

The Relationship Between Pain Catastrophizing and Outcomes of a 3-Week Comprehensive Pain Rehabilitation Program

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Abstract

Objective. Pain catastrophizing is an important predictor of functioning and disability among individuals with chronic pain, and modification of catastrophic interpretations of pain is a proposed treatment mechanism of pain rehabilitation. The purpose of the current study is to examine the relationship between changes in catastrophic thinking and treatment outcomes for a large sample of patients with chronic pain.

Methods. 648 adult patients with chronic pain completed a 3-week intensive outpatient comprehensive pain rehabilitation program. Measures of pain severity, pain-related life interference, depression, and pain catastrophizing were completed at admission and discharge.

Results. Consistent with prior research, pain catastrophizing was associated with several negative pain-related outcomes. Results of a within-subjects mediational analysis indicated that pain catastrophizing not only improved during the treatment program, but also accounted for a significant portion of the variance in the reduction of pain severity, pain interference, and depression at the end of treatment.

Conclusions. This study adds further support to the position that pain catastrophizing has a detrimental role in adaptation to chronic pain, and that this construct can be successfully modified in treatment to improve patient outcomes.

Key Words. Pain Management; Rehabilitation Medicine; Chronic Pain; Catastrophizing; Psychology

Introduction

The construct of pain catastrophizing emerged out of research in the 1980s on the role of coping strategies in chronic pain. In an early study, the tendency to “catastrophize” in response to pain was associated with poorer adjustment to chronic pain [1]. Since that time, pain catastrophizing, a cognitive style of coping that involves negative interpretations and predicted outcomes for pain sensations [2], has emerged as a consistent and robust predictor of adaptation to various forms of chronic pain. For example, a review of 41 studies found that perceived control over pain, catastrophizing, and perceived disability were consistently related to functioning across studies [3]. In another study, catastrophizing and other psychological coping styles explained 55% of the variance in disability level for patients with chronic headache or lower back pain, whereas pain severity or duration were not significantly related to subjective disability [4]. In a more recent review, researchers concluded that cognitive factors, including pain catastrophizing, predict pain-related distress and disability to a greater extent than medical status [5]. Elevated levels of pain catastrophizing are associated with poorer outcomes following lumbar spine surgery [6], spinal cord stimulation treatment [7], and post-surgical knee pain [8]. Even among healthy individuals, pain catastrophizing was a significant predictor of the number of pain sites reported after a laboratory pain induction procedure [9]. Additionally, pain catastrophizing is significantly associated with adjustment across a wide variety of chronic pain conditions, including back pain, arthritis and other degenerative conditions [6], fibromyalgia [10], postsurgical pain [8], knee pain [11], pelvic pain, and prostatitis [12], among others. Accordingly, catastrophizing can be

considered a transdiagnostic construct for conditions involving pain, rather than a disease-specific factor.

Pain catastrophizing is thought to be maladaptive because catastrophic misinterpretations in response to pain (i.e., imagining the worst possible outcomes) lead to fear of activity and subsequent avoidance. This in turn leads to deconditioning, which perpetuates a cycle of avoidance, increased pain, and distress [2,13]. The results of one study on physical activity supported this hypothesis by demonstrating that higher levels of pain catastrophizing were associated with increased sensitivity to physical activity, which mediated the relationship between catastrophizing and self-reported physical functioning among individuals with knee osteoarthritis [14]. In an experimental study utilizing a standardized pain induction procedure, findings indicated that pain catastrophizing significantly influenced pain perception, even at small increments of catastrophizing [15].

Importantly, catastrophic misinterpretations of pain and pain-related fear can be modified in treatment [16]. Comprehensive pain rehabilitation programs combine cognitive behavioral therapy (CBT) and physical reconditioning, and often incorporate opiate withdrawal. These integrated and multidisciplinary programs for chronic pain have been consistently supported by research as superior to less comprehensive modalities [5]. For example, the results of one study indicated that a 2-month comprehensive pain rehabilitation program with several weekly visits was superior to an exercise program alone in reducing fear of movement and catastrophic thinking, as well as improving quality of life [17]. Research also indicates that participation in an interdisciplinary pain rehabilitation program is associated with improvements in catastrophic thinking compared with wait-list controls [18], and that treatment gains in pain catastrophizing remain significant over time (e.g., at 6 months post treatment [19]).

