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Cognitions, Coping and Social Environment Predict Adjustment to Pain in Spinal Cord Injury

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Abstract

The current study examined the utility of a biopsychosocial model of chronic pain, and the associations between specific pain-related beliefs, coping, and social support and both mental health and pain interference, in persons with Spinal Cord Injury (SCI) and pain. A total of 157 patients completed surveys assessing physical and psychological functioning, as well as psychosocial, demographic, and injury-related variables. Greater catastrophizing and pain-related beliefs (e.g., the belief that pain signals damage) were related with increased pain interference and poorer mental health, while coping styles (e.g., resting, asking for assistance) were related only with pain interference. Alternatively, greater perceived social support was related with better mental health. The findings are consistent with a biopsychosocial model, implicating the need to consider the impact of process and clinical variables on adjustment to chronic pain in persons with SCI.

Perspective: This article identifies several psychosocial variables, including coping, catastrophizing, pain-related beliefs, and social support, that are related to adjustment in persons with SCI and pain. These results have implications for interventions designed to treat pain interference in persons with SCI.

Keywords

mental health; coping; spinal cord injury; pain

Pain following spinal cord injury (SCI) is well-documented, with prevalence rates from 11% to 94%, and reports of ‘current’ pain problems between 67% to 79%. Pain in persons with SCI has been found to interfere with daily activities beyond the functional limitations related to the injury 47,52,60,69,70. A recent survey found that participants with SCI-related pain rated only a few pharmacological pain treatments as more than “somewhat” helpful 76.

These issues highlight the importance of identifying psychosocial variables related to adjustment and pain interference in persons with SCI-related pain. Biopsychosocial models of pain recognize the likely impact of both biological and psychosocial components. The most common psychosocial categories within the biopsychosocial model (i.e., cognitions and appraisals, coping responses, and social environmental variables 50) have evidenced

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substantial associations with functional limitations in a variety of populations of persons with pain 17,18,33,54.

Of particular interest is catastrophizing (unrealistic and negative self-evaluations in response to pain), which has been associated with increased pain intensity, disability, and poor mental health in several pain populations 24,31,37,56,58, and linked with greater use of analgesics³⁰ and health care services²³. Catastrophizing has also been shown to be significantly related to psychological distress and pain interference in persons with SCI. 73 Studies have identified a number of interpersonal correlates of catastrophizing, including solicitousness 8,21, instrumental social support 44, and punishing responses⁵, suggesting that catastrophizing responses may play an important role in interpersonal functioning be understood within the context of social relationships. 63,67

Numerous studies have examined the impact of social relationships upon morbidity and mortality 4,29 and upon responses to pain 1,15,26. Perceived social support appears to buffer against pain intensity, depressed mood, and decreased involvement in activities for various populations with acute and chronic pain 1,15,24,26,31. Alternatively, solicitous responding (offering sympathy or aid in response to pain behaviors), has been related to greater pain-related disability in persons who are more depressed⁵⁴, increased pain interference and depression^{24,31}, and increased pain behaviors and pain intensity⁷⁷. Thus, the nature of social support on patient functioning may depend upon the circumstance and type of support offered.

Regarding pain-related beliefs, perceived control over pain (beliefs that one has the resources or ability to control or manage pain or its impact), has been a consistent predictor of mental health, disability, pain interference, and coping behavior for persons with chronic pain 11,33, 66,72. Specifically, relatively higher perceptions of control over pain are related to engagement in more active behavioral coping responses²⁵. However, we lack an understanding of perceived control as it relates to pain interference and adjustment in individuals with SCI.

Coping responses to pain, including resting, distraction from pain, task persistence, and positive self-talk have been shown to impact adjustment, disability, and pain intensity 6,33,72. Fordyce¹⁹ proposed that pain-contingent resting contributes to muscle atrophy, decreased tolerance for activities, and disability, which is supported by a positive association between pain-contingent resting and pain intensity and pain interference for several chronic pain populations 31,39,72. No studies have examined the potential impact of coping responses on adjustment or pain interference in individuals with SCI.

The current study seeks to examine the use of a biopsychosocial model to understand and treat pain in persons with SCI. Specifically, we hypothesize that several psychosocial variables, including beliefs/appraisals, coping responses, and different indices of social support, will be uniquely related with mental health and pain interference in persons with SCI and pain, beyond demographic and clinical variables.

