerbate muscle pain, fatigue, and depression. This puts emphasis on the supplements and good dietary selection for those at risk (Bazzichi et al., 2024). In addition, melatonin, a hormone regulating the sleep-wake cycle, is receiving more attention as a viable treatment option. One study, conducted by France's Institute of Medical Research on Sleep (SFRMS), found melatonin to enhance the quality of sleep and stabilize mood in individuals coping with FM and SAD by addressing circadian rhythm problems (Herrero, 2024). Psychological aspects and sleep issues also contribute to conditions such as temporomandibular disorders, and some studies consider the use of non-invasive brain stimulation as a potential cure.

Fibromyalgia (FM), Type 2 Diabetes Mellitus (T2DM), Seasonal Affective Disorder (SAD), and insomnia are all tightly connected by a combination of biological, psychological, and environmental underpinnings. Melatonin and serotonin are two of the principal hormones involved in helping to understand how these disorders intersect. Melatonin is made by the pineal gland when it gets dark outside, helping control our sleep and wake routines. While scientists aren't completely sure how it all works, some research suggests that too much melatonin during the long winter nights might contribute to feelings of depression in SAD. Light therapy, especially when done in the morning, is believed to lower melatonin levels and help improve symptoms. Studies have also looked at the connection between SAD and fibromyalgia, noticing that people with fibromyalgia tend to experience SAD more often than the general population. What's more, having SAD symptoms seems to be linked with how severe fibromyalgia symptoms are, and the reverse is also true. Recent research by Yildiz and colleagues in 2023 showed that fibromyalgia patients are more likely to also have SAD and depression compared to healthy individuals.

Additionally, the neurotransmitter serotonin, which is associated with mood, appetite, and sleep regulation, is also implicated in SAD, as lower brain serotonin availability (from lower serotonin transporter binding) was found in individuals with SAD (Sigmon et al., 2019), and may account for some of the depressive symptoms associated with SAD, particularly during the winter months. Since both FM and SAD are characterized by poor sleep and mood disturbances, serotonin dysregulation likely accounts for some of the symptom overlap, and treatments that increase serotonin may be effective for both.

Another study found that women with FM were more likely to have comorbid mental health disorders like depression and anxiety, and that women were not as much expected as men to seek treatment for mental well-being, suggesting that women may experience more severe psychosomatic warning signs and may struggle more with the bodily and psychological health facets of FM (Carrasco-Querol et al., 2024). In fact, there is some research to suggest that individuals living in low-altitude regions with less exposure to winter climates may exhibit different patterns of sleep and pain symptoms associated with disorders such as SAD and fibromyalgia (high altitude or winter-prone areas) frequently experience cold weather, which can make fibromyalgia patients' pain worse by decreasing their pain threshold and making their muscles more rigid (Fors& Sexton, 2002).

Another study by Jung et al. (2023) also emphasized the probable of vitamin D in regulating circadian rhythms. This can be particularly helpful for people breathing in low-sunlight environments where SAD is more predominant; vitamin D is important for adaptation to both fibromyalgia and SAD in this population due to its role in mood regulation and sleep quality, which has been related to reduced SAD symptoms. Although the evidence

is still inconclusive, vitamin D treatment has been demonstrated to reduce depression symptoms in people with SAD.

When considered collectively, the studies indicate that Type 2 diabetes, SAD, fibromyalgia, and sleep problems have a complicated and multidimensional interaction. Even though each of these illnesses can have an impact on a person's quality of life on its own, when they coexist, symptoms—particularly those about mood, pain, and sleep—are made worse. When creating treatment plans for Type 2 diabetics, healthcare professionals should take these interactions into account. They should also try to describe not just the medical aspects of these illnesses but also their psychological and sleep-related effects.

The disruptions in melatonin and serotonin regulation can exacerbate sleep problems, fatigue, and mood symptoms in individuals with FM and SAD, highlighting the importance of circadian rhythm and neurotransmitter balance in managing both conditions.

The current study aims to analyze how poor sleep quality affects the association between seasonal affective disorder and fibromyalgia in patients with type 2 diabetes. The truth is that both of these factors are related to the quality of sleep. There is evidence from the literature that it also contributes to the development of fibromyalgia and exacerbates SAD. According to a study, even in healthy people, fibromyalgia symptoms can be brought on by sleep deprivation or poor sleep quality. According to the study, sleep disturbance may be both pathogenic and a result of pain (Andersen et al., 2018).

