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Clinical Study

Insomnia in a chronic musculoskeletal pain with disability population is independent of pain and depression

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Abstract

BACKGROUND CONTEXT: Insomnia is frequently experienced by patients suffering from chronic musculoskeletal disorders but is often seen as simply a symptom of pain or depression and not as an independent disorder. Compared with those who experience only chronic pain, patients with both chronic pain and insomnia report higher pain intensity, more depressive symptoms, and greater distress. However, insomnia has not yet been systematically studied in a chronic musculoskeletal pain with disability population.

PURPOSES: This study assessed the prevalence and severity of patient-reported insomnia, as well as the relationship among insomnia, pain intensity, and depressive symptoms, in a chronic musculoskeletal pain with disability population.

STUDY DESIGN/SETTING: This was a retrospective study of prospectively captured data.

PATIENT SAMPLE: A consecutive cohort of 326 chronic musculoskeletal pain with disability patients (85% with spinal injuries) entered a functional restoration treatment program. All patients signed a consent form to participate in this protocol.

OUTCOME MEASURES: Insomnia was assessed with the Insomnia Severity Index, a validated patient-report measure of insomnia symptoms. Four patient groups were formed: no clinically significant insomnia (score, 0–7); subthreshold insomnia (score, 8–14); moderate clinical insomnia (score, 15–21); and severe clinical insomnia (score, 22–28). Three patterns of sleep disturbance were also evaluated: early, middle, and late insomnia. Additional validated psychosocial patient-reported data were collected, including the Pain Visual Analog Scale, the Beck Depression Inventory, the Oswestry Disability Index, and the Pain Disability Questionnaire.

METHODS: Patients completed a standard psychosocial assessment battery on admission to the functional restoration program. The program included a quantitatively directed exercise process in conjunction with a multimodal disability management approach. The four insomnia groups were compared on demographic and psychosocial variables. The shared variances among insomnia, depression, and pain were determined by partial correlational analyses.

RESULTS: The presence of no clinically significant insomnia, subthreshold insomnia, moderate clinical insomnia, and severe clinical insomnia was found in 5.5%, 21.2%, 39.6%, and 33.7% of the cohort, respectively. More than 70% of patients reported moderate to severe insomnia symptoms, which is a considerably higher prevalence than that found in most patient cohorts studied previously. A stepwise pattern was found, in which severe clinical insomnia patients reported the highest pain, the most severe depressive symptoms, and the greatest disability. The severe clinical

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insomnia patients also reported a higher number of sleep disturbance types (early, middle, and late insomnia) than the other three groups. In fact, 62.9% of them reported all three disturbance types. Although correlations were found between insomnia and depressive symptoms and between insomnia and pain, the shared variances were small (12.9% and 3.6%, respectively), indicating that depression and pain are separate constructs from insomnia.

CONCLUSION: This research indicates that insomnia is a significant and pervasive problem in a chronic musculoskeletal pain with disability population. Most importantly, although insomnia has traditionally been assumed to be simply a symptom of pain or depression, the findings of the present study reveal that it is a construct relatively independent from both pain and depression. Specific insomnia assessment and treatment is therefore recommended for this chronic musculoskeletal pain with disability population.

Keywords: Insomnia; Pain intensity; Depressive symptoms; Chronic musculoskeletal pain; Functional restoration; Disability; Workers' compensation

