

## Psychosocial factors and adjustment to chronic pain in spinal cord injury: Replication and cross-validation

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**Abstract**—Recent studies have documented the importance of psychological factors in the experience of chronic pain in persons with spinal cord injury (SCI). The current study sought to replicate and extend previous work demonstrating associations among specific pain-related beliefs, coping, mental health, and pain outcomes in persons with SCI. A return-by-mail survey assessing psychological functioning and pain was completed by 130 individuals with SCI. Measures included short forms of the Survey of Pain Attitudes and the Chronic Pain Coping Inventory. After factor analysis, multiple regression was used to predict pain outcomes (psychological functioning and pain interference) after controlling for pain intensity. Results indicated that psychological factors, particularly beliefs about pain (including catastrophizing) and pain-related coping strategies (including passive coping), were significant predictors of pain outcomes and accounted for 21% to 25% of unique variance. Zero-order correlations suggested that the specific variables most closely associated with negative pain outcomes were perception of oneself as disabled, perceptions of low control over pain, and tendency to catastrophize. In general, negative attributions and coping were stronger predictors of pain adjustment than were positive ones. Results highlight the importance of psychological factors in understanding chronic pain in persons with SCI and provide further support for the biopsychosocial model.

**Key words:** adjustment, attributions, biopsychosocial model, catastrophizing, chronic pain, coping, CPCI, pain interference, rehabilitation, SOPA, spinal cord injury.

## INTRODUCTION

Spinal cord injury (SCI) is commonly associated with a number of chronic pain problems, including musculo-skeletal pain [1], paresthesias (abnormal sensations such as burning or prickling), dysesthesias (unpleasant sensations produced by touch), and allodynia (painful sensations that result from stimuli that do not normally cause pain) [2–6]. Recent evidence suggests that the vast majority of patients with SCI report chronic painful sensations and that as many as 26 percent of these report the pain as severe [5,7]. Research also indicates that pain associated with SCI tends to worsen, rather than improve, over time [8–9] and that most treatments for SCI-related pain are rated as only “somewhat” helpful by those who have tried them [10].

**Abbreviations:** BPI = Brief Pain Inventory, CPCI = Chronic Pain Coping Inventory, CSQ = Coping Strategies Questionnaire, CSQ-1 = CSQ 1-item version, IRB = Institutional Review Board, PCA = principal components analysis, SCI = spinal cord injury, SD = standard deviation, SF-36 = 36-item Short Form Health Survey, SOPA = Survey of Pain Attitudes.

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Although medical factors such as the level and the completeness of SCI are important in the experience of SCI-related pain, most researchers now believe that pain in SCI is best understood from a biopsychosocial perspective. Biopsychosocial models of pain consider the biological, psychological, and social variables that contribute to pain and the inherent feedback that occurs among those variables over time [11]. Furthermore, when compared with simple biological models of pain, biopsychosocial models have demonstrated a better ability to predict pain and behavioral responses to chronic pain [12]. Three key psychosocial variables emphasized in the biopsychosocial model are cognitions/appraisals, coping responses, and social environment. All these variables have demonstrated significant relationships with indices of physical and psychological functioning in a number of chronic pain populations [13–16].

With regard to cognitions/appraisals and coping responses, a great deal of empirical research has focused on catastrophizing, which is characterized by unrealistic and excessively negative self-statements in response to pain (e.g., labeling pain sensations as awful, horrible, and unbearable) [17]. In studies involving individuals with chronic pain, catastrophizing has been related to a variety of negative outcomes, including greater pain intensity and pain interference, poorer psychological functioning, and increased use of analgesics and healthcare services [18–23]. Alternately, changes in pain beliefs, including decreases in catastrophizing, have been shown to be associated with decreases in self-reported patient disability, pain intensity, and depression at 6- and 12-month follow-ups [24]. Specifically in persons with SCI, catastrophizing emerges as a strong and independent predictor of a variety of outcome measures (e.g., greater pain intensity, disability, and psychological distress), even when controlling for level of physical impairment and other pain-related variables [25–27].

