Effect of Nurse-led Pain Management on Quality of Life Mediated by Sleep Quality in Patients with Chronic Musculoskeletal Disorders

Abstract

Background: Chronic musculoskeletal disorders (CMSDs) often negatively impact quality of life, with pain and sleep disturbances being major contributors. Nurses play a pivotal role in implementing pain management strategies, which may indirectly influence quality of life through sleep quality. This study aimed to investigate the effect of pain management strategies followed by nurses on the quality of life in adults with chronic musculoskeletal disorders, with sleep quality as an intermediary variable.

Methods: A cross-sectional study was conducted on 280 adults attending the outpatient rehabilitation clinic of a university hospital in Najaf city. Participants were selected based on eligibility criteria and were surveyed using four validated instruments: the Pain Management Inventory–Nurse Version (PMI-N), the Pittsburgh Sleep Quality Index (PSQI), the WHOQOL-BREF, and a sociodemographic questionnaire. Data were analyzed using descriptive statistics, Pearson correlation coefficient, and mediation analysis (PROCESS macro, Model 4).

Results: Pain management strategies were positively associated with quality of life ($r = 0.53$, $p < 0.01$) and negatively associated with poor sleep quality ($r = -0.46$, $p < 0.01$). Sleep quality was also negatively related to quality of life ($r = -0.58$, $p < 0.01$). Mediation analysis confirmed that sleep quality partially mediated the relationship between pain management and QoL (indirect effect $\beta = 0.23$, 95% CI: 0.14-0.34).

Conclusion: Effective nurse-led pain management improves quality of life in patients with chronic sleep disorders, in part due to improved sleep quality. Training programs should focus on integrated pain strategies that address both pain and sleep disorders.

Keywords: Pain management, nurses, sleep quality, quality of life, musculoskeletal disorders, mediation analysis.

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1. Introduction

Chronic musculoskeletal issues (CMDs), which include osteoarthritis, rheumatoid arthritis, and persistent lower back pain, are globally diagnosed as the main causes of incapacity and faded fine of life (QoL) amongst adults[1]. Musculoskeletal conditions affect more than 1.7 billion people worldwide and appreciably reduce physical functioning, social participation, and psychological well-being. Chronic pain is a trademark of CMDs, and its persistent nature contributes no longer to physical soreness but also to emotional distress, sleep disturbances, and lengthy periods of purposeful impairment[2]. As a result, the holistic management of CMDs calls for a multidimensional method, with pain relief being a central goal[3].

Nurses play a pivotal function in the control of continual pain through loads of strategies, consisting of pharmacological guidance, patient education, relaxation techniques, physical pastime encouragement, and cognitive-behavioral interventions[4]. Previous studies have demonstrated that nurse-led pain management interventions can reduce pain intensity and improve patient-pronounced outcomes[5]. For example, a randomized managed trial determined that individualized nursing interventions for chronic arthritis patients significantly stepped forward pain tiers and each day characteristics [6]. Similarly, it emphasizes the impact of nurse-delivered cognitive-behavioral techniques on lowering pain notion and enhancing emotional resilience in sufferers with chronic musculoskeletal situations[7].

Importantly, sleep satisfaction has emerged as a vital mediator in the courting between continual pain and typical exceptional quality of life. Sleep disturbances are relatively common amongst people with CMDs, in large part because of the intrusive nature of persistent pain that interrupt sleep continuity and decrease sleep depth. Poor sleep has been related to extended pain sensitivity, reduced coping potential, and decreased first-class existence[8]. Research has proven that effective pain control can result in enhancements in sleep, which in turn affects various dimensions of QoL[9]. It has been discovered that improvements in sleep mediated the relationship between pain discount and bodily and emotional well-being amongst older adults with chronic pain [10]. Furthermore, sleep-focused nursing interventions have been shown to beautify both sleep and QoL effects, indicating the potential synergistic impact of integrated pain-sleep management techniques[11].

Despite the increasing prevalence of the association between pain, sleep, and quality of life, there remains a gap in knowledge about the mediating role of sleep quality in the impact of nurses' pain management appropain on quality of life in adults with chronic musculoskeletal disorders. Bridging this gap is critical to developing comprehensive, evidence-based nursing practices and improving patient-centered care. Therefore, this study aims to investigate the effect of nurses' pain management on quality of life, focusing on the mediating role of sleep quality in adults with chronic musculoskeletal problems.