Materials and Methods

Participants

Participants in this study were persons with spinal cord injury (SCI) participating in an ongoing survey of the nature and scope of pain in persons with SCI. Questionnaires were mailed to 341 individuals, and each questionnaire included a consent form and a cover letter inviting recipients to participate in the study. Subjects were paid \$25 for completing and returning the consent forms and survey. If surveys were incomplete or any responses were unclear, research staff called participants to clarify their answers. The study procedures were approved by the University of Washington Human Subjects review Committee. An additional 10 completed

surveys (of the 341 surveys sent) were received since the original report³², thus updated demographic and SCI-related information are reported. Of the 341 questionnaires mailed, 189 (55%) were returned. Of these 189 surveys, 23 were returned because the subject was no longer at the address on record, 5 were returned with a note indicating that the subject was deceased, 2 were ineligible to participate in the study, and 2 were returned with a note indicating that the patient declined participation. The survey return-rate was 50% (157 completed questionnaires divided by the number of surveys sent, and excluding patients who were no longer at their previous address or who were deceased). Participants in the present analyses included the 127 individuals (80.9% of the sample) who reported that they were experiencing a current pain problem or had experienced pain in the past three months.

In this sample, 92 (72.4%) of the participants were men, and 35 (27.6%) were women. Regarding level of injury, 58 (45.7%) were injured at the cervical level, while the remaining were injured at the thoracic or lower (67; 52.7%) (data on level of injury were missing for two study participants). The mean age of the study subjects was 48.5 years (standard deviation, SD = 11.7; range = 21 – 79). There was a large amount of variability in the number of years since SCI (range, 1.3 to 57.4 years; SD=10.6; mean = 16.6). Additional demographic and SCI-related descriptive information for the 127 survey respondents included in the current analyses are presented in Table 1.

Data from the current dataset have already been, or will be, reported, yet represent meaningfully different aspects of the data. Specifically, these papers focus on the prevalence, course and treatment of pain problems in persons with SCI and pain (e.g., psychological functioning)³², the utility of different pain treatments for persons with SCI⁷, and the psychometric properties of pain-interference measures in persons with SCI⁵¹.

Measures

Demographic information—The survey questionnaire assessed the following demographic variables: age, gender, education level, ethnicity, marital status, and employment status. The survey also assessed a number of SCI-related variables, including level, completeness, and cause of SCI.

Pain intensity—Survey respondents were asked to indicate the presence or absence of any recent pain problems using the following question: “Are you currently experiencing, or have you in the past three months experienced, any pain (other than occasional headaches or menstrual cramps)?” Respondents who answered “yes” to this question were included in the current study. They were then asked to rate the average intensity of this pain during the past week on a 0 – 10 numerical rating scale, with 0 = “No pain” and 10 = “Pain as bad as could be,” serving as the pain intensity measure to be included in the current analyses. Such 0 – 10 scales have demonstrated their validity and reliability as measures of pain by their strong association with other measures of pain intensity and stability over time³⁸.

Pain interference—Pain interference, one of the two criterion variables in the current study, was assessed using a modified version of the Brief Pain Inventory pain interference scale (BPI) 10,12. The original version of this scale asks respondents to rate the degree to which pain interferes with 7 daily activities, including general activity, mood, walking ability, normal work, relations with other people, sleep, and enjoyment of life, on a scale from 0 – 10 (“does not interfere” to “completely interferes”). All of the items are totaled and averaged, yielding a total scale score ranging between 0-10, with higher scores on this measure indicating greater pain interference. As in previous studies where we used this scale for assessing pain interference in persons with disabilities^{24,74} we modified the BPI in two ways. First, we changed item 3 (“Walking ability”) to read “Mobility, that is, your ability to get around,” to

be more appropriate for the participants in the current study, many of whom cannot walk. Second, we added three items to assess interference of pain with self-care, recreational activities, and social activities, to obtain a broader-based assessment of areas that could potentially be affected by pain. The BPI has demonstrated validity through its strong association to pain intensity across a number of different populations^{12,74} and the modified 10-item version of this scale has demonstrated high levels of internal consistency (Cronbach's $\alpha = .89$) and validity through its strong association with pain intensity in samples of persons with disabilities^{12,74}. The mean and standard deviation of the BPI interference scale in our sample is reported in Table 2.