The reduction of pain catastrophizing as a result of treatment modification is a proposed mechanism of chronic pain rehabilitation outcomes. One study found that improvement in pain catastrophizing was related to more successful outcomes from a comprehensive pain rehabilitation program [20], and that improvement in catastrophizing was a more important predictor of outcome than pain severity [21]. Further, in a study examining mechanisms across different treatment time points, researchers found that early reductions in pain helplessness, catastrophizing, and pain-related anxiety predicted later treatment improvement in pain, whereas reductions in the process variables were not accounted for by reductions in pain intensity [22]. This suggests that improvement in catastrophizing leads to improvement in pain and related outcomes, not vice versa.

In summary, a large body of research supports a strong relationship between pain catastrophizing and poorer outcomes for chronic pain patients, to an even greater

extent than perceived physical pain severity. Biopsychosocial approaches to pain, particularly in the context of multidisciplinary pain rehabilitation, can successfully modify catastrophic thinking and lead to improvements in adjustment and quality of life. The improvement in pain catastrophizing may account for a significant proportion of the variance in treatment outcomes. The purpose of the current study is to replicate and extend the findings of prior studies establishing a relationship between decreased pain catastrophizing and more successful treatment outcomes among a large sample ($N = 648$) of chronic pain patients who participated in a 3-week intensive outpatient chronic pain rehabilitation program. Specifically, it was hypothesized that pain catastrophizing would be a significant mediator of treatment outcomes, including pain interference and depressed mood.

Methods

Participants

Participants in this study included 847 adult patients with chronic pain who were admitted to the Mayo Clinic Comprehensive Pain Program from January 2013 to December 2014. Of those admitted, 648 patients completed the entire 3-week program and discharge survey, and were therefore included in the final sample. Participants included 456 women (70.4%) and 192 men (29.6%), who were on average 48.20 ($SD = 14.51$) years of age and with 14.93 ($SD = 2.73$) years of education. The majority of participants identified as Caucasian ($n = 613$; 94.6%) and married ($n = 431$; 66.5%). Concerning employment status, 484 (74.7%) reported that they were not employed, and of those, 179 (37.0%) were receiving either short-term employer disability or long-term social security disability.

Regarding diagnoses, the most common primary pain site¹ was reported to be generalized pain in both upper and lower extremities (joint/muscle/body/myofascial; $n = 82$), fibromyalgia ($n = 64$), back/spine ($n = 64$), headache/migraine ($n = 26$), lower extremity (foot/ankle/knee/hip; $n = 22$), abdominal ($n = 16$), neck/throat ($n = 14$), and upper extremity pain (shoulder/wrist/hand/elbow; $n = 13$). Patients reported an average pain duration of 11.09 ($SD = 10.49$) years. A large proportion of participants endorsed current use of opioid pain medicine ($n = 362$; 55.9%). Demographic and clinical data are provided in Table 1.

There were no group differences between patients who completed ($N = 648$) and did not complete ($N = 199$) the program/discharge survey for the following variables: age [$t(845) = -.87, P = .39$], gender [$\chi^2(1, N = 847) = 3.52, P = .06$], pain duration [$t(838) = -1.82, P = .07$], primary pain site [$\chi^2(4, N = 847) = 3.52, P = .06$], use

1 Based on 330 participants due to missing data. Data collection for this variable began at the end of 2013.

Table 1 Participant characteristics

	Frequency (%)	Mean (SD)
Age (years)		48.20 (14.51)
Education		14.93 (2.73)
Sex		
Female	456 (70.4)	
Male	192 (29.6)	
Race		
Caucasian	613 (94.6)	
African American	6 (0.9)	
Asian American	7 (1.1)	
Native American/Alaska Native	4 (0.6)	
Other	14 (2.2)	
Employment status		
Not currently employed	484 (74.7)	
Marital status		
Married	431 (66.5)	
Single	126 (19.4)	
Divorced	68 (10.5)	
Separated	12 (1.9)	
Widowed	11 (1.7)	
Primary pain site ^a		
Generalized joint/muscle/myofascial	82 (24.8)	
Back/spine	64 (19.4)	
Fibromyalgia	64 (19.4)	
Headache/migraine	26 (7.9)	
Lower extremity (foot/ankle/knee/hip)	22 (6.7)	
Other	72 (22.1)	
Current narcotic use	362 (55.9)	

^aBased on 330 participants.

of opioids [$\chi^2(1, N = 847) = .23, P = .63$], duration of opioid use [$t(468) = -1.26, P = .21$], disability status [$\chi^2(4, N = 847) = 6.83, P = .15$], or employment status, [$\chi^2(1, N = 847) = 1.06, P = .30$]. However, Caucasian [$\chi^2(1, N = 847) = 5.42, P = .02$] and married [$\chi^2(1, N = 847) = 6.93, P = .01$] participants were significantly more likely to complete the program.

