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Pain Severity and Health-Related Quality of Life Among Patients With Fibromyalgia: The Mediating Role of Sleep Quality and Pain Acceptance

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ABSTRACT

Objective: This study aimed to examine the relationship between pain severity and health-related quality of life among patients with fibromyalgia and to determine the mediating roles of sleep quality and pain acceptance in this relationship.

Methods and Materials: This descriptive-correlational cross-sectional study was conducted using a structural equation modeling approach. The statistical population included adult patients with fibromyalgia who referred to rheumatology clinics, pain management centers, and specialized outpatient clinics in Tehran, Iran. A total of 286 patients were selected through convenience sampling based on the inclusion and exclusion criteria. Data were collected using a demographic and clinical information form, the Brief Pain Inventory–Short Form, the Pittsburgh Sleep Quality Index, the Chronic Pain Acceptance Questionnaire–Revised, and the 36-Item Short Form Health Survey. Data were analyzed using SPSS and AMOS software. Descriptive statistics, Pearson correlation coefficients, and structural equation modeling were used to examine the relationships among the study variables. The bootstrap method with 5,000 resamples was applied to test the significance of indirect effects.

Findings: The inferential findings showed that pain severity had a significant positive effect on poor sleep quality ($\beta = 0.52$, $p < .001$) and a significant negative effect on pain acceptance ($\beta = -0.47$, $p < .001$). Poorer sleep quality significantly predicted lower health-related quality of life ($\beta = -0.31$, $p < .001$), while pain acceptance significantly predicted higher health-related quality of life ($\beta = 0.29$, $p < .001$). Pain severity also retained a significant direct negative effect on health-related quality of life ($\beta = -0.31$, $p < .001$). Bootstrap analysis confirmed the significant indirect effects of pain severity on health-related quality of life through sleep quality ($\beta = -0.16$, $p < .001$) and pain acceptance ($\beta = -0.14$, $p < .001$).

Conclusion: The findings indicate that pain severity reduces health-related quality of life among patients with fibromyalgia both directly and indirectly through poorer sleep quality and lower pain acceptance, highlighting the importance of integrated interventions targeting pain management, sleep regulation, and acceptance-based coping.

Keywords: *Fibromyalgia; Pain Severity; Health-Related Quality of Life; Sleep Quality; Pain Acceptance; Structural Equation Modeling*

1. Introduction

Fibromyalgia is a complex chronic pain condition characterized by persistent widespread pain, tenderness, fatigue, sleep disturbance, cognitive complaints, emotional distress, and substantial impairment in daily functioning. Although fibromyalgia is not defined by structural tissue damage in the conventional biomedical sense, its clinical burden is considerable because symptoms are persistent, multidimensional, and often resistant to single-modality treatment. Patients frequently experience pain as the central and most disabling symptom, yet the impact of fibromyalgia extends beyond pain intensity alone and affects physical activity, psychological well-being, social participation, work capacity, and perceived quality of life. Contemporary discussions of fibromyalgia increasingly emphasize its heterogeneous presentation, the overlap between somatic and psychological symptoms, and the need to move beyond a narrow symptom-count approach toward a broader understanding of patient functioning and adaptation (Kang et al., 2022). This perspective is particularly important because even patients whose symptoms are classified as mild or relatively controlled may continue to experience reduced quality of life, persistent fatigue, sleep problems, depressive symptoms, and functional restrictions when compared with healthy individuals and other rheumatic populations (Wang et al., 2025).

Health-related quality of life has become a key outcome in chronic pain research because it captures the subjective consequences of illness across physical, emotional, and social domains. In fibromyalgia, quality of life is often compromised by the cumulative interaction of pain, fatigue, sleep disturbance, emotional distress, reduced physical capacity, and lifestyle limitations. Previous research has shown that disease symptoms, lifestyle-related factors, and multi-medication patterns contribute to quality of life among patients with fibromyalgia, indicating that quality of life is shaped by both direct symptom burden and broader patterns of disease management and daily living (Fernández-Feijoo et al., 2022). Psychological variables are also central to this process, as health-related quality of life in fibromyalgia is closely connected to emotional regulation, coping style, symptom interpretation, and the perceived ability to continue meaningful activity despite chronic symptoms (Campos et al., 2024). Therefore, understanding quality of life in fibromyalgia requires attention not only to the severity of pain but also to the psychological and behavioral mechanisms through which pain affects daily functioning.

Pain severity is one of the most immediate clinical indicators of fibromyalgia burden. Higher pain intensity is associated with greater disability, reduced mobility, lower participation in daily activities, and increased use of healthcare resources. However, pain severity does not influence quality of life in a simple linear manner. Some patients with high pain intensity maintain relatively better functioning, while others with comparable pain levels experience severe disruption in life roles and psychological well-being. This variability suggests that the impact of pain severity on health-related quality of life may be transmitted through intervening mechanisms, including sleep quality, pain-related cognitions, psychological distress, and acceptance of chronic pain. Research on pain catastrophizing in rheumatic diseases highlights that maladaptive cognitive-emotional responses to pain can intensify suffering, increase disability, and worsen clinical outcomes, supporting the view that pain severity becomes especially harmful when it is accompanied by negative interpretation, fear, helplessness, and reduced coping capacity (Wilk et al., 2024). Accordingly, pain severity should be examined not only as a direct predictor of quality of life but also as a factor that may undermine other adaptive processes.

Sleep disturbance is one of the most prevalent and clinically significant complaints among patients with fibromyalgia. Poor sleep may include difficulty initiating sleep, frequent awakenings, non-restorative sleep, reduced sleep efficiency, daytime sleepiness, and fatigue. In fibromyalgia, sleep problems and pain often form a reciprocal cycle: pain interferes with sleep continuity and depth, while poor sleep increases pain sensitivity, fatigue, irritability, and reduced functional capacity. The importance of sleep is supported by evidence showing that sleep disturbances and autonomic dysfunction are associated with lower quality of life among patients with fibromyalgia (Singh et al., 2021). More recent work comparing fibromyalgia with rheumatoid arthritis and healthy controls also indicates that sleep, pain, depression, and fatigue remain strongly linked to quality of life even among patients with remission or mild fibromyalgia symptoms (Wang et al., 2025). These findings suggest that sleep quality may represent a crucial pathway through which pain severity affects health-related quality of life.