In addition to catastrophizing, research has identified a number of specific pain beliefs and coping strategies that are related to poorer functioning in samples of populations with either chronic or SCI-related pain. For example, studies using the Survey of Pain Attitudes (SOPA) [28] have found that certain key beliefs are associated with greater levels of pain interference, physical disability, and psychosocial dysfunction [28–29]. These beliefs include that one is unable to function because of pain, that pain is an indication of physical damage and activities should be avoided, that medications are suitable for treating chronic pain, that a medical cure exists for pain, that emotions influence pain, and that others should offer assistance in response to pain

behaviors [28–29]. Similarly, research suggests that patients who believe that outcomes are controlled by external chance factors (e.g., fate, luck) tend to rely on maladaptive pain coping strategies and exhibit greater levels of psychological distress [30], while patients who perceive having control over their pain often demonstrate better mental health, have less disability and pain interference, and engage in more active coping responses [30–33].

In terms of coping responses, a consistent finding in the literature is that resting in response to pain, an approach that helps healing after acute pain from injury, can lead to increases in pain severity, increases in pain interference, and greater disability over time (i.e., when pain becomes chronic) [20,22,28,33–34]. These outcomes are hypothesized to result in part from the muscle atrophy and decreased tolerance for activities that occur as a consequence of pain-contingent resting [35]. In persons with SCI, similar outcomes have been found for responses such as “guarding” (limiting activity in painful body parts) and asking for assistance in response to pain [29]. Coping responses that tend to result in better functional outcomes and lower pain intensity in SCI and chronic pain populations include task persistence, distraction, and positive self-talk [15,29,33,36].

Social relationships and social support also play important roles in the experience and expression of chronic or disability-related pain. For example, perceived social support may serve as a protective factor against pain intensity, depressed mood, and decreased activity levels [22,37–39]. Similarly, in a sample of persons with SCI, greater perceived social support was associated with better mental health and lower levels of pain interference [29]. Not all types of support, however, are beneficial. Solicitous responding by significant others (e.g., offering sympathy, offering assistance, or taking over a task in response to a patient’s pain behaviors) has been linked to greater patient pain intensity and interference, increased pain behaviors and depression, and greater disability in patients who were more depressed [16,20,22,40]. These types of responses from others, while well-intentioned, tend to reinforce pain and disability behaviors in patients and may unintentionally impede their progress [11,35], whereas responses that are provided unconditionally (i.e., not contingent on pain behavior) may result in adaptive patient behaviors that are not pain- or disability-focused [20]. Given that persons with SCI often rely on significant others for a large portion of their physical care, further research is needed to elucidate the relationship between social support and the experience of pain in this population.

Although a substantial body of literature supports the aforementioned links between psychosocial factors and adjustment to pain in a variety of disability populations, much remains unknown about these relationships in persons with SCI. In one recent study from our research group, Raichle and colleagues demonstrated that psychological elements such as catastrophizing, perception of poor control over pain, and a sense of oneself as disabled predicted mental health and pain interference outcomes even after they controlled for pain severity [29]. These data require replication and extension.

In addition, the psychosocial variables identified in disability-related pain studies have traditionally been assessed with validated, but often lengthy, measures. Because individuals with physical disabilities such as SCI may be confronted with a variety of barriers to completing these questionnaires (e.g., numerous medical or therapy appointments, physical limitations, difficulties with communication), the use of abbreviated or shortened measures appears warranted; however, little research has examined how short forms of such measures function in samples of persons with SCI.

The present study replicated and extended previous associations found among various psychosocial predictors and adjustment to chronic pain in persons with SCI by using validated measures of pain-related beliefs and coping. In particular, we were interested in replicating earlier findings from our research group [29] by using shortened measures of pain-related coping and cognitions/appraisals in a new (orthogonal) sample. On the basis of previous findings, we hypothesized that—

1. Psychosocial factors such as cognitions/appraisals and coping responses would be significant predictors of pain outcomes after we controlled for pain severity.
2. “Negative” psychological factors, such as catastrophizing, would be stronger predictors of pain outcomes than would “positive” factors, such as use of reassuring coping self-statements or task persistence.

## METHODS

### Participants

Participants in this study were 130 adults with SCI who completed a postal survey asking about SCI-related pain, coping efforts, comorbid health problems, and overall quality of life and who reported ongoing chronic pain problems. The procedure was approved by the University

of Washington Institutional Review Board (IRB), and informed consent was obtained from each participant. Previous data from this survey concerning the frequency and impact of the pain in the sample have previously been reported [41]. However, our data are completely exclusive and separate from those analyzed by Raichle et al. [29].