Procedure

Patients completed questionnaire measures at admission and discharge to assess pain, functional ability, quality of life, depression, and pain catastrophizing. Patients in the study provided consent for their medical record data to be used for research purposes, and institutional review board (IRB) approval was obtained.

Intervention

The pain rehabilitation program involved an intensive outpatient program lasting 8 hours per day, 5 days per

week for 3 weeks. Patients were evaluated prior to admission to ensure that they were sufficiently physically and emotionally stable to participate (i.e., not requiring more acute medical or psychiatric hospitalization). The goal of this interdisciplinary program was to improve adaptation to pain and other associated somatic symptoms (e.g., nausea, fatigue), whereas reduction of pain was not emphasized. Patients enrolled in this program had typically attempted multiple unimodal prior treatments (e.g., surgical interventions, medication trials, interventional pain procedures, complementary and alternative approaches, etc.) with incomplete or unsatisfactory symptom relief. Participants received daily group-based CBT, psychoeducation about pain, instruction on pain self-management (e.g., reduction of pain behaviors, activity pacing), stress and mood management, biofeedback and relaxation training, occupational therapy (OT), and physical therapy (PT). Within CBT sessions, participants were encouraged to explore the connection between pain-related thoughts, emotions, and behaviors. Cognitive restructuring exercises provided skill practice in monitoring and modifying specific catastrophic thoughts. Participation in program activities also provided the opportunity for challenging catastrophic thinking; for example, engaging in physical exercises despite fears that doing so might exacerbate pain. Patient progress was monitored by an individually-assigned nurse care coordinator and biweekly patient rounds. Patients using opioids at admission also engaged in opioid withdrawal treatment, with a scheduled medication taper supervised by a clinical pharmacist. Patients using benzodiazepines, sleep medications, muscle relaxants, and nonopioid pain medications underwent a medication review. Reduction or discontinuation of these agents was part of their program goals as assessed on an individual basis.

Measures

Patient Information. Patient demographic data were collected via chart review and self-report questionnaires. Information obtained from the medical record included the following: medical diagnoses, primary pain site, and medications. Self-reported demographic variables included the following: age, gender, employment status, duration of chronic pain, educational history, and marital status. Opioid use was assessed based on the following self-report question: "Are you currently taking narcotic pain medicine for your chronic pain?" with a list of examples.

Center for Epidemiological Studies Depression Scale (CESD). The CESD [23] is a widely used measure of depressive symptoms among the general community and medically ill populations. The measure contains 20 items assessing symptoms of depression, several of which are reverse scored. Items are rated on a scale from 0 = "Rarely or none of the time" to 3 = "Most or all of the time." Results of psychometric investigations have yielded adequate to good internal consistency and test-retest reliability [24], and validity [25] across a variety of

patient and community samples. A cut-off score of 16 suggests the presence of a clinical level of depressive symptoms [23,26]. In the current sample, internal consistency (Cronbach's alpha) for the two time points ranged from .92–.93.

MOS 36-Item Short-Form Health Survey (SF-36). The SF-36 [27] is a measure of health-related quality of life across eight domains: general health perceptions, physical health functioning, mental health functioning, role functioning (emotional, physical), bodily pain, vitality, and social functioning. Items are rated on a Likert-type scale and transformed into percentages, with higher scores representing better quality of life in a given domain. Research suggests good psychometric properties for the measure, including strong convergence with clinical data [28]. Across subscales, internal consistency was adequate to good ($\alpha = .70-.89$).

Pain Catastrophizing Scale (PCS). The PCS [29] is a widely used measure of catastrophizing responses to pain. The measure consists of 13 items, rated on a Likert-type scale from 0 = "Not all the time" to 4 = "All the time." The PCS can be interpreted using a total score, and also yields three subscale scores: Rumination, Magnification, and Helplessness. The PCS has high internal consistency [29], and converges with higher levels of pain and disability [30]. A score of 30 is indicative of clinically elevated catastrophic thinking [29]. For the current study, internal consistency was high at both admission and discharge ($\alpha = .93-.94$).