The role of sleep in chronic pain conditions is not limited to fibromyalgia. A retrospective study of patients with chronic pain demonstrated that insomnia is common in this population and is clinically relevant to pain-related functioning and well-being (Ueda et al., 2024). Evidence from other musculoskeletal and inflammatory diseases further supports the centrality of sleep in patient-reported outcomes. For example, sleep behavior differs across men and women with psoriatic arthritis and axial spondyloarthritis and has implications for quality of life and depressive symptoms (Frede et al., 2023). Similarly, systematic reviews of sleep-focused nonpharmacological interventions in chronic pain and inflammatory arthritis show that sleep disturbance is an important modifiable target for improving patient outcomes (Latocha et al., 2022; Whale et al., 2022). Although these studies involve different populations, they reinforce the broader principle that sleep is not a secondary or peripheral complaint but a core determinant of health-related quality of life in chronic illness.

In fibromyalgia specifically, interventions targeting sleep and self-management have received growing attention. Resistance training has been reviewed as a potential approach for improving sleep among patients with fibromyalgia, suggesting that structured physical activity may have benefits beyond pain reduction and may contribute to sleep regulation and overall functioning (Ana Cecília Rosatelli de Freitas et al., 2023). Exercise training in women with fibromyalgia has similarly been presented as an important rehabilitation strategy with relevance for symptom reduction and functional improvement (Silva et al., 2024). Broader rehabilitation evidence also supports the effectiveness of multidisciplinary and nonpharmacological strategies in primary fibromyalgia syndrome (Pathak et al., 2023). In addition, telerehabilitation has emerged as a potentially accessible intervention model for patients with fibromyalgia, especially when face-to-face rehabilitation is limited by pain, fatigue, distance, or healthcare access barriers (Wu et al., 2023). These findings indicate that fibromyalgia care increasingly requires integrated approaches that address pain, sleep, physical function, and patient self-management simultaneously.

Psychological and mind-body interventions also provide important context for understanding mechanisms of adaptation in fibromyalgia. Mind-body interventions have been discussed as relevant treatment approaches for both irritable bowel syndrome and fibromyalgia, conditions that frequently involve dysregulated pain processing, stress sensitivity, and functional somatic symptoms (Islam et al., 2022). Mind-body therapy for fibromyalgia has also been systematically reviewed, reflecting growing interest in interventions that combine psychological, somatic, and behavioral components (Steen et al., 2024). Mindfulness-based stress reduction has demonstrated beneficial effects for adults with sleep disturbance, suggesting that psychological interventions may influence sleep through improved awareness, arousal regulation, and reduced stress reactivity (Kim et al., 2022). These approaches are clinically meaningful because patients with fibromyalgia often require strategies that reduce symptom-related struggle and improve functioning even when pain is not fully eliminated.

Pain acceptance is one such psychological factor that may explain individual differences in quality of life among patients with chronic pain. Pain acceptance refers to the willingness to experience pain without excessive avoidance, while continuing to engage in valued activities and life roles. It does not imply passive resignation or denial of suffering; rather, it reflects an adaptive orientation in which patients reduce unproductive efforts to control pain completely and instead invest energy in meaningful functioning. Low pain acceptance may intensify the impact of pain severity by increasing avoidance, inactivity, emotional distress, and perceived disability. Conversely, higher pain acceptance may buffer the harmful effects of pain by supporting activity engagement, psychological flexibility, and sustained participation in daily life. This concept is consistent with the broader shift in fibromyalgia management toward self-management, behavioral activation, psychological flexibility, and individualized care strategies. Evidence-based self-management strategies for fibromyalgia have been described as foundational for future digital therapeutic applications, further highlighting the need to identify psychological mechanisms that can be targeted in scalable interventions (Foustoukos et al., 2024).

The importance of psychological adaptation is also supported by research in other chronic and serious illness populations. Holistic approaches to psychological distress in gynecological cancer emphasize that emotional burden, coping resources, and supportive care are essential for preserving quality of life in chronic and life-altering health conditions (Byeon, 2024). In neurological autoimmune disorders, gender-related disparities in cognitive impairment further demonstrate that chronic disease outcomes often differ according to biological, psychological, and social factors that shape symptom experience and adaptation (Toumi et al., 2025). Studies on quality of life in psoriatic arthritis similarly show that musculoskeletal diseases affect multiple domains of functioning and require outcome assessment that goes beyond biomedical markers (James et al., 2024). Such evidence supports the use of multidimensional models in fibromyalgia, where pain, sleep, emotional processes, acceptance, and quality of life interact in complex ways.

Patient-reported outcomes are particularly valuable in fibromyalgia because the patient’s subjective experience is central to diagnosis, clinical monitoring, and evaluation of treatment response. The use of patient-reported outcomes has been emphasized in other chronic conditions such as migraine, where symptom burden, functional impairment, and patient priorities may not be fully captured through clinician-rated measures alone (Alpuente et al., 2024). Similar arguments have been made in systemic lupus erythematosus, where patient-reported quality-of-life outcomes are considered essential in clinical trials and increasingly relevant for routine care (Nguyen et al., 2021). In fibromyalgia, the psychometric evaluation of disease-relevant quality-of-life instruments, including tools adapted for specific functional domains such as swallowing-related quality of life, reflects the growing recognition that fibromyalgia may affect diverse aspects of daily living and requires valid patient-centered measurement (Calles-Plata et al., 2025). More broadly, the content comparison of quality-of-life instruments used in sleep disorder interventions shows that instrument selection can shape how researchers interpret the impact of sleep-related health problems on quality of life (Kaambwa et al., 2024). These methodological considerations reinforce the need for studies that use patient-reported measures to clarify how pain severity, sleep quality, and pain acceptance contribute to quality of life in fibromyalgia.