Mental health—Mental health served as the second criterion variable in this study, and was assessed with the five-item SF-36 Mental Health scale⁷⁵. All study participants completed this measure (i.e., both those reporting and those not reporting a pain problem). This commonly used measure has demonstrated reliability, as shown by high internal consistency coefficients (0.81 – 0.95) and test-retest stability coefficients (0.75 – 0.80)⁷⁵. Its validity as a measure of mental health is supported by its association with other measures of mental health⁷⁵. The SF-36 Mental Health scale items are scored with a possible range of 0 to 100, with higher scores indicating better mental health. The mean and standard deviation of the SF-36 Mental Health scale in our sample is reported in Table 2.

Pain cognitions—Pain-related cognitions were assessed using the Survey of Pain Attitudes (SOPA)³⁹. The SOPA includes the following 7 subscales which measure the extent to which an individual holds certain beliefs about pain: Control (belief in one's own control over pain), Disability (belief that one is unable to function because of pain), Harm (belief that pain is an indication of damage and that activities should be avoided), Emotion (belief that emotions influence pain), Medication, (belief that medications are suitable for treating chronic pain), Solicitude (belief that others should offer assistance in response to pain behaviors), and Medical Cure (belief that there exists a medical cure for one's pain). Items are rated on a scale from 0 - 4 (“this is very untrue for me” to “this is very true for me.”) The subscale score is the mean of all subscale items. The SOPA has demonstrated good test-retest stability, internal consistency, and criterion validity^{33,61}. Means and standard deviations of the SOPA scales in our sample are reported in Table 2.

Catastrophizing—The Coping Strategies Questionnaire (CSQ)⁵⁶ measures the extent to which seven types of coping strategies are utilized in response to chronic pain. The seven subscales include Diverting Attention, Reinterpreting Pain Sensations, Ignoring Pain, Praying and Hoping, Coping Self-Statements, Increasing Behavioral Activities, and Catastrophizing. For the purposes of the current study (primarily to limit subject assessment burden), we considered only the 6-item Catastrophizing scale of the CSQ, which assesses the frequency of pain catastrophizing cognitions (e.g., “It is terrible and I feel it is never going to get any better.”), with higher scores indicating more frequent catastrophizing in response to pain. Frequency of catastrophizing is rated on a scale from 0 – 6 (“never do” to “always do that”). The subscale score is the mean of all 6 items. The Catastrophizing scale of the CSQ has demonstrated excellent internal consistency reliability and validity in numerous studies^{3,22,27,42,43,55}. Moreover, its validity is evidenced by a number of associations with measures of psychosocial dysfunction and depression^{20,34,45,62}. The mean and standard deviation of the CSQ Catastrophizing scale in our sample is reported in Table 2.

Coping—Coping with pain was assessed using items from the original Chronic Pain Coping Inventory⁴⁰ that assess eight specific coping responses to pain (resting, task persistence, guarding, asking for assistance, relaxation, coping self-statements, exercise/strength, and seeking social support), as well as an additional set of items that assess pacing⁴⁹. The frequency

of these coping strategies is measured by the total number of days that the strategy was used in the past week (0-7). The subscale score is the mean of all of the subscale items. These scales have demonstrated validity through significant correlations in the expected directions with measures of depression and adjustment to pain, as well as through significant correlations between patient and significant other versions of the scales^{40,49}. The mean and standard deviation of the CPCI scales in our sample are reported in Table 2.

Social environmental factors—Two social environmental factors were assessed: solicitous responses of a significant other (family member or friend with whom the participant spends the most time, usually the spouse) and perceived social support. Solicitous responses were assessed using the 6-item Solicitous Responses scale of the West Haven-Yale Multidimensional Pain Inventory (WHYMPI)⁴⁶. This scale assesses the frequency with which someone close to the respondent provides solicitous responses (e.g., “Gets me to rest,” and “Takes over my jobs or duties”) when the respondent is experiencing pain, on a scale from 0 – 6 (“never” to “very often”). It has shown adequate internal consistency (Cronbach's alpha = .78) and excellent test-retest stability over a two-week interval ($r = .89$)⁴⁶. Validity of the Solicitous Responses scale has been shown through its positive association with observed spouse solicitous behaviors⁵³. The mean and standard deviation of the WHYMPI Solicitous Responding scale in our sample is reported in Table 2.