Introduction

Insomnia is highly prevalent in the general population, ranging from 19% to 27% of adults older than 18 years [1–4]. Insomnia includes difficulty initiating sleep, disrupted sleep, and early morning awakening [5]. People with insomnia report greater health problems, more limited physical activity, more interference with daily living, and greater emotional difficulty compared with healthy people without insomnia [2,6]. Poor sleep quality and insufficient sleep are associated with decreased pain thresholds in normal healthy subjects [6,7] and with hyperalgesia in chronic pain subjects [8–10]. Moreover, insomnia is frequently reported by patients with chronic pain, with about 88% reporting at least one type of sleep disturbance [8,11]. Many studies have found that increases in insomnia severity are significantly correlated with increases in pain intensity, using both subjective measures such as sleep diaries and patient-report instruments [8,12,13] and objective measures such as polysomnography, which uses electroencephalographic recordings [12,14,15], and actigraphy, which measures the frequency of movements during sleep [13,16]. Furthermore, the combination of insomnia and chronic pain has been found to be associated with a variety of negative outcomes, including anxiety, depression, and suicidal ideation [7–9,17,18]. A cycle of sleep deprivation and increased pain, due to hyperalgesia and/or decreased pain thresholds, can severely limit the daily functioning of chronic pain patients [19,20].

Insomnia is a symptom of major depressive disorder, according to the DSM-IV-TR classification system [21], and is a significant predictor of people developing depression, based on longitudinal studies [22]. When insomnia occurs comorbidly with depression, it is commonly misdiagnosed as simply a symptom of the depressive disorder and not recognized as a separate disorder [5,23]. A similar phenomenon has also been observed in relation to pain and insomnia. Pain causes insomnia, which in turn causes increased pain intensity, resulting in more disrupted sleep. Because of the high prevalence of insomnia in chronic pain populations, insomnia is often seen as a secondary symptom of chronic pain [24]. This view of insomnia may be especially common in assessing and treating chronic pain patients who have both depression and insomnia [3]. However, this view has shifted gradually as new evidence has emerged, pointing toward insomnia as a primary disorder for many chronic pain patients [18,25].

Although insomnia has been studied in diverse chronic pain populations, it has not been studied in chronic musculoskeletal pain with disability patients undergoing functional restoration (FR) treatment. This patient population typically exhibits severe physical and psychosocial deterioration, often accompanying a workers' compensation claim. This patient population is highly associated with various psychiatric disorders, including pain disorder, major depressive disorder, and opioid dependence, which often have postinjury onset [26]. Based on the findings that other pain conditions are associated with insomnia, it is highly probable that insomnia also plays a role in the course of chronic musculoskeletal pain with disability. However, prior research has not made a distinction between patients with high and low frequency or severity of insomnia symptoms, with only a few studies categorizing participants based on whether they had symptoms severe enough and frequent enough to be classified as having ''clinical insomnia'' [9,27]. In addition, little prior research has differentiated between participants with moderate-to-severe insomnia, subthreshold insomnia, and minimal insomnia [18]. Thus, to more systematically address this issue, the present study was designed to evaluate patient-reported insomnia, including prevalence, pattern (early, middle, and late insomnia), and severity, and its association with patient-reported pain intensity, depressive symptoms, and perceived disability. In addition, the present study was intended to identify differences in pain, depression, and disability among patients with different levels of insomnia severity. It was hypothesized that insomnia would be highly prevalent in chronic musculoskeletal pain with disability patients and that associations would be found among insomnia and other

EVIDENCE & METHODS

Context
Nonmusculoskeletal pain or depression frequently presents with insomnia. Previous research has indicated that patients with concomitant insomnia have greater pain intensity. This relationship has not been previously specifically investigated in patients with chronic musculoskeletal pain.

Contribution
In this retrospective assessment of prospectively collected data using validated measures, the authors found moderate and severe insomnia in greater than 70% of their occupationally-injured population. Greater insomnia correlated with greater pain, depression, and disability. Insomnia appeared to be an independent risk factor.

Implications
The findings suggest insomnia in this patient group should be addressed separately and along with depression and pain in the hopes that such comprehensive care might maximize their function.

—*The Editors*

psychosocial distress measures. Identifying the role of insomnia in this population may lead to a greater recognition of sleep disturbances and better treatments for patients suffering from both chronic musculoskeletal pain with disability and insomnia.