Recent treatment-oriented literature also points to the complexity of fibromyalgia management. Complementary medicines are frequently considered by patients and clinicians, although their use requires careful evaluation of evidence, safety, expectations, and patient-centered outcomes (Nizard & Berna, 2025). Cannabis-based products for medical use have also been systematically reviewed in fibromyalgia, reflecting ongoing interest in alternative and adjunctive treatments for symptom relief, while also underscoring the need for cautious interpretation of effectiveness and safety evidence (Кугушева, 2024). Systematic review evidence on interventions for fibromyalgia comorbid with irritable bowel syndrome further highlights the frequent overlap between fibromyalgia and other functional syndromes, suggesting that symptom burden may be amplified when pain, gastrointestinal symptoms, sleep disturbance, and psychological distress coexist (Elkalla et al., 2025). These complexities demonstrate why explanatory models should evaluate not only whether pain is associated with quality of life, but how this relationship occurs through modifiable mediating factors.

The relevance of sleep and quality of life is also evident in health conditions outside fibromyalgia. Sleep disturbance has been shown to affect health-related quality of life in postmenopausal women, indicating that sleep problems can become a major determinant of perceived health during periods of physiological and psychosocial transition (Soares et al., 2025). Physical exercise has been associated with improvements in symptoms and quality of life among women in the climacteric period, further supporting the broader link between bodily symptoms, sleep, psychological well-being, and perceived health (Trujillo-Muñoz et al., 2025). In adults with primary brain tumors and their caregivers, sleep disturbance is also prevalent and clinically important, showing that the burden of poor sleep extends across diagnostic categories and affects both patients and care systems (Martin et al., 2023). Even in palliative and oncology contexts, quality-of-life assessment remains central to evaluating care approaches and patient outcomes, as illustrated in research comparing medicinal cannabis or standard palliative care among patients with cholangiocarcinoma (phansila et al., 2022). Collectively, these findings support the conceptualization of sleep quality and health-related quality of life as transdiagnostic outcomes that are highly relevant to chronic pain research.

Lifestyle and functional status are also relevant to fibromyalgia outcomes. Eating behaviors have been associated with functional status among female patients diagnosed with fibromyalgia, suggesting that daily health behaviors may interact with symptom severity and physical functioning (Mengi, 2023). Self-care support programs have been shown to influence knowledge, health status, and sleep disturbance among patients with fibromyalgia, indicating that education and behavioral support may improve disease management and patient functioning (Mohamed et al., 2024). These findings align with the broader view that fibromyalgia outcomes are shaped by the interaction of symptoms, behavior, psychological adaptation, and healthcare support. In this context, pain acceptance may be especially important because it reflects the patient's capacity to remain engaged in daily life despite ongoing symptoms, while sleep quality may represent a physiological and behavioral mechanism through which pain severity reduces energy, mood, and daily functioning.

Despite growing evidence on fibromyalgia symptoms, sleep disturbance, psychological factors, and quality of life, there remains a need for integrated models that examine these variables simultaneously. Many studies have investigated the direct association between pain and quality of life, while others have focused on sleep, exercise, rehabilitation, self-management, or psychological interventions. However, fewer studies have tested whether sleep quality and pain acceptance function as parallel mediating mechanisms in the relationship between pain severity and health-related quality of life among patients with fibromyalgia. Such a model is theoretically important because it combines a symptom-related pathway, represented by sleep quality, with a psychological adaptation pathway, represented by pain acceptance. It is also clinically relevant because both sleep quality and pain acceptance are potentially modifiable through behavioral, psychological, rehabilitative, and self-management interventions.

The aim of this study was to examine the relationship between pain severity and health-related quality of life among patients with fibromyalgia in Tehran and to determine the mediating roles of sleep quality and pain acceptance in this relationship.

2. Methods and Materials

2.1. *Study Design and Participants*

This study was conducted using a descriptive-correlational cross-sectional design with a structural equation modeling approach to examine the relationship between pain severity and health-related quality of life among patients with fibromyalgia, with sleep quality and pain acceptance considered as mediating variables. The statistical population included adult patients diagnosed with fibromyalgia who referred to rheumatology clinics, pain management centers, and specialized outpatient clinics in Tehran, Iran. The final sample consisted of 286 patients with fibromyalgia who were selected through convenience sampling based on the inclusion and exclusion criteria. Eligibility criteria included being between 18 and 65 years of age, having a confirmed diagnosis of fibromyalgia by a rheumatologist based on clinical criteria and medical records, having experienced fibromyalgia-related symptoms for at least six months, having sufficient literacy to complete the questionnaires, and providing informed consent to participate in the study. Patients were excluded if they reported severe psychiatric disorders, major neurological diseases, inflammatory rheumatic diseases other than fibromyalgia, malignancy, current substance dependence, or incomplete questionnaire responses. Before data collection, the objectives of the study were explained to all participants, and they were assured that participation was voluntary, their information would remain confidential, and they could withdraw from the study at any stage without any consequences for their treatment process.

2.2. *Measures*

Data were collected using a demographic and clinical information form and standardized self-report questionnaires. The demographic and clinical information form was designed by the researchers to collect information regarding age, gender, marital status, educational level, employment status, duration of fibromyalgia diagnosis, duration of pain symptoms, use of pain medication, and history of psychological or medical treatment. Pain severity was assessed using the Brief Pain Inventory–Short Form, originally developed by Cleeland and Ryan in 1994. This instrument evaluates pain intensity and the extent to which pain interferes with different aspects of daily functioning. In the present study, the pain severity dimension was used, which includes items assessing worst pain, least pain, average pain, and current pain during the recent period. Items are scored on an 11-point numerical rating scale ranging from 0, indicating no pain, to 10, indicating the most severe pain imaginable. Higher scores indicate greater pain severity. The Brief Pain Inventory has been widely used among patients with chronic pain conditions and has demonstrated acceptable validity and reliability in previous clinical and health-related studies.

