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A multilevel path model analysis of the relations between sleep, pain, and pain catastrophizing in chronic pain rehabilitation patients

Joshua A. Wilt [a,*], Sara Davin [b], Judith Scheman [b]

[a] Case Western Reserve University, United States
[b] Neurological Center for Pain, Neurological Institute, Cleveland Clinic, United States

HIGHLIGHTS

- We examine pain catastrophizing, sleep, and pain among chronic pain patients.
- Improved sleep predicts decreased pain and lower pain catastrophizing.
- Low pain during treatment predicts decreased pain catastrophizing post-treatment.
- Pain mediates the association between sleep and pain catastrophizing.
- Treating sleep in chronic pain patients may improve pain-related outcomes.

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ABSTRACT

Background and aim: Pain catastrophizing is linked to heightened pain and poorer coping among individuals with chronic pain, yet little is known about how pain catastrophizing associates with sleep and pain over the course of treatment for chronic pain. Previous research employing a cross-sectional design suggests that sleep mediates the association between pain catstrophizing and pain, but there have been no longitudinal studies examining the directionality of these associations. Thus, the aim of this study was to test two competing theoretical models. The first model specified that pain catastrophizing leads to increased pain via poor sleep. The second model specified that poor sleep leads to increased pain catastrophizing via increased pain.

Methods: This study examined the relations between pain catastrophizing, sleep, and pain among 50 consecutive patients (36 female, 14 male) ages 20–80 (M = 45.96, SD = 13.94) with chronic, non-malignant pain who were admitted to the Cleveland Clinic, Chronic Pain Rehabilitation Programme (CPRP). The CPRP, within the Neurological Centre for Restoration, Neurologic Institute at the Cleveland Clinic, is a comprehensive, interdisciplinary programme designed to treat patients with disabling chronic pain. As part of their daily, morning update with their case manager, patients completed self-report ratings of their previous night's sleep time (TST), and their current pain, anxiety, and depression. Pain catastrophizing was assessed at admission and discharge.

Results: Over the course of treatment, daily TST increased from approximately 5 h and 20 min per night to nearly 6 h and 30 min per night, and average daily pain, daily depression, and daily anxiety decreased over the course of treatment. As the data in this study has a multilevel structure, with daily reports nested with in patients, we conducted multilevel path models to examine the longitudinal relations between pain catastrophizing, sleep, and pain. Multilevel path analysis permits the analysis of interdependent data without violating the assumptions of standard multiple regression. Models were conducted for pain catastrophizing and each of its subscales: rumination, magnification and helplessness. The findings were uniform across the composite pain catastrophizing scale and its subscales. There was an indirect path from sleep to pain catastrophizing (post-treatment) via pain, but not from pain catastrophizing (pre-treatment) to pain via sleep. There were also direct effects of sleep on pain and from pain to pain catastrophizing (post-treatment). Additionally, decreases in pain over the course of treatment were related to lower pain catastrophizing post-treatment.

* Corresponding author at: Department of Psychological Sciences, Case Western Reserve University, 10900 Euclid Avenue, Cleveland, OH 44106-7123, United States. Tel.: +1 614 370 5677; fax: +1 216 368 4891.
E-mail address: joshua.wilt@case.edu (J.A. Wilt).

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Conclusion and implications: These results call into question previous evidence that pain catastrophizing indirectly affects pain by way of its impact on sleep. Rather, our findings suggest that pain mediates the relationship between sleep and levels of pain catastrophizing. These results therefore underscore importance and value in collecting longitudinal data and potential influence on the conclusions gained with regards to sleep, pain and psychological variables. These findings may be of clinical importance when tailoring interventions for individuals with chronic pain and perhaps even more so for those with comorbid pain and sleep disturbance; prioritizing the treatment of sleep difficulties could result in improvements to pain-related outcomes.

1. Introduction

Pain and sleep disturbance are associated with one another, and the majority of chronic pain patients (50–88%) experience difficulties with sleep [15,18,30,31]. Early studies showed a bidirectional association between pain and sleep [2,10,21,27], but recent studies using more sophisticated measurement and analytic strategies suggest a temporal precedence of sleep difficulties for predicting pain [3,4,11,16,36].