West Haven-Yale Multidimensional Pain Inventory (MPI). The MPI [31] was developed to assess multiple domains of chronic pain, consistent with cognitive-behavioral models of pain. This measure contains 52 items and 3 distinct sections. The first section includes 5 subscales: pain severity, interference in life due to pain, perception of control over life, affective distress, and social support. Questions are rated on a Likert-type scale from 0–6, with anchors varying depending on the question (e.g., 0 = "Not at all severe," 6 = "Extremely severe"). The second section involves questions about others' responses to the individual, and the third section assesses activity engagement. Evaluations of the measure's psychometric properties have generally confirmed the original factor structure of the measure [32]. Research supports the validity of the measure, and internal consistency ranges from adequate to high [33]. For the current study, only the pain severity and interference subscales were used (pain severity $\alpha = .74-.81$; interference $\alpha = .85-.89$).

Results

Data Analytic Strategy

To evaluate the relationship between pain catastrophizing and related variables, correlational analyses were conducted using Pearson bivariate correlations for associations between continuous variables, and one-way

ANOVA analyses were used for categorical variables. Next, in order to assess the relationship between baseline characteristics and treatment outcomes, a series of mixed-model ANOVAs were conducted.

To test our main hypothesis that pain catastrophizing mediates treatment outcomes for pain interference and depressed mood, a within-subjects mediational approach was used. This analysis was conducted using the causal steps within-subjects mediational approach described by Judd and colleagues [34], a commonly used method for assessing mediation in repeated measures designs (e.g., [35–37]), and expanded upon by Montoya and Hayes's [38] method to estimate the direct and indirect effects. In this model, mediation means that the decrease in symptom severity (i.e., the effect of treatment on symptoms) is related to the corresponding decrease in pain catastrophizing (i.e., the effect of treatment on symptoms is associated with the effect of treatment on catastrophizing). For mediation to occur, the following criteria must be met: (1) a significant treatment effect for both pain catastrophizing (M) and symptom severity (Y) in the theoretically appropriate direction (i.e., both catastrophizing and symptoms improve over the course of treatment), and (2) the effect of treatment on symptom severity occurs through the change in the mediator (i.e., the indirect effect of X-M-Y, or path *ab*, is significant). In repeated measures models, the "X" variable denotes treatment and is represented by repeated measurements of the mediator and outcome variable (M and Y). In order to conduct this mediational analysis, differences scores are calculated for each of the mediators and the outcome variable and included in the model along with the centered means of the mediators [34]. The significance of the indirect was tested using a bootstrap estimation approach with 5000 samples, generating a 95% confidence interval. Analyses were performed using the MEMORE for SPSS Beta Release macro (©Montoya, 2015), and analyzed with IBM SPSS software version 22.0. For the current study, the hypothesized process variable (pain catastrophizing) was included in the mediational analysis along with a second mediator, pain severity. The purpose of including pain severity was to account for the relationship between decreased pain and treatment outcomes, demonstrating the significant mediating effect of pain catastrophizing over and above the effect of experiencing less intense pain.

Relationship Between Pain Catastrophizing, Mental Health Functioning, Physical Health Functioning, and Demographic Variables

Correlations Between Measures. In order to examine the relationship between pain catastrophizing and other chronic-pain relevant variables, Pearson bivariate correlations were conducted using survey data collected at admission. As expected based on prior research, results indicated that there was a significant positive correlation (all *P*'s < .01) between pain catastrophizing and depressed mood ($r = .53$), pain severity ($r = .38$), and interference in life due to pain ($r = .40$). Pain

Table 2 Correlations between baseline measures of catastrophizing, depression, pain, and quality of life

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. PCS	—	—	—	—	—	—	—	—	—	—	—
2. CESD	.53**	—	—	—	—	—	—	—	—	—	—
3. MPI-Pain Severity	.38**	.30**	—	—	—	—	—	—	—	—	—
4. MPI-Pain Interference	.40**	.41**	.49**	—	—	—	—	—	—	—	—
5. SF36-Phys. Function	-.07	-.13**	-.33**	-.38**	—	—	—	—	—	—	—
6. SF36-Role Physical	-.12**	-.26**	-.17**	-.31**	.23**	—	—	—	—	—	—
7. SF36-Pain	-.32**	-.36**	-.62**	-.55**	.43**	.33**	—	—	—	—	—
8. SF36-General Health	-.29**	-.34**	-.20**	-.28**	.14**	.17**	.20**	—	—	—	—
9. SF36-Vitality	-.35**	-.53**	-.25**	-.45**	.16**	.19**	.31**	.41**	—	—	—
10. SF36-Soc. Function	-.36**	-.49**	-.37**	-.64**	.27**	.37**	.55**	.26**	.45**	—	—
11. SF36-Role Emotional	-.40**	-.57**	-.19**	-.33**	.09*	.29**	.26**	.22**	.30**	.45**	—
12. SF36-Mental Health	-.59**	-.70**	-.25**	-.40**	.06	.21**	.26**	.34**	.53**	.46**	.58**

Note. PCS = Pain Catastrophizing Scale; CESD = Center for Epidemiological Studies Depression Scale; MPI = West Haven-Yale Multidimensional Pain Inventory; SF36 = MOS 36-Item Short-Form Health Survey. * $P < .05$; ** $P < .01$.