Methods

Participants

This was a retrospective study of prospectively captured data that consisted of a consecutive cohort of 326 chronic musculoskeletal pain with disability patients who were admitted to a FR program at a regional rehabilitation center. All patients signed a consent form to participate in this protocol. The majority of patients had spinal disorders (85%), of which most were compensable under state or federal workers' compensation. The inclusion criteria for participation in the treatment program were at least 4 months of disability after injury; primary and/or secondary care was unsuccessful in improving pain and function; the patient failed to improve despite previous surgical treatment or was not a surgical candidate; and severe pain and functional limitations remained. The participants in this study formed a consecutive cohort that was admitted between June 2010 and December 2011. Of the initial sample of 420 patients, 94 were excluded because they did not complete all the items on the Insomnia Severity Index (ISI), the primary sleep measure in this study, leaving 326 patients with complete data for subsequent analyses. Patients who did and those who did not complete the ISI were not significantly different in age, gender proportion, or length of disability. Fig. 1 depicts the flow of patients through the study.

Measures

The ISI is a brief patient-report measure that assesses the severity of both nighttime and daytime components of insomnia, using a five-point Likert scale (0="not at all" to 4="extremely"), generating a total score ranging from 0 to 28 [27]. A cutoff score of 15 has been shown to have good sensitivity (94%) and specificity (94%) in identifying clinical insomnia [28]. Four groups were formed based on the ISI total score collected on admission to the treatment program: no clinically significant insomnia (ISI score: 0–7, N=18), subthreshold insomnia (ISI score: 8–14, N=69), moderate clinical insomnia (ISI score: 15–21, N=129), and severe clinical insomnia (ISI score: 22–28, N=110) [27]. In addition, the four groups were evaluated for three patterns of sleep disturbance: early (difficulty initiating sleep), middle (difficulty staying sleep), and late insomnia (early morning awakening). The ISI asks subjects to rate the level of problems for each insomnia type (from 0="none" to 4="very severe"). A score of 3 (indicating a severe disturbance) was chosen to indicate the presence of early, middle, or late insomnia [29]. Demographic comparisons among the no clinically significant insomnia, subthreshold insomnia, the moderate clinical insomnia, and the severe clinical insomnia showed no significant differences in age, gender, ethnicity, length of disability, or pretreatment surgery (Table 1).

In addition to the ISI, patient-report measures evaluating pain intensity, depressive symptoms, and disability were also administered. The Pain Visual Analog Scale (PVAS) was used to measure pain intensity, with scores ranging from 0 to 10 [30]. The Beck Depression Inventory (BDI) [31] was used to assess depressive symptoms, with scores ranging from 0 to 63. The Pain Disability Questionnaire (PDQ, with

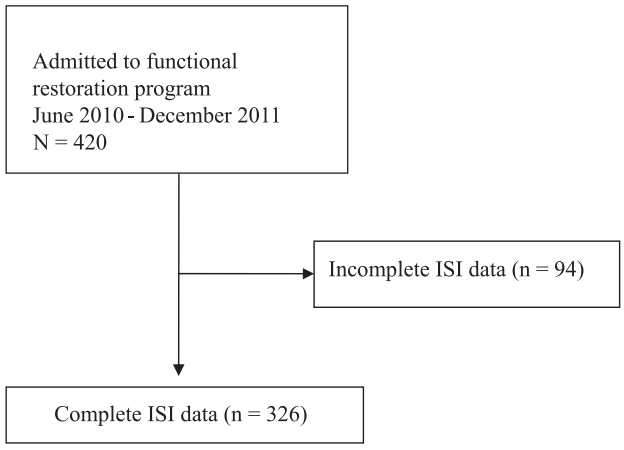

Fig. 1. Flow of participants through the program. ISI, Insomnia Severity Index.