In the context of an interdisciplinary chronic pain rehabilitation programme (ICPRP), it was also shown that previous night's total sleep time (TST) predicted next-day pain, but the strength of this association was not the same magnitude for each person; rather, its association varied across individuals [9]. That is, for some people a night of less sleep was very strongly associated with heightened next day pain, whereas others had weaker associations. Furthermore, people with strong, inverse associations between previous night's sleep and next-day pain had stronger associations between changes in sleep and changes in pain over the course of treatment. These results suggest that improvements in TST over the course of treatment relate to meaningful reductions in pain over the course of treatment to the extent that TST and pain are correlated within the level of the individual. These preliminary findings underscore the importance of developing a better understanding of the association between sleep and pain, particularly in the context of treatment for individuals with chronic pain difficulties.

One study relevant to this goal investigated whether pain catastrophizing influenced the relationship between sleep and pain in patients with myofascial tempromandibular disorder [6]. Pain catastrophizing reflects a fearful attitude towards pain that involves three distinct, yet related, cognitive-affective responses: rumination, magnification, and helplessness [35]. In a cross-sectional design [6], it was determined that pain catastrophizing was related to both sleep disturbance and pain difficulties. Results of mediation analyses revealed that pain catastrophizing indirectly influenced pain via sleep difficulties. The mediation results held for a composite pain catastrophizing measure as well as the subscales assessing rumination and helplessness (the indirect effect of magnification on pain via sleep disturbance was not significant). The results were interpreted as consistent with the idea that pain catastrophizing affects sleep through contributing to increased physiological arousal as well as increased attention and worry related to pain [7,12,40].

These findings highlight the potential importance of pain catastrophizing in the sleep–pain association but are limited due to the use of a cross-sectional design, as the direction of causality is ambiguous. A further limitation of this study is that it did not include measures of depression and anxiety, as it has been shown that negative moods are related to sleep and pain [15,17,22].

The current study builds on previous findings by employing a longitudinal design and examining the association of pain catastrophizing on sleep and pain within the context of an ICPRP. Measurements of pain catastrophizing (and its facets of rumination, helplessness, and magnification) were obtained at admission and discharge, as well as daily ratings of estimated sleep time and pain during the course of treatment. This design allowed for the examination of both the directional model proposed previously (pain catastrophizing leads to increased pain through sleep difficulties) [6], and the reverse of that model (sleep difficulties lead to increased pain catastrophizing via difficulties with pain). Discriminating between these models was the primary purpose of this study. Additionally, the current study controlled for daily levels of depression and anxiety.

2. Methods

Participants were 50 consecutive patients (36 female, 14 male) ages 20–80 (M = 45.96, SD = 13.94) with chronic non-malignant pain who were admitted to the Cleveland Clinic, Chronic Pain Rehabilitation Programme (CPRP).

The CPRP, within the Neurological Centre for Restoration, Neurologic Institute at the Cleveland Clinic, is a comprehensive, interdisciplinary programme designed to treat patients with disabling chronic pain. Patients attend the CPRP Monday through Friday from 7:30 A.M. to 5 P.M. The CPRP is an outpatient treatment programme that combines physical therapy, occupational therapy, psychodynamic group psychotherapy, individual psychotherapy incorporating relaxation training and biofeedback, substance use education, cognitive behavioural therapy (CBT), vocational counselling, family education and medication management. All psychological interventions are delivered by counsellors, social workers or psychologists trained in diverse psychotherapy approaches including CBT and psychodynamic therapy. Medication management occurs daily and includes weaning from opiate analgesics, sedative hypnotics and benzodiazepines during the CPRP. The programme's goals emphasize functional restoration and self-management of pain, depression, anxiety and associated disability.

The average duration of pain from the sample of patients was 14.6 years (SD = 10.74). Participants demonstrated a high rate of pain and psychiatric comorbidities, with the mean number of pain related and psychiatric diagnoses being 6.8 (SD = 2.17). The most common presenting pain complaints were low back pain (36%), total body pain/fibromyalgia (28%), neck pain (8%) and knee pain (8%). The majority of the participants (58%) were not working due to pain. These characteristics are largely representative of the overall population of chronic pain patients seeking treatment at interdisciplinary pain treatment centres [32].

All participants underwent informed consent procedures and completed a standard questionnaire packet including the Pain Catastrophizing Scale (PCS) [33] as part of their routine clinical care upon admission and again upon completion of the CPRP. The PCS is a 13-item self-administered inventory that assesses cognitive rumination, magnification and helplessness regarding the pain experience. Items on the PCS are presented on a 5-point scale (0–4), with higher scores indicating increased pain catastrophizing. This measure has been shown to have high internal consistency, and pain catastrophizing has been repeatedly associated with heightened disability, increased pain and illness behaviours, greater use

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