Table 3 Admission and discharge levels of catastrophizing, depression, pain, and quality of life

	Admission <i>M</i> (<i>SD</i>)	Discharge <i>M</i> (<i>SD</i>)	Statistical comparison (paired samples t-test)
1. PCS	25.94 (11.38)	14.03 (9.63)	$t(637) = 26.47^{***}$
2. CESD	26.50 (8.08)	20.68 (6.52)	$t(637) = 18.50^{***}$
3. MPI-Pain Severity	4.33 (.94)	3.23 (1.26)	$t(638) = 23.22^{***}$
4. MPI-Pain Interference	4.66 (.95)	3.52 (1.18)	$t(637) = 26.80^{***}$
5. SF36-Phys. Function	38.64 (23.71)	63.06 (24.60)	$t(644) = -30.58^{***}$
6. SF36-Role Physical	10.70 (23.53)	54.91 (39.65)	$t(644) = -26.20^{***}$
7. SF36-Pain	28.47 (16.96)	54.46 (19.85)	$t(643) = -29.26^{***}$
8. SF36-General Health	40.76 (20.50)	57.90 (20.01)	$t(644) = -24.48^{***}$
9. SF36-Vitality	22.12 (18.20)	51.72 (22.40)	$t(642) = -31.99^{***}$
10. SF36-Soc. Function	39.65 (25.99)	72.83 (23.10)	$t(643) = -28.91^{***}$
11. SF36-Role Emotional	38.36 (40.99)	71.72 (37.47)	$t(644) = -17.83^{***}$
12. SF36-Mental Health	53.40 (20.77)	72.98 (17.76)	$t(642) = -24.76^{***}$

Note. PCS = Pain Catastrophizing Scale; CESD = Center for Epidemiological Studies Depression Scale; MPI = West Haven-Yale Multidimensional Pain Inventory; SF36 = MOS 36-Item Short-Form Health Survey. *** $P < .001$. Author Queries

catastrophizing was significantly negatively correlated (all P 's $< .01$) with several quality of life domains (i.e., higher catastrophizing was related to decreased quality of life), including general health-related quality of life ($r = -.29$), physical pain ($r = -.32$), physical role functioning ($r = -.12$), emotional role functioning ($r = -.40$), vitality ($r = -.35$), social functioning ($r = -.36$), and mental health functioning ($r = -.59$). There was not a significant relationship between pain catastrophizing and perceived overall physical functioning ($r = -.07$, $P = .06$). Correlations among measures are presented in Table 2. Means and standard deviations at admission and discharge for all outcome measures are in Table 3.

Group Differences in Outcome Variables: Gender, Pain Condition, Employment Status, and Opioid Use. In order to determine whether there were baseline or treatment-related differences in catastrophizing between groups of

patients with chronic pain, a series of mixed-model ANOVA analyses were conducted. Regarding gender, results of a 2 (Group: male, female) \times 2 (Time: admission discharge) indicated that there was not a significant Group \times Time interaction, $F(1,636) = 3.34$, $P = .07$, or main effect of Group, $F(1,636) = 2.54$, $P = .11$, on pain catastrophizing. Similarly, there was not a significant Group \times Time interaction, $F(1,637) = 2.32$, $P = .13$, or main effect of Group, $F(1,637) = .45$, $P = .50$, on pain severity, and no significant Group \times Time interaction, $F(1,636) = 3.18$, $P = .08$, or main effect of Group, $F(1,636) = .63$, $P = .43$, on pain interference. There was a significant Group \times Time interaction for depressed mood, $F(1,636) = 10.05$, $P = .002$, which indicates that women reported increased depressive symptoms at baseline ($P = .001$). However, there were no significant differences between groups at discharge ($P = .74$).