Perceived social support was assessed with the 12-item Multidimensional Scale of Perceived Social Support (MSPSS)⁷⁸, which can be scored to measure perceived support from family, friends, and a significant other, or global perceived support (e.g., “There is a special person around when I am in need.”). The items are rated on a scale from 1- 7 (“very strongly disagree” to “very strongly agree”). The total MSPSS score assessing global perceived social support was used in the current study. Internal consistencies of the subscales and total scale are all excellent (Cronbach's alphas = .85 to .91), and the scales have demonstrated strong test-retest stability over a two- to three-month interval ($r = .72$ to $.85$)⁷⁸. Validity of the total MSPSS scale has been demonstrated through its significant (negative) association with depression⁷⁸. The mean and standard deviation of the MSPSS scale in our sample is reported in Table 2.

Data Analyses

The distributions of all study variables were examined and none were significantly skewed, thus meeting necessary assumptions for the subsequent statistical analyses performed. Correlation coefficients between the predictors were computed to examine multicollinearity. The results of these analyses indicated minimal overlap among the predictors; the largest coefficient was 0.54, indicating that no more than 29% of the variance was shared among the predictors, well below the level indicative of a significant problem with multicollinearity⁶⁴ (see Table 3). Bivariate correlation, t-test, and regression analyses were conducted to examine the extent to which demographic characteristics (i.e., age, education, sex, marital status), pain ratings (e.g., pain intensity in previous week on a scale from 0-10), and SCI-related variables (e.g., level of injury, completeness of spinal cord injury) were related with the outcome variables of interest, mental health and pain interference. Preliminary analyses demonstrated that none of the demographic variables or SCI-related variables was significantly related with the outcome variables of interest ($p > .10$). Therefore, these variables were not included in the main regression analyses. However, pain intensity in the previous week evidenced a significant positive correlation with pain interference ($r = .63, p < .01$) and significant negative correlation with mental health ($r = -.31, p < .01$), thus pain intensity was included in all subsequent regression analyses.

In light of the current sample size and the number of other predictors in subsequent regression equations, the subscale scores of the CPCI and SOPA were subjected to principal components

analyses (PCAs) as a means of reducing the number of predictor variables. PCA was chosen over a number of different possible analyses, as this solution maximizes variance extracted by orthogonal components⁶⁴. Varimax rotation, an orthogonal technique, was chosen in order to maximize the variance of the loadings within the components and across variables, thus simplifying and aiding in the interpretability of the underlying components⁶⁴. We used the scree test and the Kaiser criterion⁴¹ to determine the number of components.

The PCA of the CPCI subscales showed evidence for two underlying components that accounted for 58% of the variance in coping (CPCI scores; eigenvalues = 4.0, 1.3, .79, .67, .57, .54, .43, .41, & .32). Five CPCI scale scores loaded on the first component, including Guarding (component loading = .75), Resting (.73), Asking for Assistance (.73), Coping Self-Statements (.60), and Seeking Social Support (.77). Three scale scores loaded on the second component, including Task Persistence (.74), Exercise/Strength (.67), and Pacing (.63). Relaxation loaded almost equally on the first and second components (.54 and .55, respectively). The first and second components were termed Passive Coping and Proactive Coping, respectively. These two component scores were used in all subsequent regression analyses.

The PCA of the SOPA subscales showed evidence for two underlying components that accounted for 56% of the variance in coping (SOPA scores; eigenvalues = 2.5, 1.4, .87, .69, .62, .50, & .39). Four SOPA scale scores loaded on the first component, including Disability (component loading = .70), Harm (.69), Medication (.69), and Medical Cure (.57). Three scale scores loaded on the second component, including Emotion (.86), Solicitude (.73), and Control (.34). The first and second components were termed Pain as Illness Beliefs, and Emotion and Solicitude Beliefs, respectively. These two component scores were used in all subsequent regression analyses.

Primary statistics included multiple linear regressions and bivariate correlation analyses to examine the associations between the psychosocial variables and outcome variables of interest (pain interference and mental health). Both types of analyses were implemented to both reduce the number of predictor variables in our regression analyses and comment on the specific types of coping responses that are related to the outcome variables of interest, respectively. We have utilized this combination of analyses in previous studies^{37,72}.