Health-related quality of life was measured using the 36-Item Short Form Health Survey, developed by Ware and Sherbourne in 1992. This questionnaire is one of the most widely used generic instruments for assessing perceived health status and quality of life in clinical and non-clinical populations. The SF-36 evaluates eight dimensions of health-related quality of life, including physical functioning, role limitations due to physical health problems, bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems, and mental health. Scores for each dimension are transformed to a scale from 0 to 100, with higher scores indicating better health-related quality of life. The instrument also allows the calculation of physical and mental component summaries. In the present study, the total health-related quality of life score was used as the main outcome variable. Previous studies have confirmed the acceptable psychometric properties of the SF-36, including its validity and reliability for assessing quality of life among patients with chronic pain and fibromyalgia.

Sleep quality was assessed using the Pittsburgh Sleep Quality Index, developed by Buysse and colleagues in 1989. This self-report questionnaire measures sleep quality and sleep disturbances over the previous month. The PSQI consists of 19 self-rated items that generate seven component scores, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. These component scores are summed to produce a global sleep quality score ranging from 0 to 21. Higher scores indicate poorer sleep quality, and a global score above the established cut-off point reflects clinically significant sleep problems. The PSQI has been extensively applied in patients with chronic pain conditions and has shown satisfactory validity and reliability in previous research. In this study, the global PSQI score was used to represent sleep quality as a mediating variable between pain severity and health-related quality of life.

Pain acceptance was measured using the Chronic Pain Acceptance Questionnaire–Revised, developed by McCracken, Vowles, and Eccleston in 2004. This questionnaire assesses the extent to which individuals with chronic pain are able to engage in valued life activities despite pain and reduce unsuccessful attempts to control or avoid pain. The revised version includes two main components: activity engagement and pain willingness. Activity engagement reflects the degree to which a person continues meaningful activities despite pain, while pain willingness reflects reduced avoidance and lower efforts to control pain as a prerequisite for functioning. Items are scored on a Likert-type scale, and higher scores indicate greater acceptance of chronic pain. Pain acceptance is considered an important psychological factor in adjustment to chronic pain and has been associated with better emotional functioning, lower disability, and improved quality of life. Previous studies have supported the reliability and validity of the Chronic Pain Acceptance Questionnaire–Revised in chronic pain populations.

2.3. Data Analysis

Data analysis was performed using SPSS and AMOS software. Before conducting the main analyses, the dataset was screened for missing values, outliers, normality, and accuracy of data entry. Descriptive statistics, including mean, standard deviation, frequency, and percentage, were used to describe the demographic and clinical characteristics of the participants and the main research variables. The normality of the variables was examined using skewness and kurtosis indices, and the internal consistency of the questionnaires was assessed using Cronbach's alpha coefficients. Pearson correlation coefficients were calculated to examine the bivariate relationships among pain severity, sleep quality, pain acceptance, and health-related quality of life. To test the proposed mediation model, structural equation modeling was used. In the hypothesized model, pain severity was entered as the independent variable, health-related quality of life as the dependent variable, and sleep quality and pain acceptance as mediating variables. Model fit was evaluated using standard fit indices, including the chi-square to degrees of freedom ratio, comparative fit index, Tucker–Lewis index, goodness-of-fit index, root mean square error of approximation, and standardized root mean square residual. The indirect effects of pain severity on health-related quality of life through sleep quality and pain acceptance were examined using the bootstrap method with 5,000 resamples and 95% confidence intervals. An indirect effect was considered statistically significant when the confidence interval did not include zero. The level of statistical significance for all analyses was set at $p < .05$.

3. Findings and Results

A total of 286 patients with fibromyalgia from Tehran were included in the final analysis. The mean age of the participants was 43.62 years with a standard deviation of 9.84 years, and the age range was between 22 and 65 years. Most participants were women, with 222 female patients representing 77.6% of the sample and 64 male patients representing 22.4%. Regarding marital status, 199 participants were married, 47 were single, and 40 were divorced or widowed. In terms of educational level, 81 participants had a high school diploma or lower education, 145 had an associate or bachelor's degree, and 60 had postgraduate education. With respect to employment status, 122 participants were employed, 101 were homemakers, and 63 were unemployed or retired. The mean duration of fibromyalgia diagnosis was 5.18 years with a standard deviation of 3.47 years, while the mean duration of pain symptoms was 7.42 years with a standard deviation of 4.66 years. In addition, 238 participants reported regular or intermittent use of prescribed pain-related medication, while 57 participants reported a history of psychological or behavioral treatment for pain, sleep problems, or emotional distress. Before conducting the main statistical analyses, the data were examined for missing values and response patterns. Questionnaires with substantial missing data had already been excluded during data screening, and the final dataset included complete responses for all study variables.