In order to evaluate differences between groups related to chronic pain conditions, a 4 (Group: generalized pain, fibromyalgia, back/spine pain, headache/migraine) \times 2 (Time: admission, discharge) mixed-model ANOVA was conducted using the most commonly reported categories of primary pain site. Results indicated that there was no significant Group \times Time interaction, $F(3,227) = .38$, $P = .77$, or main effect of Group on pain catastrophizing, $F(3,227) = .15$, $P = .93$. Similarly, there was no significant Group \times Time interaction, $F(3,228) = .02$, $P = .995$, or main effect of Group, $F(3,228) = 1.51$, $P = .21$, for pain severity, no significant Group \times Time interaction, $F(3,227) = .35$, $P = .79$, or main effect of Group, $F(3,227) = .55$, $P = .65$, for pain interference, and no significant Group \times Time interaction, $F(3,227) = .88$, $P = .45$, or main effect of Group, $F(3,227) = .71$, $P = .55$, for depressed mood.

Employment status was also evaluated. Results of a 2 (Group: employed, unemployed) \times 2 (Time: admission, discharge) mixed-model ANOVA revealed no significant Group \times Time interaction, $F(1,636) = .06$, $P = .80$, or main effect of Group, $F(1,636) = .60$, $P = .44$, on employment status on pain catastrophizing. There was a main effect of Group for pain severity, $F(1,637) = 11.36$, $P < .001$, suggesting that participants who reported working for wages endorsed less severe pain compared with those who were not. However, there was no Group \times Time interaction, $F(1,637) = .33$, $P = .57$, suggesting no treatment-related differences between the two groups. A similar pattern was found for pain interference. A main effect of Group, $F(1,636) = 12.92$, $P < .001$, indicated that participants who were employed endorsed less pain-related interference overall; however, the absence of a Group \times Time interaction, $F(1,636) = .01$, $P = .91$, suggested that the two groups responded similarly to the treatment program. For depression, there was not a Group \times Time interaction, $F(1,636) = 1.49$, $P = .22$, or main effect of Group, $F(1,636) = 1.07$, $P = .30$.

Next, the results of a 2 (Group: opioid use, no opioid use) \times 2 (Time: admission, discharge) mixed-model ANOVA indicated that there was not a significant Group \times Time interaction, $F(1,639) = .164$, $P = .69$, or main effect of Group, $F(1,639) = 3.08$, $P = .08$, on pain catastrophizing, suggesting that opioid use was not associated with significantly different levels of pain catastrophizing at either time point. Similarly, there was not a significant Group \times Time interaction for pain severity, $F(1,640) = 1.570$, $P = .21$. A main effect of Group was present, $F(1,640) = 4.955$, $P = .03$, indicating that patients using opioids reported greater pain severity on admission ($P = .003$); however, there were no differences between groups on discharge ($P = .30$). For pain interference, there was not a significant Group \times Time interaction, $F(1,639) = .012$, $P = .91$, nor main effect of Group, $F(1,639) = 3.521$, $P = .06$. Finally, there was no relationship between opioid use and depression scores, as indicated by a nonsignificant Group \times Time interaction, $F(1,639) = .225$, $P = .64$, and no main effect of Group, $F(1,639) = 1.226$, $P = .27$. In summary,

these analyses suggest no baseline differences between participants for pain catastrophizing, pain interference, or depressed mood, and no treatment outcome-related differences for any of the dependent variables when comparing opioid use groups.

Pain Catastrophizing as a Mediator of Treatment Outcome

Pain Interference. First, results indicated that participation in the rehabilitation program was associated with a significant total treatment effect for pain interference (c pathway), $b = 1.156$, $SE = .043$, $P < .001$. Next, the indirect effect (ab pathway) was significant overall, $b = .709$, $SE = .049$, 95% CI = .612, .806, and individually for both pain catastrophizing (ab^1), $b = .396$, $SE = .048$, 95% CI = .302, .492, and pain severity (ab^2), $b = .313$, $SE = .046$, 95% CI = .224, .406. These findings support the mediational hypothesis; furthermore, pain catastrophizing was a significant mediator beyond the effect of pain severity. After including the mediator variables, the direct effect (c' pathway) remained significant, which is consistent with partial mediation, $b = .447$, $SE = .053$, $P < .001$. See Figure 1.²

Depression. As above, there was a significant total treatment effect for depression (c pathway), $b = 5.805$, $SE = .312$, $P < .001$. The indirect effect (ab pathway) was also significant, $b = 4.970$, $SE = .356$, 95% CI = 4.276, 5.688. Furthermore, the indirect effect for each individual indirect pathway was significant: pain catastrophizing (ab^1), $b = 3.406$, $SE = .368$, 95% CI = 2.73, 4.151, and pain severity (ab^2), $b = 1.564$, $SE = .313$, 95% CI = .940, 2.187. This indicates the presence of mediation by pain catastrophizing and severity, and further supports the mediational effect of pain catastrophizing beyond what can be accounted for by decreased pain. However, as before, the direct effect (c' pathway) remained significant, suggesting partial mediation, $b = .836$, $SE = .405$, $P = .040$. See Figure 2.