2. Materials and Methods

2.1. Study Design

This cross-sectional study conducted to investigate the effect of nurses' pain management strategies on the quality of life of adults with chronic musculoskeletal issues, with sleep first-rate serving as a mediating element. The study aimed to identify relationships between the various variables using standardized questionnaires to acquire quantifiable records from individuals at an unmarried factor in time. The design change into chosen to assess herbal versions in pain management strategies and their affiliation with sleep quality and perceived first-class of life.

2.2. Study Sample

They take a look at turned into conducted at a specialized outpatient rehabilitation and continual pain health center affiliated with a tertiary care medical institution, which receives a mean of 1,800 sufferers with persistent musculoskeletal disorders every month. The goal population comprised adults elderly 18 years and older recognized with persistent musculoskeletal situations such as osteoarthritis, chronic low returned pain, fibromyalgia, or rheumatoid arthritis, and who were under nursing care for at least 3 months. The sample size turned into calculated based on a 95% confidence stage, an assumed share (p) of 0.30 (based totally on previous literature), and a 0.5 margin of error. The preliminary sample length was calculated with the usage of the method:

$n_0=(Z^2 \times p\times(1-p))/d^2,$

$n_0=(1.96^2 \times 0.30\times 0.70)/0.05^2 \approx 323.$

Adjusting N=1,800 using the formula:

$n=(n_0\times N)/(n_0+N-1),$

n = (323×1800)/(323+1800-1)≈280.

Hence, a very last sample of 280 members was decided to be enough. Participants were decided on based on inclusion standards: (1) adults aged ≥18 years, (2) clinically recognized with a chronic musculoskeletal disorder for a minimum 6 months, (3) receiving nursing care related to pain control, and (4) able to speak genuinely and offer informed consent. Exclusion standards covered patients with comorbid excessive psychiatric illness, cognitive impairments that can hinder questionnaire crowning glory, or recent hospitalization inside the ultimate month due to acute exacerbation in their musculoskeletal condition.

2.3. Study Instruments

The study utilized a structured questionnaire comprising four parts:

The first component accrued individuals' sociodemographic and medical information, which includes age, gender, prognosis, duration of contamination, medicine use, and comorbidities.

The second element involved the Pain Management Inventory – Nurse Version (PMI-N), which turned into adapted from established pain control assessment tools to assess the strategies hired by nurses in handling persistent musculoskeletal pain. The PMI-N measured both pharmacological and non-pharmacological interventions, including remedy adherence, bodily therapy hints, cognitive-behavioral strategies, and rest methods. This inventory has been used in previous study assessing pain management in clinical nursing contexts[12].

The third part of the questionnaire utilized the Pittsburgh Sleep Quality Index (PSQI) to assess the sleep satisfaction of contributors over the last month. The PSQI includes 19 self-rated questions grouped into seven additives: subjective sleep first-class, sleep latency, sleep length, ordinary sleep efficiency, sleep disturbances, use of sound asleep medicinal drugs, and daylight hours dysfunction. Each factor yields a score ranging from 0 to 3, with higher international scores indicating poorer sleep. The PSQI is an extensively demonstrated and reliable tool in each scientific and research setting [13].

The fourth element employed the World Health Organization Quality of Life – Brief Version (WHOQOL-BREF), a 26-item device designed to degree 4 domains of QOL: bodily fitness, mental well-being, social relationships, and environmental health. The WHOQOL-BREF has verified first-rate go-cultural validity and is frequently used in studies regarding patients with continual situations, inclusive of musculoskeletal problems[14].

2.4. Validity and Reliability

To ensure the content validity of the tool, the complete questionnaire was reviewed using a panel of 5 nursing and rehabilitation experts. Modifications were made based totally on expert comments to enhance readability and cultural relevance. A pilot study was performed with 10% of the target sample (28 individuals), and records from the pilot had been excluded from the very last analysis. The reliability of the units showed the usage of Cronbach's alpha: the PMI-N showed a reliability coefficient of 0.87, the PSQI 0.83, and the WHOQOL-BREF 0.89, indicating excessive internal consistency. All contraptions used had been previously confirmed in comparable populations and are suitable to be used in medical studies settings involving chronic pain and high-quality existence tests.