Table 1
Demographic variables according to Insomnia Severity Index (N=326)

Variable	Insomnia Severity Index score				F/χ^2 Value	p Value
	No clinically significant insomnia, N=18 (5.5%)	Subthreshold insomnia, N=69 (21.2%)	Moderate clinical insomnia, N=129 (39.6%)	Severe clinical insomnia, N=110 (33.7%)		
Gender, N (% male)	12 (66.7)	46 (66.7)	87 (67.4)	75 (68.2)	0.51	.997
Age, mean±SD	48.0±10.7	45.3±12.8	45.9±9.8	44.6±10.7	0.62	.602
Area of injury, N (%)					17.86	.270
Cervical only	0	1 (1.4)	1 (0.8)	6 (5.5)		
Thoracic/lumbar only	4 (22.2)	28 (40.6)	35 (27.1)	38 (34.5)		
Extremity only	5 (27.8)	9 (13.0)	15 (11.6)	14 (12.7)		
Multiple spinal	2 (11.1)	5 (7.2)	15 (11.6)	6 (5.5)		
Spinal+additional injury	7 (38.9)	26 (37.7)	59 (45.7)	44 (40)		
Other	0	0	4 (3.1)	2 (1.8)		
Race, N (%)					13.33	.148
Caucasian	12 (70.6)	42 (61.8)	68 (54.0)	69 (63.9)		
African-American	2 (11.8)	12 (17.6)	40 (31.7)	30 (27.8)		
Hispanic or Latino	3 (17.6)	13 (19.1)	15 (11.9)	9 (8.3)		
Other	0	1 (1.5)	3 (2.4)	0		
Pretreatment surgeries, N (%)	10 (58.8)	35 (56.5)	68 (55.7)	60 (55.6)	0.07	.995
Length of disability in months, mean±SD	10.9±10.4	28.2±46.5	35.1±54.0	28.0±45.1	1.42	.238

SD, standard deviation.

scores ranging from 0 to 150) [32] and the Oswestry Disability Index (ODI; with scores ranging from 0 to 100) [33] were used to evaluate perceived disability. For all measures, a higher score indicates more severe symptoms, and all measures have been shown to be reliable and valid for use in chronic pain populations.

Procedure

All patients participated in an interdisciplinary FR treatment program, consisting of a quantitatively directed exercise progression, supervised by physical and occupational therapists, and aimed at restoring muscular strength, flexibility, endurance, and cardiovascular fitness. The exercise program was administered in conjunction with multimodal disability management, which included cognitive behavioral therapy, biofeedback, stress management training, educational classes, vocational reintegration, and future fitness management [34–36]. All patients received a comprehensive evaluation before the start of the program, which included a physical examination, a medical history, a medical case management/disability assessment, a quantitative functional capacity evaluation, and a psychosocial intake interview. Demographic data and socioeconomic information such as occupational characteristics and work status were collected as part of the intake interview. Patients completed a battery of patient-report instruments on admission to the FR program, including the ISI, PVAS, BDI, ODI, and the PDQ. Because all assessments were part of the standard medical record for patients participating in the interdisciplinary FR program, the study was granted an exemption from review by the Institutional Review Board of the University of Texas at Arlington.

Statistical methods

An a priori power analysis was conducted before data collection to determine an appropriate sample size [37,38]. To detect a medium effect size of 0.5 on the basis of Cohen f [39], with power $\beta=0.8$ and $\alpha=0.05$, a total of 180 subjects were required. Thus, this study had a more than sufficient sample size (N=326). The insomnia groups were compared on demographic and psychosocial variables using one-way analyses of variance for continuous variables and chi-square tests for categorical variables. Finally, the shared variances of insomnia, depression, and pain were determined by partial correlation analyses.