Table 1

Descriptive Statistics, Internal Consistency, and Normality Indices of the Main Study Variables

Variable	Possible Score Range	Observed Minimum	Observed Maximum	Mean	Standard Deviation	Skewness	Kurtosis	Cronbach's Alpha
Pain severity	0–10	1.50	9.75	6.42	1.61	-0.38	-0.12	0.89
Sleep quality	0–21	3.00	19.00	10.86	3.42	0.34	-0.27	0.83
Pain acceptance	0–120	24.00	103.00	62.47	16.28	0.11	-0.42	0.87
Health-related quality of life	0–100	18.22	82.76	46.91	13.74	0.29	-0.35	0.91

As shown in Table 1, the participants reported a relatively high level of pain severity, with a mean score of 6.42 on a 0-to-10 scale, indicating that the sample generally experienced moderate to severe fibromyalgia-related pain. The mean score of sleep quality was 10.86, and because higher scores on the Pittsburgh Sleep Quality Index indicate poorer sleep quality, this result suggests that sleep disturbance was highly prevalent among the participants. The mean score of pain acceptance was 62.47, showing a moderate level of acceptance of chronic pain, while the mean score of health-related quality of life was 46.91 on a 0-to-100 scale, indicating that the participants experienced a considerable reduction in perceived physical and psychological quality of life. The skewness values ranged from -0.38 to 0.34, and the kurtosis values ranged from -0.42 to -0.12, which were within the acceptable range for normal distribution assumptions. Therefore, the distribution of the main variables was considered suitable for parametric analysis and structural equation modeling. In addition, Cronbach's alpha coefficients ranged from 0.83 to 0.91, demonstrating acceptable to excellent internal consistency for all study instruments.

Table 2

Pearson Correlation Matrix Among Pain Severity, Sleep Quality, Pain Acceptance, and Health-Related Quality of Life

Variable	1	2	3	4
1. Pain severity	1			
2. Sleep quality	0.52**	1		
3. Pain acceptance	-0.47**	-0.44**	1	
4. Health-related quality of life	-0.61**	-0.58**	0.55**	1

The correlation results presented in Table 2 show significant relationships among all main study variables. Pain severity had a significant positive correlation with sleep quality score, indicating that higher pain severity was associated with poorer sleep quality. Pain severity was also significantly and negatively correlated with pain acceptance, suggesting that patients who experienced more severe pain tended to report lower acceptance of chronic pain. In addition, pain severity was significantly and negatively correlated with health-related quality of life, meaning that greater pain intensity was associated with poorer perceived quality of life. Sleep quality score was negatively correlated with pain acceptance and health-related quality of life, indicating that poorer sleep quality was related to lower pain acceptance and lower health-related quality of life. Pain acceptance had a significant positive correlation with health-related quality of life, showing that patients with greater acceptance of chronic pain reported better functioning and better perceived quality of life. Overall, the pattern of correlations supported the theoretical assumptions of the study and justified the examination of sleep quality and pain acceptance as mediating variables in the relationship between pain severity and health-related quality of life.

Table 3

Model Fit Indices for the Proposed Mediation Model

Fit Index	Obtained Value	Recommended Criterion	Interpretation
χ^2	82.64	Lower values indicate better fit	Acceptable

df	39	—	—
χ²/df	2.12	Less than 3	Good fit
GFI	0.95	0.90 or higher	Good fit
CFI	0.96	0.90 or higher	Good fit
TLI	0.94	0.90 or higher	Good fit
IFI	0.96	0.90 or higher	Good fit
RMSEA	0.063	Less than 0.08	Acceptable fit
SRMR	0.047	Less than 0.08	Good fit

The model fit indices in Table 3 indicate that the proposed mediation model had an acceptable and theoretically meaningful fit with the observed data. The ratio of chi-square to degrees of freedom was 2.12, which was below the commonly accepted threshold of 3 and therefore indicated a good relative fit. The goodness-of-fit index, comparative fit index, Tucker–Lewis index, and incremental fit index were all above 0.90, suggesting that the hypothesized model adequately represented the covariance structure among the study variables. The root mean square error of approximation was 0.063, which was within the acceptable range, and the standardized root mean square residual was 0.047, indicating a good level of residual fit. Taken together, these indices show that the structural model examining pain severity as the predictor, health-related quality of life as the outcome, and sleep quality and pain acceptance as mediating variables was statistically acceptable and suitable for interpretation.

Table 4

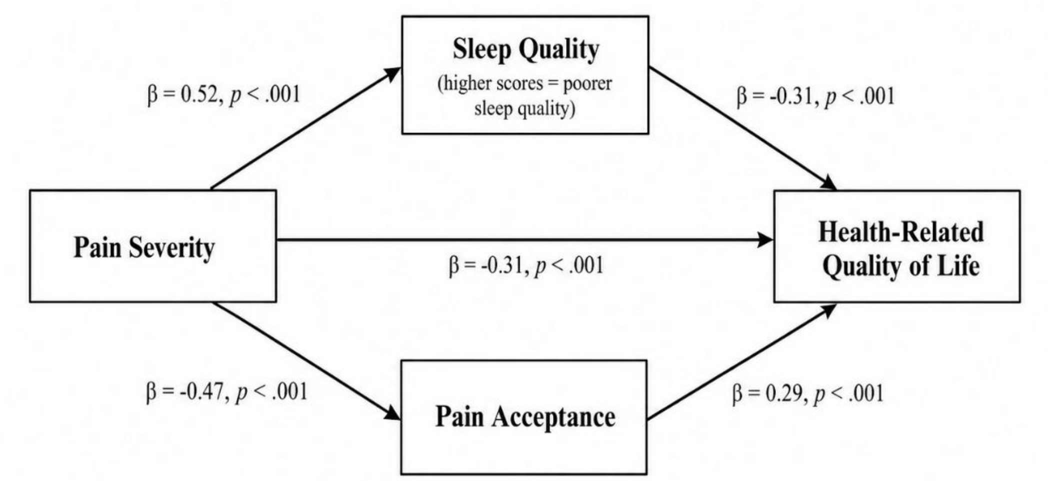
Standardized Direct Effects in the Structural Model

Path	Standardized Beta	Standard Error	Critical Ratio	p-value	Interpretation
Pain severity → Sleep quality	0.52	0.07	8.91	< .001	Significant positive effect
Pain severity → Pain acceptance	-0.47	0.08	-7.84	< .001	Significant negative effect
Sleep quality → Health-related quality of life	-0.31	0.06	-5.42	< .001	Significant negative effect
Pain acceptance → Health-related quality of life	0.29	0.05	5.18	< .001	Significant positive effect
Pain severity → Health-related quality of life	-0.31	0.07	-5.36	< .001	Significant negative effect