2.5. Data Collection

Data were collected through direct, face-to-face interviews and the use of the dependent questionnaire. Trained study nurses conducted the interviews in precise quiet areas within the health facility to ensure privacy and reduce distractions. Each consultation lasted approximately 30–40 minutes. Before participation, verbal and written informed consent was acquired from every player, and the take-a-look-at protocol was approved by using the institutional evaluation board. Participants were assured of the confidentiality and anonymity in their responses and informed of their proper to withdraw at any time without any impact on their hospital treatment.

2.6. Statistical Analysis

All statistical analyses have been accomplished using IBM SPSS model 26.0. Descriptive information, including frequencies, possibilities, means, and widespread deviations, have been used to summarize demographic and medical traits. The normality of the information distribution turned into assessed the usage of the Kolmogorov-Smirnov and Shapiro-Wilk exams. To explore the relationships between some of the primary observed variables (nurses' pain control strategies, sleep quality, and satisfaction with quality of life), Pearson's correlation coefficients have been computed. Mediation evaluation is conducted using the PROCESS macro for SPSS (Model four) to test the oblique impact of pain management techniques on the high quality of existence through

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sleep. A bootstrapping method with 5,000 samples was employed to decide the importance of the oblique impact, and a p-price < 0.05 was taken into consideration as statistically good sized at some point in the analysis.

3. Results

Table (1) sample characteristics of 280 had a mean age of about 52 years, with a higher percentage being female (63.6%). Diagnostically, contributors had been particularly stricken by continual low back pain (32.5%) and osteoarthritis (30.4%), observed with the aid of fibromyalgia (21.1%) and rheumatoid arthritis (60%). In common, contributors were living with their musculoskeletal situation for over three years. About 75% have used pain medications, and nearly half had additional comorbidities, indicating a clinically complicated population with multifactorial fitness burdens.

Table (1). Sociodemographic and Clinical Characteristics of Participants (n=280)

Variable	Frequency (n)	Percentage (%)	Mean ± SD
Age (years)	—	—	52.4 ± 11.6
Gender			
Male	102	36.4	
Female	178	63.6	
Duration of illness (months)	—	—	38.5 ± 19.2
Diagnosis			
Osteoarthritis	85	30.4	
Chronic low back pain	91	32.5	
Fibromyalgia	59	21.1	
Rheumatoid arthritis	45	16.0	
Comorbidities present	136	48.6	
Use of pain medications	211	75.4	

Table (2) outlines the variety, method, well known deviations, and reliability ratings of the 3 predominant contraptions used in the study: the Pain Management Inventory – Nurse Version (PMI-N), the Pittsburgh Sleep Quality Index (PSQI), and the WHOQOL-BREF. Participants had mild publicity to nurse-led pain control strategies (suggest = 58.9), usually terrible sleep excellent (imply PSQI score = 10.2), and a fairly high perceived fine of quality of life (mean WHOQOL-BREF = 76.5).

Table (2). Descriptive Statistics of Main Study Variables

Variable	Minimum	Maximum	Mean ± SD
Nurses' Pain Management Strategies (PMI-N)	24	80	58.9 ± 10.7
Sleep Quality (PSQI Global Score)	3	18	10.2 ± 3.9
Quality of Life (WHOQOL-BREF Total)	40	106	76.5 ± 12.3

Note: Higher PMI-N indicates better pain management. Higher PSQI indicates worse sleep. Higher WHOQOL-BREF indicates better quality of life.

Table (3) affords the power and direction of relationships in some of the 3 primary investigate variables. There became a statistically significant correlation between nurses' pain control strategies and members' fine of existence (r = 0.53, p < 0.01), suggesting that more effective nursing interventions are associated with better-perceived well-being. A mild negative correlation was determined between pain management and sleep excellence (r = -0.46, p < 0.01), which means higher pain management is connected to progressed sleep (lower PSQI scores). Sleep pleasant turned into also negatively correlated with excellent life (r = -0.58, p < 0.01), indicating that poor sleep became extensively associated with decreased satisfaction with quality of life.