Discussion

The purpose of the current study was to evaluate the role of pain catastrophizing in treatment outcomes for a large sample of patients ($N = 648$) who participated in an intensive 3-week multidisciplinary pain rehabilitation program. Consistent with previous research, results of this study demonstrated a significant relationship between pain catastrophizing and other factors adversely related to functioning with chronic pain, including greater depressed mood, decreased mental and physical health-related quality of life, and higher pain severity and life interference. Furthermore, results indicated that participation in a

- Given the high correlation between depression and pain catastrophizing, this analysis was also conducted entering depression as a third mediator. Adding depression did not change the significance of the direct or indirect effects of catastrophizing or pain severity in the model.

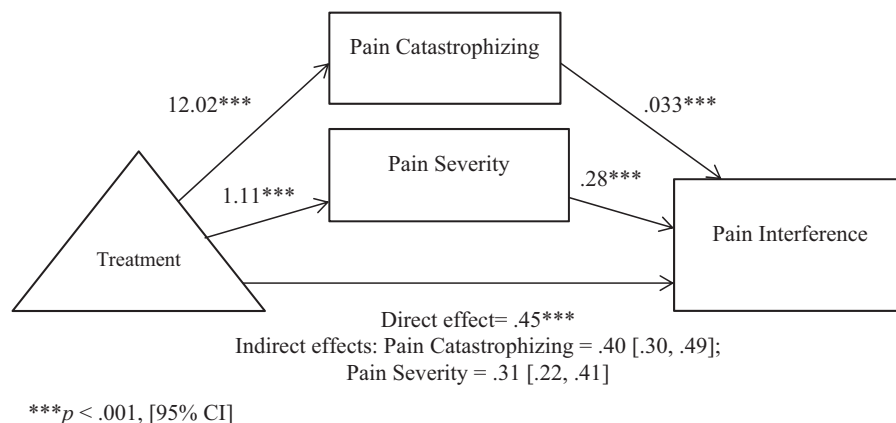


Figure 1 Within-subjects mediation of treatment outcomes for reduced pain interference by reductions in pain catastrophizing and pain severity.

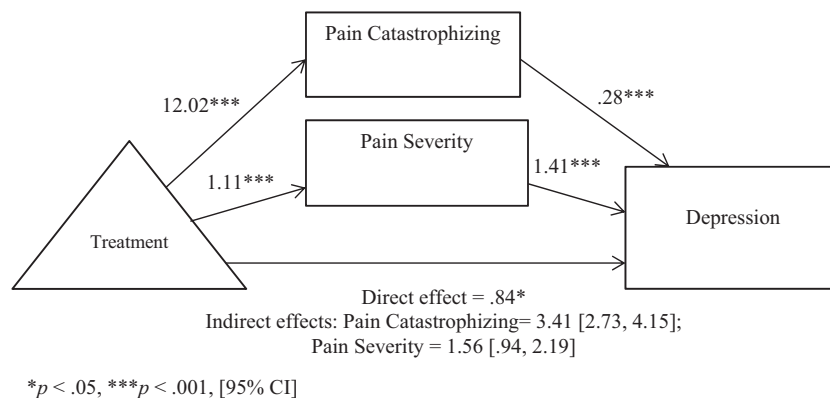


Figure 2 Within-subjects mediation of treatment outcomes for reduced depression by reductions in pain catastrophizing and pain severity.

comprehensive rehabilitation program resulted in significant decreases in pain catastrophizing, and that this decrease was a significant partial mediator of the corresponding improvement in treatment outcomes (i.e., pain interference and depressed mood) upon program completion. The current findings underscore the important role of pain catastrophizing in treatment outcomes for patients with chronic pain, particularly given that the decrease in pain catastrophizing was related to decreased pain-related interference and depressed mood beyond that accounted for by improvements in the intensity of pain.