Mood disorders have been classically linked with sleep. Sleep quality is often associated with depressive symptoms. Seasonal changes in daylight have numerous effects on sleep. In a study, persons with SAD reported feeling sleepier during the day but had longer sleep duration overall with inferior quality. Inadequate, regular sleep can lead to disruption of circadian rhythm, which can result in hormone production and alteration of cortisol, leading to Seasonal Affective Disorder (Silva et al., 2021). The association between fibromyalgia and Seasonal Affective Disorder (SAD) and other associated aspects has been investigated in the literature before. In 2023, a study was published in the Pakistan Journal of Medical and Health Sciences that revealed a high correlation between depression and fibromyalgia. Mascarenhas et al. (2021) state that this study exhibited that depression was predominant among patients with fibromyalgia and that depression treatment was important to improve patients' quality of life.

While the exact connection between fibromyalgia and depression remains elusive, a 2022 Pakistan Institute of Medical Sciences (PIMS) study discovered that depression was one of the most common comorbidities in patients with fibromyalgia (Tahir et al., 2022). The study reports that depression should be successfully treated as it can exacerbate pain and other symptoms of fibromyalgia.

Approximately 60% of the subjects of a 2021 study on the prevalence of depression and anxiety in Karachi FMS patients also reported comorbid depressive symptoms (Abdalla, 2021). To provide comprehensive treatment to fibromyalgia patients, the researchers recommended early screening for mental disorders. The need for holistic care approaches that target both somatic as well as psychological symptoms is also accentuated by a Lahore-based 2020 study, which found high prevalence of fibromyalgia among patients with co-existing mental illnesses, along with SAD (Bokhari et al., 2025). However, there has been a perceivable dearth of research on the role of sleep quality in this context, despite the number of studies on fibromyalgia and depression. Research on the steadfast correlation between fibromyalgia, sleep quality, and its co-morbidity with SAD in Pakistan is still very limited, although it is a well-recognized problem that interferes with sleep among fibromyalgia patients. Poor sleep quality caused patients suffering from fibromyalgia in Rawalpindi to experience more pain and tiredness, as indicated by a research study by Tahir et al. (2022). Nonetheless, the interrelation between sleep disorders and depression,

particularly in the context of SAD, has not been extensively researched. In order to fill this research gap, a huge number of clinical psychology studies are required. Greater insight into how the quality of sleep impacts conditions such as SAD and fibromyalgia might provide better treatments for patients experiencing these conditions.

Material and Methods

To examine the association between fibromyalgia, seasonal affective disorder (SAD), and quality of sleep in type 2 diabetes patients, this study employed a survey-based approach. Surveys allowed for data gathering in a more valid way and helped results be extended to a broader population by providing systematic information about different factors.

Sample

The study comprised 200 patients with Type -2 Diabetes Mellitus. These patients were recruited from Abbottabad hospitals and clinics, Neelum Valley (Muzaffarabad), Jhelum, and Lahore. Purposive sampling was used in choosing the right participants in such a manner that they met some necessary criteria pertaining to the study objectives. For analytical reasons, the participants were grouped based on important demographic data like age, gender, vitamin D intake in the diet, and location. This grouping helped us in understanding how these factors might impact the prevalence and intensity of fibromyalgia symptoms, and their relation with seasonality and sleep disorders.

Instrument

The research employed three established questionnaires to analyze sleep quality, fibromyalgia, and mood seasonal patterns. One, the Fibromyalgia Fast Screening Test (FiRST) is a six-item, yes/no, short self-scoring quiz. It is meant to assist in the identification of individuals with fibromyalgia, and a mark of 5 out of 6 typically indicates the individual has the disorder. The consistency of the test, as calculated by Cronbach's alpha, is 0.684 (Cho et al., 2019). The following is the Pittsburgh Sleep Quality Index (PSQI) developed by Buysse and others in 1989. PSQI is a 19-item self-report questionnaire that queries individuals about their sleep behavior over the past month. It addresses seven components: general sleep quality, how long it takes to fall asleep, quantity of sleep, efficiency of sleep, disruption during nighttime, use of sleep medication, and impact of sleep problems on daytime functioning. A score of 5 or more means sleep is of poor quality. Its reliability score is 0.68 (Zhang et al., 2020). Last but not least, the Seasonal Pattern Assessment Questionnaire (SPAQ), which was created by Rosenthal and co-workers in 1984, consists of 17 items. It queries mood changes throughout seasons and how these changes could influence daily functioning. It includes demographic questions and items assessing the degree of seasonal change, calendar identification of worst months, environmental factors affecting mood, and functional impairment due to seasonal changes. A score above 11 on the Global Seasonality Score (GSS) indicates Seasonal Affective Disorder. The Cronbach's alpha reliability is 0.86 (Reynaud et al., 2021).