The participants were primarily Caucasian (89.5%) men (71.5%) and an average of 10.1 years from their injury (standard deviation [SD] = 10.0 years). They ranged in age from 18 to 82 (mean = 45), and the majority reported completing at least a high school education (95.4%). Regarding employment, 43.8 percent reported being unemployed because of disability, while only 29.2 percent reported either full- or part-time employment. Complete SCI was reported by 35.4 percent, and the most common levels of injury were at the fifth to seventh cervical (approximately 25%) and tenth thoracic to first lumbar (approximately 20%). Demographic and clinical variables for these participants are reported in **Table 1**.

## Measures

### *Demographics*

Participants provided information regarding age, race/ethnicity, educational level, and employment status. They also answered questions regarding their SCI, including time since injury, cause of injury, and injury level.

### *Pain Intensity*

Average pain intensity (for the past week) was assessed using a standard 11-point numerical rating scale ranging from 0 (“no pain”) to 10 (“pain as bad as could be”). This approach is widely used in the pain literature [42] and has been shown to correlate with other measures of pain intensity [43].

### *Pain Interference*

For measurement of pain-related impairment, participants completed a modified version of the Pain Interference Scale taken from the Brief Pain Inventory (BPI) [44]. This BPI scale assesses the degree to which pain interferes with seven activities of daily living: general activity, mood, household work, getting around, sleep, enjoyment of life, and relationships with other people. For this study, three additional items measuring pain interference with self-care, recreational activities, and social activities were added. Participants were asked to rate pain interference on an 11-point numeric rating scale ranging from 0 (“does not interfere”) to 10 (“completely

**Table 1.**  
Demographic and clinical data of spinal cord injury (SCI) sample.

Variable	Mean ± SD	n	%
Age	45.0 ± 14.4	130	—
Average Pain (last week)*	5.3 ± 2.6	130	—
Sex			
Male	—	93	71.5
Female	—	37	28.5
Marital Status			
Single	—	36	27.7
Married	—	66	50.7
Divorced/Widowed	—	28	21.5
Education			
<12th Grade	—	6	4.6
High School or GED	—	34	26.1
Voc/Tech School	—	11	8.5
Some College	—	38	29.2
College Graduate	—	41	31.6
Employment Status†			
Full-Time	—	26	20.0
Part-Time	—	12	9.2
Retired	—	24	18.5
Unemployed			
Because of Pain	—	20	15.4
Because of Disability	—	57	43.8
Level of Injury†			
C1–C8	—	118	90.7
T1–T12	—	105	80.8
L1–L5	—	35	26.9
S1–S5	—	5	4.8
Injury Status			
Complete	—	46	35.4
Incomplete	—	68	52.3
Does Not Know	—	16	12.3
Cause of SCI			
Gunshot Wound	—	6	4.6
Fall	—	17	13.1
Motor Vehicle Accident	—	59	45.4
Sport Accident	—	19	14.6
Other	—	29	22.3

\*Assessed using 11-point numerical rating scale ranging from 0 (“no pain”) to 10 (“pain as bad as could be”).

†Represents nonorthogonal groups.

C = cervical, GED = general equivalency diploma, L = lumbar, S = sacral, SD = standard deviation, T = thoracic, Voc/Tech = vocational/technical.

interferes”). The original 7-item BPI has shown acceptable reliability and validity in several disease states [45]. The 10-item version used here demonstrated strong internal consistency (Cronbach  $\alpha = 0.96$ ) based on a single factor structure and has been shown to relate to subjective pain ratings in individuals with disability [46].

#### *Pain-Related Beliefs*

Pain-related beliefs were assessed with a short form (14-item version) of the SOPA [47]. This short form assesses seven scales (of two items each): Control (belief in one’s own control over pain), Disability (beliefs that one is unable to function because of pain), Harm (belief that pain is an indication of physical damage and that activities that cause pain should be avoided), Emotion (belief that emotions influence pain), Medication (belief that medications are suitable for treating chronic pain), Solicitude (belief that others should provide assistance in response to pain behaviors), and Medical Cure (belief that a medical cure exists for one’s chronic pain). Scale anchors range from 0 (“this is very untrue for me”) to 4 (“this is very true for me”). The 14 items were taken from the original 57-item version of the SOPA [28] and have demonstrated strong psychometric properties as 2-item subscales, including a high degree of correlation with the full version [47].