Results

The pattern of insomnia and psychosocial patient-report measures

Of the total sample, 36.4% of patients reported severe problems with all three types of sleep disturbance patterns (early, middle, and late insomnia); 40.5% reported severe problems with two types; and 23.1% reported severe problems with a single sleep disturbance. Of those patients who reported severe problems with two or more sleep disturbance patterns, 59.0% reported difficulty falling asleep, 91.6% reported difficulty staying asleep, and 49.4% reported early morning awakening. Patients reporting a severe problem with a single sleep pattern most frequently reported difficulty staying asleep (41.5%). The patterns of severe sleep disturbance for each of the insomnia groups are presented in Fig. 2. The prevalence of patients in the subthreshold insomnia group who reported severe problems with a single sleep disturbance and two sleep disturbance patterns was

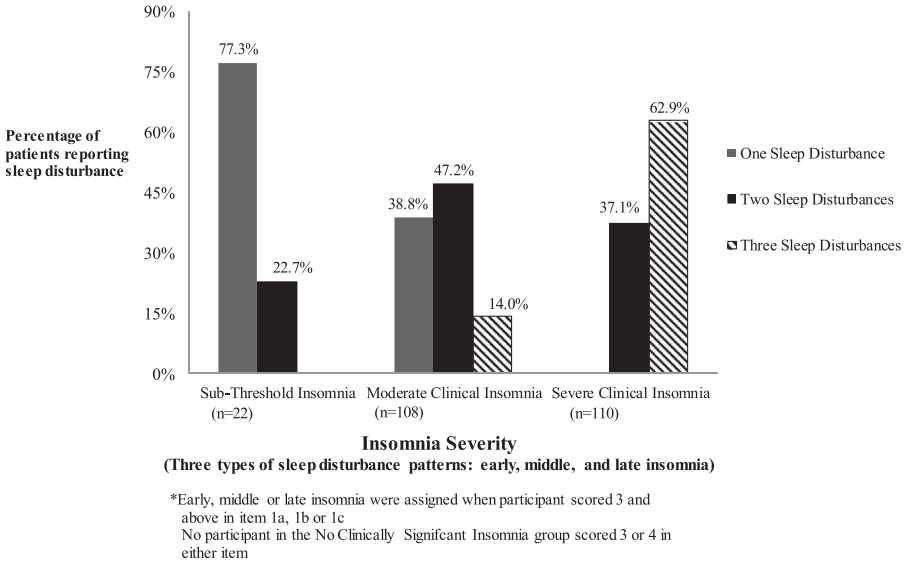

Fig. 2. Patterns of insomnia.

77.3% and 22.7%, respectively. The prevalence of patients in the moderate clinical insomnia group who reported a single severe sleep disturbance, two severe sleep disturbances, and three severe sleep disturbance patterns was 38.8%, 47.2%, and 14%, respectively. The prevalence of patients in the severe clinical insomnia group who reported two severe sleep disturbances and three severe sleep disturbances was 37.1% and 62.9%, respectively. No patients in the no clinically significant insomnia group reported a severe sleep disturbance pattern.

The psychosocial patient-report measures for the insomnia groups are presented in Table 2. As can be seen, the psychosocial measures were significantly different among the four insomnia groups ($p<.001$) with a stepwise pattern. The patients in the no clinically significant insomnia group reported the lowest level of pain intensity, depressive symptoms, and pain-related disability. In contrast, the severe clinical insomnia patients reported the highest level of pain intensity, depressive symptoms, and pain-related disability. The psychosocial patient-report outcomes for subthreshold insomnia and moderate clinical insomnia groups lay in between, with poorer outcomes associated with the more severe group. Furthermore, the severe clinical insomnia group had the highest percentage of patients with

Table 2
Patient-report psychosocial variables (N=326)