As shown in Table 4, all direct paths in the structural model were statistically significant. Pain severity had a significant positive effect on sleep quality score, meaning that greater pain severity predicted poorer sleep quality among patients with fibromyalgia. Pain severity also had a significant negative effect on pain acceptance, indicating that as pain intensity increased, patients were less likely to accept pain and continue meaningful activities despite pain. Sleep quality had a significant negative effect on health-related quality of life, showing that poorer sleep quality predicted lower quality of life. Pain acceptance had a significant positive effect on health-related quality of life, suggesting that greater acceptance of chronic pain was associated with better perceived health status and functioning. Finally, pain severity retained a significant direct negative effect on health-related quality of life even after accounting for sleep quality and pain acceptance. This finding indicates that although sleep quality and pain acceptance explain part of the relationship between pain severity and quality of life, pain severity itself continues to exert an independent adverse effect on health-related quality of life.

Figure 1

Standardized structural model of the mediating roles of sleep quality and pain acceptance in the relationship between pain severity and health-related quality of life.



The standardized structural model demonstrated that pain severity had both direct and indirect associations with health-related quality of life. Higher pain severity was associated with poorer sleep quality and lower pain acceptance. In turn, poorer sleep quality was associated with lower health-related quality of life, while higher pain acceptance was associated with better health-related quality of life. The direct path from pain severity to health-related quality of life remained statistically significant after the inclusion of the mediating variables, indicating that sleep quality and pain acceptance partially mediated this relationship. The model therefore suggests that fibromyalgia-related pain may reduce health-related quality of life not only through the direct burden of pain but also through its negative effects on sleep and psychological adaptation to chronic pain.

Table 5

Bootstrap Analysis of Indirect Effects

Indirect Path	Standardized Indirect Effect	Bootstrapped Standard Error	Lower 95% Confidence Interval	Upper 95% Confidence Interval	p-value	Mediation Result
Pain severity → Sleep quality → Health-related quality of life	-0.16	0.04	-0.25	-0.09	< .001	Significant
Pain severity → Pain acceptance → Health-related quality of life	-0.14	0.04	-0.22	-0.07	< .001	Significant
Total indirect effect	-0.30	0.05	-0.40	-0.21	< .001	Significant
Direct effect after mediators	-0.31	0.07	-0.44	-0.19	< .001	Significant
Total effect	-0.61	0.06	-0.72	-0.49	< .001	Significant

The bootstrap analysis presented in Table 5 confirmed the mediating roles of sleep quality and pain acceptance in the relationship between pain severity and health-related quality of life. The indirect effect of pain severity on health-related quality of life through sleep quality was significant, as the 95% confidence interval did not include zero. This result indicates that higher pain severity contributed to poorer sleep quality, which in turn reduced health-related quality of life. The indirect effect through pain acceptance was also significant, showing that higher pain severity reduced pain acceptance, and lower pain acceptance was associated with poorer health-related quality of life. The total indirect effect was statistically significant, demonstrating that the combined mediating influence of sleep quality and pain acceptance accounted for a meaningful portion of the association between pain severity and health-related quality of life. However, the direct effect of pain severity on health-related quality of life remained significant after the mediators were included in the model. Therefore, the findings support a partial mediation model, in which pain severity influences health-related quality of life both directly and indirectly through impaired sleep quality and reduced acceptance of chronic pain.

Overall, the findings showed that patients with fibromyalgia who experienced more severe pain reported poorer sleep quality, lower pain acceptance, and lower health-related quality of life. The correlation analysis demonstrated significant associations among all study variables, and the structural equation modeling results provided support for the proposed mediation model. Sleep quality and pain acceptance were both significant mediators, indicating that the negative effect of pain severity on health-related quality of life is not limited to physical pain intensity alone but is also transmitted through sleep disturbance and psychological adjustment to pain. These results suggest that the quality of life of patients with fibromyalgia may be improved by interventions that simultaneously target pain management, sleep regulation, and acceptance-based coping with chronic pain.

4. Discussion

The present study examined the relationship between pain severity and health-related quality of life among patients with fibromyalgia and tested the mediating roles of sleep quality and pain acceptance. The findings showed that patients with fibromyalgia experienced moderate to severe pain, poor sleep quality, moderate pain acceptance, and substantially reduced health-related quality of life. Correlation analysis indicated that higher pain severity was significantly associated with poorer sleep quality, lower pain acceptance, and lower health-related quality of life. In addition, poorer sleep quality was related to lower health-related quality of life, while higher pain acceptance was associated with better health-related quality of life. The structural equation model demonstrated acceptable fit, and all direct paths were statistically significant. Pain severity directly predicted poorer health-related quality of life and also indirectly affected health-related quality of life through both sleep quality and pain acceptance. Therefore, the results supported a partial mediation model, indicating that pain severity reduces quality of life both through its direct clinical burden and through its negative effects on sleep and psychological adaptation to chronic pain.

The finding that pain severity was negatively associated with health-related quality of life is consistent with the multidimensional nature of fibromyalgia. Fibromyalgia is not limited to pain as an isolated sensory experience; rather, pain interacts with fatigue, functional limitations, emotional distress, and reduced participation in daily life. This interpretation is consistent with evidence showing that patients with fibromyalgia, even those with remission or mild symptoms, may continue to experience compromised quality of life, pain, fatigue, depression, and sleep difficulties compared with healthy individuals and patients with other rheumatic conditions (Wang et al., 2025). The present findings also align with research emphasizing that disease symptoms, lifestyle characteristics, and medication-related factors contribute to quality of life in fibromyalgia, suggesting that quality of life is shaped by the cumulative burden of symptoms and the patient's daily management of illness (Fernández-Feijoo et al., 2022). Moreover, the observed negative effect of pain severity on quality of life supports the view that fibromyalgia management requires a comprehensive clinical approach that goes beyond diagnostic clarification and includes continuous attention to symptom burden, functional capacity, and patient-centered outcomes (Kang et al., 2022).