#### *Pain-Related Coping*

Strategies for coping with chronic pain were assessed with six items taken from the short form (1-item version) of the Chronic Pain Coping Inventory (CPCI) [34,47]. These items assessed six strategies commonly used to manage chronic pain: Guarding, Resting, Asking for Assistance, Relaxation, Task Persistence, Seeking Social Support, and Coping Self-Statements.

Participants were asked to describe how many days in the past week they used each strategy to manage pain. Items included “Asked for help with a chore or task” (Asking for Assistance), “Got support from a friend” (Seeking Social Support), and “Told myself the pain will get better” (Coping Self-Statements). The validity of the short form (1-item version) of the CPCI has previously been established through correlation with the subscales of the original 65-item version as well as association with measures of pain and pain-related function [34,47].

Pacing, or the ability to manage pain by breaking larger tasks into manageable pieces, was assessed with five items taken from the Activity Pacing Scale [48]. The

Activity Pacing Scale was originally designed to be an add-on subscale to the CPCI [48] and has demonstrated strong psychometric properties in patients with chronic pain, including reliability (Cronbach  $\alpha = 0.91$ ) and validity through moderate to high associations with other CPCI subscales (0.79–0.85) [48]. The five items used in the present study asked participants how many days in the past week they used pacing strategies, including “I broke up tasks into manageable pieces so I could still get a lot done despite pain” and “I paced my activities by going ‘slow but steady.’”

### *Psychological Functioning*

Current global psychological functioning was assessed with the five-item 36-item Short Form Health Survey (SF-36) Mental Health scale [49]. This measure is widely used in survey research literature and has demonstrated excellent psychometric properties, including high internal consistency and test-retest stability [49]. Criterion validity has also been established through association with other measures of mental health. The five items of the Mental Health scale are summed and recoded to range from 0 to 100, with higher scores indicating better psychological functioning.

### *Catastrophizing*

The tendency to catastrophize was assessed with the Catastrophizing subscale of the Coping Strategies Questionnaire (CSQ) 1-item version (CSQ-1) [47,50]. The original Catastrophizing subscale of the CSQ has demonstrated excellent internal consistency in numerous populations [19,51–53]. The CSQ-1 used in the present study has been validated as a measure of catastrophizing through associations with the parent scale (CSQ;  $r = 0.74$ – $0.83$ ) [47] and with theoretically related constructs such as depression ( $r = 0.47$ ) [47]. The single item asked participants to rate the extent to which they endorse the following statement when in pain: “It is terrible and I feel it is never going to get any better.” Response anchors ranged from 0 (“never do that”) to 6 (“always do that”).

### **Procedures**

A survey that included the study measures was mailed to 426 individuals identified through a combination of sources, including study brochures and flyers, physician referrals, and the mailing list of the Northwest Regional Spinal Cord Injury System, a service-delivery model system funded in part by the National Institute on Disability and Rehabilitation Research. Although a subset (223) of these individuals had also responded to a previ-

ous survey of chronic pain problems in persons with SCI [54–55], none of the participants in the present study were included in the sample described by Raichle et al. [29].

Of the 426 surveys mailed, 163 were returned, yielding a response rate of 38.3 percent. All participants signed an informed consent document approved by the University of Washington IRB and were paid \$25 for participation. Of the 163 individuals who returned the survey, 33 reported experiencing no problems with pain in the past 3 months and were excluded in subsequent analyses, yielding a final  $n$  of 130.

### **Data Screening**

Before analysis, frequencies of missing data were examined and the distributions of all study variables were checked for skew and kurtosis. Regarding missing data, no variable was missing more than 3 percent of scores, with the exception of the CPCI Guarding subscale, which was missing 16 percent ( $n = 109/130$ ). On closer examination, we realized that the wording of this item (“Limited my standing time”) would not apply to participants without lower-limb mobility. For this reason, we decided to delete the Guarding subscale from further analysis. Regarding normality, all variables demonstrated acceptable distributions for analysis (absolute values of skew  $< 1.0$ , kurtosis  $< 2.0$ ).