Variable	Insomnia Severity Index score				F Value	p Value	ES*
	No clinically significant insomnia, N=18 (5.5%)	Subthreshold insomnia, N=69 (21.2%)	Moderate clinical insomnia, N=129 (39.6%)	Severe clinical insomnia, N=110 (33.7%)			
Insomnia Severity Index (ISI), mean±SD, valid N=326	3.9±2.5	11.6±2.1	18.3±1.8	24.6±2.1	940.53	<.001	0.90
Pain Visual Analog Scale (PVAS), mean±SD, valid N=324	6.2±2.1	6.8±2.1	7.2±1.9	7.9±1.5	8.34	<.001	0.07
% PVAS≥6, N (%),† valid N=324	15 (83.3)	56 (82.4)	105 (81.4)	103 (94.5)	9.73	.021	0.17
Beck Depression Inventory (BDI), mean±SD, valid N=324	12.2±8.4	13.7±8.0	18.8±9.8	23.4±11.8	15.6	<.001	0.13
% BDI≥20, N (%),† valid N=324	2 (11.1)	14 (20.6)	52 (40.3)	59 (54.1)	26.10	<.001	0.28
Pain Disability Questionnaire (PDQ), mean±SD, valid N=321	85.5±21.2	88.7±25.9	98.8±27.2	109.0±21.6	11.51	<.001	0.10
% PDQT≥71, N (%),† valid N=321	14 (77.8)	53 (79.1)	110 (85.9)	101 (92.7)	7.80	.05	0.16
Oswestry Disability Index (ODI), mean±SD, valid N=312	30.7±12.1	37.5±15.9	41.3±17.4	50.1±17.1	12.53	<.001	0.11
% ODI≥41, N (%),† valid N=312	3 (16.7)	28 (41.8)	61 (50.4)	75 (70.8)	26.66	<.001	0.29

ES, effect size; SD, standard deviation.

* Effect size ($\eta\rho^2$): small=0.20, medium=0.50, and large=0.80. Effect size (Cohen W) is defined 0.10 as small, 0.30 as medium, and 0.50 as large.

† The cutoff scores were based on references [30–33].

moderate-to-severe depressive symptoms on the BDI (54.1%) and severe pain-related disability on the PDQ (92.7%) compared with other insomnia groups.

The relationship among insomnia, pain, and depression

The correlations among insomnia, pain, and depression are presented in Table 3. Insomnia was moderately correlated with pain ($r=0.29$, $p<.001$). After controlling for depression, the correlation between pain and insomnia was weak ($r=0.19$, $p=.001$), with a shared variance of only 3.6%. The correlation between depressive symptoms and insomnia was moderate ($r=0.41$, $p<.001$). After controlling for pain, the correlation between insomnia and depressive symptoms was moderate ($r=0.36$, $p<.001$), with a shared variance of 12.9%. The small proportion of shared variance between insomnia and pain as well as between insomnia and depressive symptoms indicated that insomnia is only a very small part of pain and depression constructs.

Discussion

The purpose of this present study was to evaluate the prevalence and severity of insomnia in a chronic musculoskeletal pain with disability population. Of 326 patients assessed, only 6% reported no clinically significant insomnia symptoms. Furthermore, 73% met criteria for clinical insomnia (moderate-to-severe symptoms), and 21% were classified as having subthreshold insomnia. The prevalence of clinical insomnia in this population is therefore extremely high and is more than double the rate of insomnia found in the general population [1–4]. The mean ISI score for those patients classified with clinical insomnia (21.2) was slightly higher in this sample of chronic musculoskeletal pain with disability patients than mean scores reported for a separate cohort of insomniacs with chronic low back pain (19.1) [9]. In addition, the presence of clinical insomnia, particularly severe clinical insomnia, was associated with greater patient-reported psychosocial distress, including pain, depressive symptoms, and perceived disability.