Included in the regression analyses were the component scores for the CPCI and SOPA, representing coping and pain beliefs, as well as social support and solicitous responses of significant others in response to pain. Pain intensity was entered first in the regression equations to control for its effect. We examined the relationships between specific psychosocial variables, including each subscale of the CPCI and SOPA scales, and our primary outcome variables of interest (pain interference and mental health) in the correlation analyses. Due to the large number of correlations performed (19 psychosocial predictor variables per criterion measure), we used a Bonferroni correction for each criterion measure ($.05/19 = .0026$) to determine whether each association was significantly different from zero.

Results

Pain Characteristics

Among survey respondents reporting pain, the most common pain sites were shoulder (61.4%) and lower back (57.5%). On average, the 127 participants included in the analyses reported a moderate level of pain intensity in the past week (5.10 on the 0 – 10 NRS, according to studies of pain intensity classification)^{35,57}. Forty-six (36.2%) reported mild pain (1-4 on the 0 – 10 scale), 39 (30.7%) reported moderate pain (5-6 on the 0 – 10 scale), and 40 (31.5%) reported severe pain (7 – 10 on the 0 – 10 scale). Two respondents (1.6%) reported that they had

experienced a pain problem in the past three months but reported a pain intensity of 0 during the past week. On average participants reported a pain interference level of 3.53 (SD = 2.62, range = 0-9.4 on a scale from 0-10) according to the Interference subscale of the BPI. The mean Mental Health score was 69.39 (SD = 18.98, range = 20-100, on a scale from 0-100).

Study Question 1: Association Between Psychosocial Variables and Mental Health

Two regression analyses were conducted to predict mental health. Because of the nature of the WHYMPI Solicitous scale, which requests information about a significant other's responses to pain, and the fact that many participants (34%) did not have a primary caretaker or significant other, many participants did not complete the WHYMPI Solicitous scale. This greatly reduces the number of participants available for analyses that include the WHYMPI. Therefore, analyses were conducted both with the WHYMPI Solicitous scale (in order to identify the unique contribution of this construct to the prediction of the criterion measures), and again without the WHYMPI Solicitous scale in order to increase the number of participants included in, and the power of, the analyses.

In the model predicting mental health, including the WHYMPI, pain intensity explained 14% of the variance in the criterion ($p < .01$). The psychosocial scales as a whole accounted for an additional 46% of the variance in mental health after controlling for pain intensity. The only psychosocial scales to make significant, independent contributions to the explanation of variance in SF-36 Mental Health scale scores were perceived social support, as measured by the MSPSS, and the Emotions and Solitude component. Specifically, greater perceived social support was significantly associated with better mental health ($\beta = .30, p < .01$), while higher scores on Emotions and Solitude beliefs were associated with poorer mental health ($\beta = -.30, p < .01$).

The results of the regression analyses predicting mental health, excluding the WHYMPI Solicitous scale, are shown in Table 4. Analyses conducted without the WHYMPI Solicitous scale yielded similar findings and afforded the inclusion of an additional 34 participants in the analyses. Pain intensity explained 9% of the variance ($p < .01$) in the criterion. The psychosocial variables, taken as a whole, accounted for an additional 43% of the variance in SF-36 Mental Health scale scores after adjusting for pain intensity. Similar to the regression analysis that included the WHYMPI Solicitous scale, scores on the MSPSS scale and the Emotions and Solitude Beliefs component remained statistically significant independent predictors of variance in mental health scores ($\beta_s = .26$ and $-.26$, respectively, $ps < .01$). Again, greater levels of perceived social support were associated with better mental health, while greater levels of Emotions and Solitude beliefs were associated with poorer mental health. The main difference between the analyses with and without the WHYMPI was that, without the WHYMPI, catastrophizing emerged as a significant independent predictor of mental health. Greater catastrophizing was associated with poorer mental health ($\beta_s = -.30, p < .01$).

The use of component scores in the present analyses limits our ability to ascertain the unique relationships between specific beliefs and coping strategies and our outcome variables (mental health and pain interference). However, using component scores was necessary to limit the number of factors in the regression equations, in light of the current sample size. It may also be difficult to replicate these findings with additional populations, as it is possible that the CPCI and SOPA components are unique to this sample. Thus, zero-order correlation coefficients between the process variables (coping and beliefs) and outcome variables of interest will be discussed and are presented in Table 5.