### **Analytic Plan**

Since our intent was to cross-validate and replicate previous work from our group that looked at psychosocial predictors of mental health and pain interference in persons with SCI, we followed the analytic plan presented in Raichle et al. [29] as closely as possible. Consistent with this earlier work, we first performed principal components analyses (PCAs) by using a Varimax rotation on the SOPA and CPCI subscales (including the Activity Pacing subscale) as a means of reducing the number of predictor variables. The number of components was established using the scree plot and Kaiser criterion (i.e., eigenvalues  $> 1.0$ ) [56]. We then performed two multiple linear regressions to evaluate the effect of the predictor variables (factors from the SOPA, factors from the CPCI, Catastrophizing) on each of the outcome variables (mental health, pain interference). Because coping responses and pain beliefs are influenced by the severity of the pain problem, we also included pain intensity in the previous week as a control in all the regression analyses.

After we determined significance of the block with only psychosocial variables, we computed zero-order bivariate correlations between all the CPCI and SOPA subscales and the criterion variables. Significance for this

last step was evaluated at  $p < 0.003$  (i.e., using a Bonferroni correction to account for the large number of variables in the correlation matrix).

## RESULTS

### Demographics and Pain Characteristics

Demographic and SCI-related descriptive information are presented in **Table 1**. Consistent with previous data [29,41], 130 of 163 participants (79%) in this study reported chronic pain associated with SCI. Of the 130 reporting pain problems, 41 percent reported chronic "mild" pain (i.e., 1–4), 22 percent reported chronic "moderate" pain (i.e., 5–6), and 36 percent reported chronic "severe" pain (i.e., 7–10). The most common sites of pain were the shoulder (44%), the lower back (46%), and the legs (37%). Average pain intensity in the past week was 5.3 (SD = 2.6) and average pain interference was 3.3 (SD = 2.6).

### Factor Analysis

The PCA of the CPCI subscales (Resting, Asking for Assistance, Relaxation, Task Persistence, Seeking Social Support, Coping Self-Statements, and Pacing) evidenced two underlying factors accounting for 61.1 percent of the variance in coping (eigenvalues = 2.8, 1.5, 0.74, 0.58, 0.53, 0.47, 0.40). Three CPCI subscales loaded on the first factor: Resting (0.67), Asking for Assistance (0.83), and Seeking Social Support (0.63). Two CPCI subscales clearly loaded on the second factor: Pacing (0.76) and Coping Self-Statements (0.73). Relaxation (0.43 and 0.65) and Task Persistence (–0.59 and 0.57) loaded equally on both factors. According to item content, the first factor was labeled "Passive Coping" and the second, "Self-management Coping." Factor loadings for the CPCI are presented in **Table 2**.

The PCA of the SOPA subscales revealed three underlying factors accounting for 63.1 percent of the variance in pain beliefs (eigenvalues = 1.9, 1.4, 1.0, 0.76, 0.70, 0.60, 0.52). Three subscales loaded on the first factor: Control (–0.87), Disability (0.64), and Harm (0.71). The second factor also contained three subscales: Emotion (0.80), Medication (0.60), and Solicitude (0.75). The third factor contained only one subscale, Medical Cure (0.93). Based on item content, the first factor was labeled "Disability Conviction," the second was labeled "Emotion and Solicitude Beliefs," and the third was labeled "Belief in Cure." Factor loadings for the SOPA are presented in **Table 3**.

### Association Among Psychosocial Variables and Psychological Functioning

A hierarchical linear regression, including average pain intensity in the past week (block 1) and SOPA factors 1 to 3, CPCI factors 1 to 2, and Catastrophizing (block 2), was used to predict SF-36 Mental Health scores. The overall model was significant ( $F(7,118) = 7.9, p < 0.001$ ). In block 1, pain intensity was a significant predictor ( $\beta = -0.33, p < 0.001$ ) and accounted for 11 percent of the variance in the SF-36 Mental Health score. Psychosocial variables (i.e., SOPA and CPCI factors and Catastrophizing) accounted for an additional 21 percent of the variance in the SF-36 Mental Health score ( $F\Delta = 6.13, p < 0.001$ ). However, the only psychosocial variables to make significant independent contributions were SOPA factor 1 (Disability Conviction:  $\beta = -0.30, p < 0.01$ ) and Catastrophizing ( $\beta = -0.31, p < 0.01$ ). These results are presented in **Table 4**.

**Table 2.**

Varimax-rotated factor loadings following principal components analysis of Chronic Pain Coping Inventory (CPCI).