The research literature on chronic pain indicates that cognitive variables, including pain catastrophizing, predict pain-related distress and disability to a larger extent than medical factors [5]. Accordingly, targeting cognitive contributions to coping with pain is an important aspect of pain rehabilitation. This is further supported by research indicating that various biopsychosocial treatment approaches (e.g., physical therapy, CBT, multidisciplinary programs) are associated with improvements in pain catastrophizing,

and that pain catastrophizing is a significant mediator of pain-related treatment outcomes [20–22,39]. The results of the current study add support to this previous body of research by replicating these relationships in a significantly larger sample of chronic pain patients. Furthermore, given the poor functional status, long pain duration, and high prevalence of opioid use of patients in this sample, the current study strengthens the findings of prior research emphasizing the importance of pain catastrophizing in patient outcomes. Methods for restructuring maladaptive cognitions with chronic pain patients are described in detail in several clinical textbooks and therapy protocols [40–42]. The results of our study highlight the importance of disseminating these methods in order to improve evidence-based care for chronic pain.

Regarding the magnitude of improvement in pain catastrophizing, prior research has suggested that clinically meaningful change for this measure ranges between 30% and 60% [43]. The results of one study, for example, found that reductions in pain catastrophizing of

37–44% were associated with better outcomes for pain severity and returning to work after treatment [43]. Given that patients in the current sample reported an average decrease in catastrophizing of 54%, outcomes for pain catastrophizing in this study are consistent with successful treatment outcomes for other chronic pain treatment programs described in the literature.

Despite the strengths of the current study, several limitations caution the interpretation of these findings. First, the within-subjects meditational approach utilized does not establish causal direction (i.e., that pain catastrophizing produces change in pain outcomes, rather than the opposite). However, the proposed direction is consistent with theory and prior research establishing that changes in catastrophizing precede changes in pain and related outcomes [22]. It would be beneficial for future researchers to study this treatment process variable by adding a mid-treatment assessment point. Furthermore, because this treatment program included a variety of different components, it is unclear which aspect of treatment (i.e., cognitive challenging of catastrophic thoughts, daily physical therapy, education about pain, etc.) was associated with the decrease in pain catastrophizing. Prior research indicates that at longer-term follow-up, treatment gains for pain catastrophizing remain significant from baseline, although slightly diminished compared with outcomes at discharge [19]. Thus, a limitation of the current study is that there was not a longer-term assessment point, making it impossible to establish the durability of improvements of catastrophizing in our sample.

Another limitation of this study is that the data collected were primarily self reported, and were not compared against objective measures of functioning. Reliance on self-reported data to categorize patients based on opioid use is a less reliable method of establishing use compared with urine drug screen or medication review methods, and this could have impacted our findings that there were few group differences based on opioid use status. However, our findings are consistent with prior research using a similar sample that also did not find an association between pain catastrophizing and opioid use status [19]. In addition, the ethnic and socioeconomic diversity in the current sample was low, consisting primarily of Caucasian patients with at least some college education, which limits the generalizability of these findings to other samples of chronic pain patients. Although prior studies have investigated the construct of pain catastrophizing across a variety of diverse groups [44], the research on treatment outcomes for pain catastrophizing among individuals of varying socioeconomic, cultural, and racial/ethnic background is limited. The finding in the current study that participants in minority groups were less likely to complete the program highlights the importance of this research, as increasing the cultural competence, program availability, and retention efforts in pain rehabilitation programs may be needed.

In addition, an important limitation in the current study is that 23.5% of patients who enrolled in the pain

rehabilitation program did not complete either the program or discharge survey, and were not included in the final sample. Although there were few differences between program completers and noncompleters in baseline characteristics, with the notable exceptions of racial/ethnic identification and marital status, it is unknown whether the results of this study extend to those who did not complete the program. Further, the reasons why some patients did not complete the program are unknown; therefore, we are limited in our ability to assess feasibility or acceptability of the intervention in the current study. Additionally, there was no available data on the number of patients admitted to the program compared with those who were referred to the program. This potentially limits the representativeness of the current sample to a broader chronic pain population who may have elected not to participate in a rehabilitation approach to pain management, and warrants consideration of possible selection bias. An important topic of future study is to determine factors associated with not enrolling in or completing the rehabilitation program.

Interdisciplinary rehabilitation programs for chronic pain that combine CBT with physical reconditioning and medical approaches have been consistently supported by the research as leading to superior treatment outcomes for patients with chronic pain [5]. Unfortunately, these programs have been replaced over time by more procedure-oriented (e.g., injections) interventions [5]. The results of the current study provide additional support for the treatment benefit of one such comprehensive rehabilitation program. Additional research should continue to explore best treatment approaches for chronic pain, and how important mediating factors such as pain catastrophizing impact patient outcomes.

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