Procedure

The study was conducted following ethical approval from the relevant hospital and clinic authorities, ensuring adherence to research guidelines. Participants were approached in the outpatient departments (OPDs) of selected hospitals, where the researcher explained the study's objectives and obtained informed consent, assuring participants of confidentiality and that all data would be used solely for research purposes. Initially, 373 individuals with a diagnosis of Type 2 Diabetes Mellitus were assessed using the Fibromyalgia Rapid Screening Test (FiRST). Based on the inclusion criteria, 173 participants were excluded for not meeting the required score threshold. The final sample comprised

200 eligible participants who met the fibromyalgia criteria. These individuals were then administered the Pittsburgh Sleep Quality Index (PSQI) to assess sleep quality and the Seasonal Pattern Assessment Questionnaire (SPAQ) to evaluate seasonal affective tendencies. These three standardized instruments—FiRST, PSQI, and SPAQ—were used as the primary research tools to collect quantitative data relevant to the study's objectives.

Table1
Sample Distribution

Variable	*f*	%
Gender		
Male	107	53.5
Female	93	46.5
Climate Zone		
Low-land	97	58.5
High-land	103	51.5
Marital Status		
Married	114	72
Un-Married	56	28
Vitamin D		
Deficient	115	57.5
Non deficient	85	42.5

Results and Discussion

Table 2
Hierarchical Regression Analysis for the predictive role of Sleep quality in the relationship between fibromyalgia and Seasonal Affective Disorder among type 2 diabetics(N=200)

Variables	B	95% CI		SEB	B	R^2	ΔR^2
		LL	UL				
Step1						.302	.302
Constant	-18.923	-25.379	-12.468	3.274			
FiRST	5.505	4.331	6.678	.595	.549***		
Step 2						.573	.271
Constant	-7.075	-12.552	-1.597	2.778			
FiRST	2.124	1.027	3.221	.556	.212***		
PSQI	.690	.568	.812	.062	.620***		

*p < .05. **p <. 01. ***p <.001

Table 2 showed that the seasonality or sleep quality was strongly predicted and positively impacted by fibromyalgia (ß =.549, p <.001). The model elucidated 30.2% of the change in the SPAQ scores (R2 = 0.302, F = 85.549, p <.001), showing a robust model fit. Overall, 57% of the change in SPAQ scores was accounted for by sleep quality, which also significantly positively predicted the dependent variable in the second step (ß =.620, p <.001) and enlightened an additional 27% of the diversity [(ΔR^2 =.271, F = 124.928, p <.001)].

Table3
Mean, Standard Deviation, and t-values of gender on Pittsburgh Sleep Quality Index Seasonal and Pattern Assessment Questionnaire (N=200)

Variable	Male (n=107)		Female (n=93)		t (198)	P	Cohen's d
	M	SD	M	SD			
PSQI	8.45	4.34	11.043	4.47	-3.97	.000	0.56
SPAQ	10.06	4.89	12.56	5.87	-3.33	.001	0.48

Note. PSQI=Pittsburgh Sleep Quality Index, SPAQ=Seasonal Pattern Assessment Questionnaire

Table 3 shows notable gender-based disparities in the seasonal pattern assessment questionnaire and sleep quality level. Compared to male patients, female patients with type 2 diabetes and fibromyalgia have worse sleep quality (M=11.04) and more severe symptoms of seasonal affective disorder (M=12.55), according to the mean score comparison.