The significant relationship between pain severity and poorer sleep quality provides further support for the reciprocal connection between pain and sleep disturbance in fibromyalgia. Patients with more severe pain may experience difficulty initiating sleep, frequent nocturnal awakenings, non-restorative sleep, and daytime dysfunction. In turn, poor sleep may intensify pain sensitivity, reduce emotional regulation, and increase fatigue, thereby worsening the overall clinical picture. The present findings are consistent with previous evidence showing that sleep disturbances and autonomic dysfunction are associated with lower quality of life in patients with fibromyalgia (Singh et al., 2021). They are also aligned with research on chronic pain more broadly, in which insomnia has been identified as a prevalent and clinically important problem among patients with persistent pain conditions (Ueda et al., 2024). The finding that sleep quality mediated the relationship between pain severity and health-related quality of life suggests that sleep disturbance is not merely a secondary symptom but a meaningful pathway through which pain becomes translated into poorer daily functioning and reduced perceived health.

This mediating role of sleep quality is also supported by intervention-oriented literature. Systematic reviews of non-pharmacological sleep interventions for individuals with chronic pain have highlighted the relevance of sleep-focused approaches in improving pain-related outcomes and quality of life (Whale et al., 2022). Similarly, evidence from inflammatory arthritis indicates that nonpharmacologic interventions targeting sleep disturbances can improve patient outcomes, reinforcing the importance of sleep as a modifiable clinical target in musculoskeletal and rheumatic conditions (Latocha et al., 2022). In fibromyalgia specifically, resistance training has been reviewed as a potential strategy for improving sleep among patients with fibromyalgia, suggesting that physical activity may influence sleep regulation and symptom burden (Ana Cecília Rosatelli de Freitas et al., 2023). Exercise training for women with fibromyalgia has also been recognized as a clinically relevant approach for improving symptoms and functioning (Silva et al., 2024). Therefore, the present mediation result strengthens the argument that sleep quality should be routinely assessed and targeted in fibromyalgia care, particularly among patients reporting high pain severity.

The finding that pain severity negatively predicted pain acceptance is also theoretically meaningful. Higher pain intensity may increase the perceived threat of symptoms and encourage avoidance, hypervigilance, fear of activity, and repeated attempts to control or eliminate pain before engaging in daily life. These responses may reduce pain acceptance and contribute to poorer functioning. The observed association between pain acceptance and better health-related quality of life suggests that patients who are more able to remain engaged in valued activities despite pain may experience better psychological and functional adaptation. This finding is consistent with the broader literature emphasizing psychological factors in fibromyalgia-related quality of life (Campos et al., 2024). It also aligns with research on pain catastrophizing in rheumatic diseases, which indicates that maladaptive interpretations of pain can intensify suffering and contribute to disability (Wilk et al., 2024). From this perspective, pain acceptance may operate as a protective psychological process that reduces the extent to which pain severity dominates the patient’s identity, behavior, and perceived quality of life.

The significant indirect effect through pain acceptance supports the clinical importance of acceptance-based and self-management approaches in fibromyalgia. Pain acceptance does not mean passively tolerating pain or neglecting treatment; rather, it reflects a flexible orientation in which the patient acknowledges pain while continuing to pursue meaningful activities and personal goals. This interpretation is compatible with evidence-based self-management strategies for fibromyalgia, which emphasize education, behavioral regulation, symptom monitoring, pacing, and patient engagement as foundations for modern digital and non-digital therapeutic applications (Foustoukos et al., 2024). Mind-body interventions are also relevant in this context because they may enhance awareness, reduce symptom-related struggle, and improve coping with chronic somatic symptoms (Islam et al., 2022). Systematic review evidence on mind-body therapy for fibromyalgia further supports the potential value of interventions that integrate psychological and bodily processes in the management of pain, fatigue, sleep problems, and emotional distress (Steen et al., 2024). The present findings therefore suggest that pain acceptance may be one psychological mechanism through which such interventions could contribute to better quality of life.

The partial mediation observed in this study is particularly important. Although sleep quality and pain acceptance significantly explained part of the relationship between pain severity and health-related quality of life, the direct effect of pain severity remained significant. This indicates that pain severity continues to exert an independent adverse effect on quality of life even after accounting for sleep and acceptance. In clinical terms, this means that improving sleep and enhancing acceptance may reduce part of the quality-of-life burden associated with fibromyalgia, but they may not fully eliminate the impact of pain intensity itself. This finding is consistent with the complex and multifactorial nature of fibromyalgia treatment, in which pharmacological, rehabilitative, psychological, lifestyle, and complementary strategies are often considered simultaneously (Nizard & Berna, 2025). It is also consistent with systematic review evidence on rehabilitation strategies in primary fibromyalgia syndrome, which suggests that multimodal approaches may be more appropriate than isolated interventions for addressing the broad symptom profile of the condition (Pathak et al., 2023).

The present findings also resonate with research on digital and remote care approaches. Telerehabilitation has been systematically reviewed as an intervention model for fibromyalgia, reflecting growing interest in accessible strategies for symptom management, especially for patients whose pain, fatigue, or functional limitations make regular in-person care difficult (Wu et al., 2023). Because both sleep quality and pain acceptance are potentially modifiable through education, behavioral monitoring, cognitive-behavioral techniques, mindfulness, pacing, and activity planning, they may be suitable targets for digital or blended interventions. In addition, self-care support programs have been shown to affect knowledge, health status, and sleep disturbance among patients with fibromyalgia, further supporting the relevance of structured patient education and behavioral support (Mohamed et al., 2024). The present results contribute to this literature by clarifying that improving quality of life may require interventions that simultaneously address symptom control, sleep regulation, and adaptive psychological responses to chronic pain.