CPCI Subscale	Factor 1	Factor 2
Resting	<b>0.67</b>	0.32
Asking for Assistance	<b>0.83</b>	0.03
Seeking Social Support	<b>0.63</b>	0.37
Coping Self-Statements	0.30	<b>0.73</b>
Pacing	0.04	<b>0.76</b>
Relaxation	0.43	0.65
Task Persistence	–0.59	0.57
Eigenvalue	2.8	1.5
% Variance Explained	40.0	21.1

**Table 3.**

Varimax-rotated factor loadings following principal components analysis of Survey of Pain Attitudes (SOPA).

SOPA Subscale	Factor 1	Factor 2	Factor 3
Control	<b>–0.87</b>	–0.07	–0.11
Disability	<b>0.64</b>	0.22	–0.37
Harm	<b>0.71</b>	–0.06	–0.01
Emotion	–0.14	<b>0.80</b>	0.01
Medication	0.31	<b>0.60</b>	0.26
Solicitude	0.09	<b>0.75</b>	–0.07
Medical Cure	–0.02	0.07	<b>0.93</b>
Eigenvalue	1.9	1.4	1.0
% Variance Explained	28.0	20.4	14.7

**Table 4.**Regression model predicting SF-36 Mental Health score ( $n = 125$ ).

Variable	$\beta$	$t$	$p$ -Value	$R^2\Delta$	$F(R^2\Delta)$	$p$ -Value
Block 1				0.11	12.86	<0.001
Pain Intensity	-0.33	-3.86	<0.001			
Block 2				0.21	6.13	<0.001
CPCI Factor 1: Passive Coping	0.03	0.35	NS			
CPCI Factor 2: Self-Management Coping	-0.09	-1.00	NS			
SOPA Factor 1: Disability Conviction	-0.30	-2.48	<0.01			
SOPA Factor 2: Emotion and Solicitude Beliefs	-0.14	-1.56	NS			
SOPA Factor 3: Belief in Cure	0.08	1.00	NS			
Catastrophizing	-0.31	-3.00	<0.01			

Note: Overall model:  $F(7,118) = 7.9, p < 0.001$ .

CPCI = Chronic Pain Coping Inventory, NS = not significant, SF-36 = 36-item Short Form Health Survey, SOPA = Survey of Pain Attitudes.

To better understand the unique relationships among psychosocial variables and psychological functioning and to replicate previous methodology, we also computed zero-order correlations among Catastrophizing, the SOPA and CPCI subscales, and the SF-36 Mental Health scale. The correlation matrix is presented in **Table 5**. Briefly, significant correlates of SF-36 Mental Health were the Control ( $r = 0.46$ ) and Disability subscales of the SOPA ( $r = -0.43$ ) and Catastrophizing ( $r = -0.49$ ) (all  $p < 0.003$ ).

### Association Among Psychosocial Variables and Pain Interference

Next, a hierarchical linear regression including average pain intensity in the past week (block 1) and SOPA factors 1 to 3, CPCI factors 1 to 2, and catastrophizing (block 2) was used to predict pain interference (BPI mean score). The overall model was significant ( $F(7,118) = 29.2, p < 0.001$ ) and accounted for 64 percent of the variance in pain interference. In block 1, pain intensity was a significant predictor ( $\beta = 0.62, p < 0.001$ ) and accounted for 39 percent of total variance. Psychosocial variables (i.e., SOPA and CPCI factors and catastrophizing) accounted for an additional 25 percent of the variance in pain interference ( $F\Delta = 13.31, p < 0.001$ ). Only CPCI factor 1 (Passive Coping;  $\beta = 0.36, p < 0.001$ ) and Catastrophizing ( $\beta = 0.17, p < 0.05$ ) were independently significantly associated with the outcome after we controlled for pain intensity. These results are presented in **Table 6**.

The correlation matrix describing zero-order relationships among SOPA and CPCI subscales, the Catastrophizing scale, and pain interference are presented in the **Table 5**. Significant correlates of BPI pain interfer-

ence were the Control ( $r = -0.46$ ), Harm ( $r = 0.36$ ), and Disability ( $r = 0.56$ ) subscales of the SOPA; the Resting ( $r = 0.37$ ), Asking for Assistance ( $r = 0.48$ ), and Task Persistence ( $r = -0.43$ ) subscales of the CPCI; and the Catastrophizing scale ( $r = 0.49$ ) (all  $p < 0.003$ ).