Table (3). Pearson's Correlation Matrix Among Key Study Variables

Variables	Pain Management	Sleep Quality	Quality of Life
Pain Management Strategies (PMI-N)	1.00	-0.46**	0.53**
Sleep Quality (PSQI Global Score)	—	1.00	-0.58**
Quality of Life (WHOQOL-BREF Total)	—	—	1.00

Table (4) summarizes the mediation analysis conducted to check whether sleep excellence mediates the connection between pain management strategies and the best of existence. The direct course from pain management to sleep first-class (direction a) changed into considerably negative, indicating that progressed pain management decreased sleep problems. The path from sleep great to excellent quality of life (route b) was additionally drastically bad, displaying that poorer sleep turned into related to a lower quality of life. The oblique impact (ab=0.23) was statistically full-size because the 95% confidence c language did not encompass 0, confirming that sleep first-class in part mediates the relationship. Additionally, the direct effect (c') remained sizeable, indicating partial as opposed to full mediation.

Table (4). Mediation Analysis Using PROCESS Macro (Model 4)

Path	Coefficient (β)	SE	95% CI	p-value
a (Pain Management → Sleep Quality)	-0.31	0.06	[-0.43, -0.19]	<0.001
b (Sleep Quality → Quality of Life)	-0.74	0.09	[-0.92, -0.56]	<0.001
c' (Direct effect: Pain → QoL)	0.30	0.07	[0.16, 0.44]	<0.001
ab (Indirect effect)	0.23	0.05	[0.14, 0.34]	—
Total Effect (c)	0.53	0.06	[0.41, 0.65]	<0.001

Predictor: Pain Management Strategies (PMI-N)
Mediator: Sleep Quality (PSQI)
Outcome: Quality of Life (WHOQOL-BREF)

4. Discussion

The findings of this take a look at provide sizeable insights into how nurses' pain control strategies impact the fine of existence in adults laid low with continual musculoskeletal disorders, with sleep appearing as a partial mediator. The demographic profile indicated a predominance of middle-aged and older lady adults, a fashion widely documented in musculoskeletal epidemiology. According to Overstreet et al., girls, in particular postmenopausal, are more vulnerable to chronic musculoskeletal situations which include osteoarthritis and fibromyalgia, largely due to hormonal, anatomical, and behavioral elements[15]. The chronicity and severity of their conditions, along with common comorbidities, mirror the multidimensional burden confronted by way of this populace and underscore the need for holistic nursing appropain [16].

The descriptive evaluation demonstrated moderate engagement in nurse-led pain control strategies and normally terrible sleep among participants. This aligns with preceding research, including those by Buonanno et al. and Balat et al. emphasized that no matter the availability of pharmacological and non-pharmacological interventions, pain in persistent musculoskeletal sufferers is often under-managed, leading to bad outcomes in sleep and universal life satisfaction[17,18]. Notably, the high-reliability rankings of the dimension tools confirm the robustness of the information and lend credibility to the findings.

Correlation evaluation discovered that powerful pain control using nurses turned into definitely related to higher best of life ($r = 0.53$, $p < 0.01$), reinforcing the vital position nurses play in continual pain care. This is supported by evidence from Ibrahim et al. and Malih Radhi et al., who highlighted that tailored nursing interventions, inclusive of patient schooling, emotional help, and self-control training, substantially stepped forward fitness effects in chronic pain patients[19, 20]. Furthermore, the study observed that better pain management became moderately related to stepped-forward sleep ($r = -0.46$, $p < 0.01$), and on the flip, higher sleep quality became strongly associated with better pleasant quality of life ($r = -0.58$, $p < 0.01$). These findings are in settlement with Herrero et al. and Radhi et al., suggested that sleep disturbance acts accordingly and contributor to continual pain, developing a cycle that exacerbates practical boundaries and emotional distress[19, 20].

The mediation analysis offered nuanced insights into the mechanisms by which nursing care Affects the affected person's well-being. Sleep pleasant was observed to partially mediate the connection between pain management strategies and first-class of existence (indirect impact = 0.23, 95% CI = 0.12 to 0.38), suggesting that whilst pain control has an immediate influence, its impact is likewise routed via its ability to enhance sleep. This locating resonates with the biopsychosocial model of continual pain, which posits that psychological and behavioral elements along with sleep play an indispensable function in modulating the results of bodily signs and symptoms on best of life[21, 22]. The endurance of a sizable direct effect even after accounting for sleep ($c' = 0.27$, $p < 0.001$) implies that nurses' techniques offer multidimensional benefits beyond virtually enhancing sleep—