This study also evaluated the relationship among insomnia, pain, and depressive symptoms in much greater detail. As noted previously, insomnia is often viewed as simply a symptom of depression and not as an independent disorder [23]. Indeed, we did find that insomnia was significantly related to depressive symptoms. However, the shared variance between insomnia and depressive symptoms was relatively small (12.9%). Insomnia was also significantly correlated with pain intensity, although the shared variance between insomnia and pain was negligible (3.6%). Taken together, these results clearly demonstrate that insomnia can occur independently of depressive symptoms and pain within a chronic musculoskeletal pain with disability population. These findings support previous research results suggesting that insomnia, pain, and depressive symptoms are related yet independent constructs. For example, Wilson et al. [40] found that 40% of subjects in a chronic musculoskeletal pain population had insomnia without comorbid major depression, 27% had major depression with comorbid insomnia, and 33% did not have either insomnia or depression. A study of psychiatric patients with major depressive disorder found that insomnia was a significant predictor of pain, even after controlling for depression. As noted by Wickwire and Smith [5], insomnia can originate from a painful medical condition but, in time, may evolve into its own disorder related to, but separate from, the precipitating condition. Dysfunctional sleep and sleep habits can become primary factors that perpetuate and maintain the insomnia, so that sleep disturbance is no longer directly caused by pain intensity [41]. When this happens, insomnia can evolve from a secondary symptom of chronic pain to a primary comorbid condition, with characteristics similar to primary insomnia [42]. This appears to be the case with many of the chronic musculoskeletal pain with disability patients in the present study.

In analyzing types of sleep disturbance patterns (early, middle, and late insomnia), 36.4% of the patients reported severe problems with all three types, 40.5% reported severe problems with two types, and 23.1% reported severe problems with a single type of sleep disturbance. Severe problems with all three sleep disturbance patterns was reported only by patients meeting criteria for clinical insomnia (moderate and severe). The majority of subthreshold insomnia subjects (77.3%) reported severe problems with only one sleep disturbance. Compared with late insomnia, the prevalence of severe problems with early and middle insomnia combined was somewhat higher in this population. High rates of severe problems with early insomnia may be related to the tendency of chronic musculoskeletal pain with disability patients who are not working to spend most of their day reclining or napping, which may interfere with their normal sleep patterns. Education about proper sleep hygiene may be beneficial for these patients with early insomnia.

Some limitations pertaining to this study were identified. A relatively large percentage of patients failed to complete all items on the ISI, so those data were unavailable for analysis. As a result, there is a possibility that a selection bias may have occurred. Another limitation was the absence of a control group due to the chosen study design. It should

Table 3
Correlation among insomnia, pain and depression

Variable*	Insomnia	Pain	Depressive symptoms
Insomnia	—	0.19†	0.36‡
Pain		—	0.20§
Depressive symptoms			—

* Insomnia was assessed with the Insomnia Severity Index; pain intensity was assessed with the Pain Visual Analog Scale; and depressive symptoms were assessed with the Beck Depression Inventory.

† Correlation after controlling for depressive symptoms: $p=.001$.

‡ Correlation after controlling for pain intensity: $p<.001$.

§ Correlation after controlling for insomnia: $p<.001$.

also be noted that other sleep disorders such as sleep apnea can also affect the prevalence and severity of patient-reported insomnia in chronic musculoskeletal pain with disability patients. Unfortunately, information on other sleep disorders was not included in the standard medical record. In addition, data on the onset (preinjury or postinjury) or duration of insomnia were not available in the present study. Furthermore, pain levels in this study were assessed only during treatment intake and not while patients were experiencing insomnia. Therefore, future clinical research studies should examine other characteristics of sleep disturbance and assess pain ratings and other psychosocial measures, at specific times when patients are unable to sleep, to provide even more insight into the relationships among insomnia, pain, and depression in chronic musculoskeletal pain with disability patients.

In conclusion, we found a high prevalence of clinical insomnia within a chronic musculoskeletal pain with disability population, and chronic musculoskeletal pain with disability was almost universally associated with some level of insomnia. Clinical insomnia was associated with increased patient-reported pain, depressive symptoms, and perceived disability. Although clinical insomnia was associated with depressive symptoms and pain, we found a significant amount of variance that was not related to these two variables, indicating that clinical insomnia can be a distinct and independent disorder within this population. The significant clinical implications of these findings are that to maximize treatment responsiveness, the specific evaluation and treatment for clinical insomnia within a chronic musculoskeletal pain with disability population appears warranted.

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