**Table 5.**

Zero-order correlation matrix of coping, beliefs, mental health, and pain interference.

Beliefs/Coping	Outcome Measures ( $r$ )	
	SF-36 Mental Health	Brief Pain Inventory
SOPA Subscales		
Control	0.46*	-0.46*
Disability	-0.43*	0.56*
Harm	-0.19	0.36*
Emotion	-0.21	0.17
Medication	-0.10	0.20
Solicitude	-0.17	0.24
Medical Cure	0.10	-0.12
CPCI Subscales		
Pacing	0.04	0.02
Resting	-0.05	0.37*
Asking for Assistance	-0.20	0.48*
Relaxation	-0.12	0.19
Task Persistence	0.22	-0.43*
Seeking Social Support	0.01	0.23
Coping Self-Statements	-0.02	0.14
Catastrophizing	-0.49*	0.49*

\* $p < 0.003$  (0.05/15 after Bonferroni correction).

CPCI = Chronic Pain Coping Inventory, SF-36 = 36-item Short Form Health Survey, SOPA = Survey of Pain Attitudes.

**Table 6.**  
Regression model predicting pain interference (Brief Pain Inventory score) ( $n = 125$ ).

Variable	$\beta$	$t$ -Value	$p$ -Value	$R^2\Delta$	$F(R^2\Delta)$	$p$ -Value
Block 1				0.39	77.88	<0.001
Pain Intensity	0.62	8.82	<0.001			
Block 2				0.25	13.31	<0.001
CPCI Factor 1: Passive Coping	0.36	5.4	<0.001			
CPCI Factor 2: Self-management Coping	0.02	0.36	NS			
SOPA Factor 1: Disability Conviction	0.14	1.5	NS			
SOPA Factor 2: Emotion and Solicitude Beliefs	0.03	0.41	NS			
SOPA Factor 3: Belief in Cure	-0.14	-2.4	<0.05			
Catastrophizing	0.17	2.2	<0.05			

Note: Overall model:  $F(7,118) = 29.2, p < 0.001$ .

CPCI = Chronic Pain Coping Inventory, NS = not significant, SOPA = Survey of Pain Attitudes.

## DISCUSSION

The present study replicated and extended prior research describing the relative importance of psychosocial factors in SCI pain. As an important secondary aim, we included shortened measures of pain appraisals/cognitions and coping responses to determine their utility for research testing biopsychosocial models of pain.

In general, many similarities are noted between our findings and those of Raichle et al. [29]. With regard to pain location, the two most common pain sites were identical in both studies, with the shoulders and lower back being the most frequently reported sites of pain by the participants. Furthermore, the percentages of participants reporting mild (41%), moderate (22%), and severe (36%) levels of pain intensity in the present study were comparable to those reported in the Raichle et al. [29] sample (36%, 31%, and 32%, respectively). In the current study, however, a greater percentage of participants reported mild pain and severe pain, while a smaller percentage reported moderate pain. The average pain intensity reported by participants during the past week was also nearly identical in both studies (5.3 vs 5.1).

The PCA of the CPCI revealed two underlying factors that accounted for 61 percent of the variance in coping—Passive Coping (Resting, Asking for Assistance, Seeking Social Support) and Self-Management Coping (Pacing, Coping Self-Statements); Relaxation and Task Persistence loaded equally on both factors. Overall, these findings are comparable to Raichle et al. [29], but some minor variations existed as a result of methodology and sample differences between the two studies. For exam-

ple, in the previous study, Guarding loaded on the first factor, labeled Passive Coping. In the present study, we decided not to use the Guarding subscale because the responses dealt primarily with standing and a large subset of our sample did not respond to this item.

Similarly, many parallels existed between the PCA of the SOPA in the present study and in Raichle et al. [29]. The most notable difference was that in the present study, the PCA of the SOPA revealed three factors (Disability Conviction, Emotion and Solicitude Beliefs, and Belief in Cure), while only two factors emerged in Raichle et al.'s analyses (Pain as Illness Beliefs and Emotion and Solicitude Beliefs) [29]. Interestingly, the Medical Cure scale score in the original SOPA loaded on the Pain as Illness Beliefs in Raichle et al. [29] but remained a single independent factor in the current study.