The importance of patient-reported outcomes should also be emphasized. Fibromyalgia is a condition in which subjective experience is central to clinical understanding, and therefore patient-reported measures of pain, sleep, acceptance, and quality of life are essential for both research and practice. The value of patient-reported outcomes has been emphasized in other chronic conditions, including migraine and systemic lupus erythematosus, where symptoms, functioning, and quality of life cannot be adequately evaluated only through clinician-based indicators (Alpuente et al., 2024; Nguyen et al., 2021). The psychometric evaluation of quality-of-life instruments in fibromyalgia further demonstrates the importance of using valid and patient-centered tools for capturing the lived impact of the disease (Calles-Plata et al., 2025). Moreover, systematic comparison of quality-of-life instruments used in sleep disorder intervention studies indicates that the selection of measurement tools can influence how researchers understand the burden of sleep-related problems and their economic and clinical consequences (Kaambwa et al., 2024). In this regard, the present study's use of standardized patient-reported instruments strengthens its relevance to clinical research and patient-centered care.

The findings are also consistent with broader evidence from other chronic health conditions showing that sleep disturbance and psychological adaptation are central determinants of quality of life. Sleep disturbances have been shown to affect health-related quality of life in postmenopausal women, suggesting that the sleep–quality-of-life relationship is not limited to fibromyalgia but is relevant across populations experiencing chronic biological and psychosocial stressors (Soares et al., 2025). Similarly, sleep disturbance has been recognized as an important issue among adults with primary brain tumors and their caregivers, demonstrating its relevance in serious and complex health conditions (Martin et al., 2023). Evidence from psoriatic arthritis also confirms that musculoskeletal diseases can substantially impair quality of life across multiple domains (James et al., 2024). These studies support the interpretation that sleep quality and psychological functioning are not secondary concerns but central components of quality-of-life outcomes in chronic illness.

5. Conclusion

Finally, the present findings should be understood within the broader context of sex, lifestyle, and comorbidity in fibromyalgia. Fibromyalgia is more frequently diagnosed among women, and evidence from related fields suggests that sex and gender may influence cognitive, emotional, and functional outcomes in chronic neurological and autoimmune disorders (Toumi et al., 2025). Studies on women's health also show that physical exercise can improve symptoms and quality of life in climacteric women, reinforcing the importance of considering biological stage, activity level, and lifestyle in quality-of-life research (Trujillo-Muñoz et al., 2025). Eating behaviors have also been associated with functional status in women with fibromyalgia, suggesting that lifestyle patterns may contribute to functioning and symptom burden (Mengi, 2023). Furthermore, fibromyalgia often overlaps with other functional conditions such as irritable bowel syndrome, and intervention studies in comorbid fibromyalgia and irritable bowel syndrome highlight the need for integrated care models (Elkalla et al., 2025). Although cannabis-based and other complementary approaches continue to receive attention in fibromyalgia research, these approaches further demonstrate that patients often seek multiple strategies for symptom relief and quality-of-life improvement (Кугушева, 2024). Overall, the present study adds to this body of evidence by showing that pain severity is linked to health-related quality of life through both sleep-related and psychological-adaptive pathways.

6. Limitations & Suggestions

This study had several limitations that should be considered when interpreting the findings. First, the cross-sectional design prevents causal conclusions about the relationships among pain severity, sleep quality, pain acceptance, and health-related quality of life. Although the proposed mediation model was theoretically grounded, longitudinal data are needed to confirm the temporal ordering of the variables. Second, the study relied on self-report questionnaires, which may be influenced by recall bias, response style, emotional state, or social desirability. Third, participants were selected through convenience sampling from clinics and outpatient centers in Tehran, which may limit the generalizability of the findings to patients in other regions, rural settings, or different healthcare systems. Fourth, the study did not control for all potentially relevant clinical variables, such as medication type, comorbid psychiatric symptoms, physical activity level, body mass index, and severity of fatigue. Finally, although the sample size was adequate for the proposed structural model, larger and more diverse samples would allow more detailed subgroup analyses based on gender, age, disease duration, and treatment history.

Future studies should use longitudinal and prospective designs to examine whether changes in pain severity predict later changes in sleep quality, pain acceptance, and health-related quality of life. Experimental and intervention studies are also recommended to determine whether improving sleep quality or increasing pain acceptance leads to measurable improvements in quality of life among patients with fibromyalgia. Future research should include more diverse samples from different cities, healthcare settings, and cultural backgrounds to improve external validity. It would also be useful to examine additional mediators and moderators, such as fatigue, depression, anxiety, pain catastrophizing, physical activity, perceived social support, medication use, and coping strategies. Future studies may also compare competing models to determine whether sleep quality and pain acceptance operate independently, sequentially, or interactively. In addition, mixed-methods research could provide a richer understanding of how patients experience pain, sleep disturbance, acceptance, and quality of life in everyday life.

The findings suggest that clinical care for patients with fibromyalgia should not focus only on reducing pain intensity but should also address sleep quality and psychological adaptation to chronic pain. Routine assessment of sleep problems, pain acceptance, daily functioning, and quality of life can help clinicians identify patients who are at greater risk of poor outcomes. Interventions should include patient education, sleep hygiene, activity pacing, graded physical activity, relaxation strategies, and acceptance-based psychological techniques. Multidisciplinary care involving rheumatologists, pain specialists, psychologists, physiotherapists, nurses, and rehabilitation professionals may be especially useful for addressing the complex needs of patients with fibromyalgia. Clinicians should also help patients develop realistic treatment goals that emphasize improved functioning and meaningful activity, rather than complete elimination of pain as the only indicator of recovery. Strengthening self-management skills and supporting adaptive engagement in daily life may improve quality of life even when pain remains present.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contributed to this article.

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