Table4
Mean, Standard Deviation, and t-values of climatic zones on Seasonal Pattern Assessment Questionnaire and Pittsburgh Sleep Quality Index (N=200)

Variable	Lowland		Highland				
	(n=97)		(n=103)		t (198)	P	Cohen's d
	M	SD	M	SD			
PSQI	8.64	4.30	10.61	5.01	-2.97	.003	0.49
SPAQ	10.09	4.93	12.27	4.45	-2.95	.003	0.42

*Note.*PSQI=PittsburghSleepQualityIndex, SPAQ=Seasonal Pattern Assessment Questionnaire *p < .05. **p <. 01. ***p <.001.

Table 4 shows a significant difference in sleep quality and seasonal pattern assessment questionnaire scores between diabetic patients living in lowland and highland climate zones. By examining the mean scores, the results show that diabetic patients with fibromyalgia living in a highland climate zone exhibited substantial symptoms of SAD, poor sleep quality compared to patients living in a lowland region climatic zone.

Table5
Mean, Standard Deviation, and t-values of vitamin D intake on Seasonal Pattern and Assessment Questionnaire and Pittsburgh Sleep Quality Index (N=200)

Variable	Deficient		Non-Deficient				
	(n=115)		(n=85)		t (198)	P	Cohen's d
	M	SD	M	SD			
PSQI	10.29	4.963	8.80	4.391	2.198	.026	0.32
SPAQ	12.17	5.691	9.93	4.466	3.112	.002	0.43

Note. PSQI=Pittsburgh Sleep Quality Index, SPAQ=Seasonal Pattern Assessment Questionnaire *p<.05.***p<.001.

Table 5 shows that seasonality and sleep quality vary significantly among diabetic individuals. The results of the comparison indicate that, in comparison to patients with normal vitamin D levels, diabetic type 2 patients with vitamin D deficiency scored higher on poor sleep quality and seasonal affective disorder.

Discussion

The purpose of this study is to investigate how the quality of sleep influences the association between SAD and FM to reevaluate the effects of demographic aspects like gender, location, and vitamin D levels on FM symptoms, seasonality, and sleep quality. According to findings, type 2 diabetic patients with low-quality sleep are likely to suffer from fibromyalgia and seasonal affective disorder. The significance of both relative and individual factors was also stressed by the finding of demographic differences in the majority of variables of sleep quality and seasonality among patients with fibromyalgia type 2 diabetes. Sleep disturbances significantly amplify pain in fibromyalgia and depressive symptoms in Seasonal Affective Disorder (SAD).

It has been reported in studies that disrupted sleep intensifies cytokine-mediated inflammation, which exacerbates bodily pain and psychological dysregulation in SAD. This is in line with research that states symptom severity in both conditions is directly correlated with sleep quality (Fries et al., 2023). Disturbed sleep quality has repeatedly been found to be associated with fibromyalgia and Seasonal Affective Disorder (SAD), according to studies. Sleep quality is a strong predictor of the severity of fibromyalgia symptoms such as pain in

widespread regions, depressive symptoms, and fatigue, according to Denche-Zamorano et al. (2024). This is supported by research indicating sleep disturbances exacerbate mood disorders such as SAD and chronic pain.

Recent study results depict notable gender differences in fibromyalgia, seasonal affective disorder (SAD), and sleep. Women experienced poorer quality of sleep and worse SAD symptoms compared to men. Results are in accordance with findings from previous studies that identified women as being susceptible to mood disorders, chronic pain, and sleep disturbance due to differences in hormones and pain hypersensitivity.

The results of this study point to important differences between men and women for fibromyalgia, SAD, and sleep quality. Women were found to have poorer sleep and more severe SAD symptoms than men. These findings are consistent with prior research that suggests that women are more likely to experience mood disorders, chronic pain, and sleep disturbances primarily due to hormonal changes as well as increased sensitivity to pain.

Hormonal fluctuations, hypersensitivity to pain, and elevated levels of depression typically put women suffering from SAD and fibromyalgia at increased risk. Research has shown that fibromyalgia and SAD in women are typically more intense than men's because of differences in hormones and brain hypersensitivity (Vidal-Neira et al., 2024). Depressive mood and pain are typically scored much more severely by women, as reflected by how gender affects pain and emotional regulation, according to Mao et al. (2024). Such differences may be moderated by social and cultural factors as well. Castel et al. (2023), for example, have determined that the symptoms of women are typically more severe, founded mainly on hormonal imbalance and greater sensitivity to stress and pain.