In terms of predictors of psychological functioning, pain intensity explained a significant and almost identical amount of the variance in both studies (11% current study, 10% Raichle et al. [29]). Although psychosocial variables predicted less of the amount of the variance in the present study (21%) than in Raichle et al. (43%) [29], one must keep in mind that the previous study included measures of social support not included in the present study. In both the present study and in Raichle et al. [29], catastrophizing emerged as a significant independent predictor of psychological functioning, which underscores the important role that this cognition/belief plays in SCI pain.

Similar patterns of results also were observed between the two studies with regard to the zero-order correlations between CPCI and SOPA subscales, Catastrophizing, and the SF-36 Mental Health scale scores. Specifically, higher

scores on Control and lower scores on Disability and Catastrophizing were significantly related to better mental health in both samples. The main difference between the two studies is that in the Raichle et al. sample [29], higher scores on Task Persistence and lower scores on Harm, Emotion, and Solicitude were all significantly related to better mental health, while these relationships were not significant in the present sample.

Consistent with our findings predicting psychological functioning, pain intensity was a significant predictor of pain interference and explained 39 percent of the variance in that outcome, which is again almost identical to Raichle et al.'s finding that pain intensity predicted 41 percent of the variance in pain interference [29]. After we controlled for pain intensity, psychosocial variables in the present sample accounted for an additional 25 percent of the variance in pain interference, which mirrors the results in the previous sample (31%). Passive Coping (from the CPCI) and Catastrophizing also emerged as significant independent predictors of pain interference in both samples, whereas only the Raichle et al. study [29] evidenced a significant independent association between the SOPA (the Pain as Illness factor) and pain interference. Zero-order correlations between the psychosocial variables also were consistent across the two studies, with higher scores on Control and Task Persistence significantly related to less pain interference and higher scores on Disability, Harm, Resting, Asking for Assistance, and Catastrophizing significantly related to greater pain interference.

Notably, and consistent with one of our study hypotheses, negative beliefs and coping variables, such as Disability and Catastrophizing, had stronger relationships with the pain interference and mental health outcomes in both studies than did the positive beliefs and coping variables, such as Control or Task Persistence.

### Limitations and Future Directions

Although these data are consistent with previous observations linking psychosocial factors to pain outcomes, several important methodological limitations of the study should be considered. All our data were based on an essentially self-selected sample (i.e., those who chose to return surveys), which introduces the possibility that our participants were not representative of persons with SCI as a whole. The fact that these data were taken from surveys completed in private also introduces the possibility that

social desirability or other response biases could have influenced results. Most importantly, the cross-sectional nature of these analyses precludes us from making causal statements regarding the relationships among variables. For example, psychological functioning possibly drives or influences beliefs about one's own pain and influences coping, rather than the other way around. In any case, we have attempted to present these data in a way that is conceptually parsimonious and consistent with data from other samples. Longitudinal and experimental studies are needed that can help clarify the causal relationships among the key variables in biopsychosocial models.

Another set of limitations comes in the fact that we did not measure some important variables, such as pain type or opioid medication use. Persons with SCI may experience a broad range of pain types at multiple locations, and certain strategies may be more or less adaptive for different types of pain. Resting, for example, may be more detrimental to pain outcomes if pain is primarily musculoskeletal rather than neuropathic. Future studies should assess these pain outcomes with greater specificity. Similarly, analgesic medication use may be a primary and common attempt to manage pain in these individuals and should be included in future studies.

### Clinical Implications

The most important implication of these results is that treatments attempting to decrease suffering in persons with SCI pain should focus on psychosocial factors as well as on pain intensity. Statistically speaking, psychosocial factors were, on average, as important in predicting pain interference and mental health outcomes as was severity (i.e., the pain intensity) of the pain problem. In particular, negative/maladaptive coping strategies and beliefs appear to be critical targets in decreasing suffering associated with SCI pain. These negative strategies include catastrophic thinking, a perception of oneself as disabled by pain, and tendencies to rest and ask for assistance in response to pain. Cognitive-behavioral and operant models of psychotherapy for chronic pain target these areas directly and should be considered in treatment planning.

### CONCLUSIONS

Results from this study replicate previous work indicating that psychological factors are significantly associated with a greater impact of pain in persons with SCI.

Specifically, perception of oneself as disabled, perception of low control over pain, and a tendency to catastrophize pain were all associated with greater pain-related impairment. These results highlight the importance of psychological factors in understanding chronic pain in persons with SCI and provide further support for the biopsychosocial model.

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