Research indicates that people living in different climatic regions are more likely to manifest a variety of symptoms related to fibromyalgia, seasonal affective disorder (SAD), and sleeping disorders. In areas with less geography and lower altitudes around 1000 meters, people sleep better in general compared to people living in mountainous regions. These results suggest that higher altitude climatic conditions are likely to worsen mood issues, chronic pain, and sleep issues due to potential disruption of the body's internal clock functioning normally and lower oxygen levels. Since higher altitudes have lower oxygen levels and also less sun exposure, they can worsen SAD and fibromyalgia symptoms by destroying circadian rhythms and increasing oxidative stress (Burtscher et al., 2024). Additionally, there is decreased melatonin secretion at higher altitudes due to reduced exposure to photoperiod, further worsening mood disorders like SAD (Munir et al., 2024). A 2022 review by Fabries and colleagues points out how, at high altitudes, there is less oxygen and fluctuating light exposure that can disrupt our internal body clock. They also state that such conditions tend to trigger pain and can worsen symptoms in chronic illnesses like fibromyalgia (FM) and seasonal affective disorder (SAD). Current research has found that the vitamin D level plays a serious role in determining the quality of sleep as well as the severity of SAD symptoms. For those people with low vitamin D intake compared to people eating an adequate quantity, the former group has worse SAD and lower quality of sleep (see Table 5). Vitamin D has a significant role in the generation of serotonin, controlling inflammation, and upholding immune function. Because it controls the perception of pain and mood, a deficiency is intimately related to illnesses such as fibromyalgia and SAD, particularly in diabetics (Climent-Sanz et al., 2021). Wimalawansa et al. in 2021 discovered that vitamin D supplement intake can relieve mood disorders and musculoskeletal discomfort. Such an effect is thought to result from serotonin increase and reduced inflammation, which is especially beneficial for patients with fibromyalgia and SAD. Other studies have also demonstrated that vitamin D supplements improve the symptoms of depression and fibromyalgia pain, highlighting just how crucial vitamin D is in the treatment of these diseases (Rizvi et al., 2020).

Conclusion

Our research discovered that the severity of seasonal affective disorder (SAD), fibromyalgia (FM), quality of sleep, vitamin D deficiency, altitude of residence, and sex are all linked to one another. Sleep plays a special role in both conditions, as poor sleep quality was associated with more severe symptoms. Being resident in high-altitude regions appeared to exacerbate the effects of both SAD and fibromyalgia, possibly because of lower oxygen levels and disrupted body clocks. Vitamin D deficiency also contributed to exacerbating symptoms, particularly in women, who are more sensitive to hormonal and psychological conditions. In general, these findings highlight how individual and environmental components should be addressed in creating treatment regimens. An integrated strategy that addresses sleep problems, environmental difficulties, and nutritional deficiencies can more effectively treat the symptoms of both SAD and fibromyalgia.

Implications

Considering the aforementioned drawbacks, the present study offers insightful information to physicians, therapists, and clinicians who treat patients with type 2 diabetes. To manage the general health and well-being of these individuals, it emphasizes the significance of treating seasonal depression, sleep issues, and fibromyalgia symptoms. This could result in more thorough and focused therapies. Understanding how the health of diabetes people can worsen in different ways will be greatly aided by the current study's findings. By shedding light on the variations in demographic characteristics, the current study seeks to fill in the gaps in the body of knowledge. Future researchers examining the effects of demographic characteristics on fibromyalgia, seasonal affective disorder, and sleep quality will also find it to be a useful guideline.

Recommendations

- The sample of the current research was drawn from Lahore, Islamabad, Mansehra, and Muzaffarabad cities. To increase the generalizability of the findings, it is recommended that subsequent research be conducted across a larger area of Pakistani regions and with increased sample sizes.
- Future research could focus on other variables that affect fibromyalgia, seasonal affective disorder, quality of life, and other illnesses apart from sleep quality. The three groups that were the sole interest of this study were vitamin D intake, region, and sex.
- The researchers in the current study found that patients responded with inaccurate ratings on the rating scales, possibly due to misinterpretations or cognitive biases. The use of a variety of rating scales in future assessments of patient status can potentially avoid these issues and provide a more comprehensive evaluation of patients' symptoms and experiences

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