The results of the univariate analyses revealed a number of significant relationships between the psychosocial variables and mental health (see Table 5). The only CPCI subscale significantly related with mental health included Task Persistence, such that greater task

persistence was related with greater mental health ($r = .33, p < .0026$). A number of SOPA subscales were significantly and inversely related with mental health, such that participants endorsing greater beliefs that one is unable to function because of pain (Disability), that pain is an indication of damage and that activities should be avoided (Harm), that emotions influence pain (Emotion), and that others should offer assistance in response to pain behaviors (Solicitude) were each related with poorer mental health ($r_s = -.55, -.28, -.34, \text{ and } -.41$, respectively, all $p_s < .0026$), while those endorsing greater belief in one's own control over pain (Control) was significantly related with better mental health ($r = .33, p < .0026$). Finally, catastrophizing (CSQ) was related with poorer mental health ($r = -.58, p < .0026$), while self-reported social support (MSPSS) was related with better mental health ($r = .46, p < .0026$). The remaining subscales of the CPCI and the SOPA, as well as the WHYMPI, were unrelated to mental health.

Study Question 2: Association Between Psychosocial Variables and Pain Interference

In the model predicting pain interference, including the WHYMPI Solicitous scale, pain intensity explained 41% of the variance ($p < .01$) in BPI pain interference scores. However, the psychosocial variables as a whole accounted for an additional 33% of the variance in pain interference scores after controlling for pain intensity. In addition, several psychosocial variables made significant, independent contributions to the variance in pain interference. Greater scores on Pain as Illness Beliefs, Passive Coping, and catastrophizing each predicted greater pain interference ($\beta = .27, .27, \text{ \& } .23$, respectively; $p_s < .01$).

The results of the regression analyses examining the impact of psychosocial variables upon pain interference, excluding the WHYMPI, are shown in Table 6. Analyses conducted without the WHYMPI yielded similar findings and afforded the inclusion of 31 additional participants in the analyses. Pain intensity explained 41% of the variance in pain interference ($p < .01$), and the psychosocial scales taken as a whole accounted for an additional 31% of the variance in interference scores after adjusting for pain intensity. The pattern of results in the regression analyses that did and did not include the WHYMPI Solicitous scale was the same. Greater scores on Pain as Illness Beliefs, Passive Coping, and the CSQ Catastrophizing scale significantly and independently predicted greater pain interference ($\beta_s = .20, .33, \text{ \& } .23$, respectively; all $p_s < .01$).

The results of the univariate analyses revealed a number of significant relationships between the psychosocial variables and pain interference, shown in Table 5. Several CPCI subscales were positively related with pain interference, such that participants who reported using guarding, resting, asking for assistance, and pacing also reported higher levels of pain interference ($r_s = .45, .43, .37, \text{ and } .28$, respectively, all $p_s < .0026$), while those who reported engaging in greater task persistence evidenced significantly lower levels of pain interference ($r = -.36, p < .0026$). Most SOPA subscales were significantly and positively related with pain interference, such that participants endorsing greater beliefs that one is unable to function because of pain (Disability), that pain is an indication of damage and that activities should be avoided (Harm), that medications are suitable for treating chronic pain (Medication), that there exists a medical cure for one's pain (Medical Cure), and that others should offer assistance in response to pain behaviors (Solicitude) evidenced significantly greater levels of pain interference ($r_s = .72, .32, .35, .30, \text{ and } .32$, respectively, $p_s < .0026$), while those endorsing greater belief in one's own control over pain (Control) evidenced lower levels of pain interference ($r = -.36, p < .0026$). Finally, greater catastrophizing (CSQ) and solicitous responding (WHYMPI) were related with greater pain interference ($r_s = -.67 \text{ and } .36$, respectively, $p < .0026$), while greater self-reported social support (MSPSS) was related with less pain interference ($r = -.28, p < .0026$). The remaining subscales of the CPCI and the SOPA were unrelated to pain interference.

Discussion

The results of the current study contribute to an emerging body of research supporting a biopsychosocial model for understanding and treating pain in persons with SCI^{26,73}. This is evidenced by the significant contribution of psychological and social variables to the prediction of patient functioning, as well as the differential relationships between a number of psychosocial variables and patient functioning in our sample. The implications of these findings for a broadened theoretical understanding and treatment of SCI-related pain are discussed.

One of the most robust findings is that greater catastrophizing was associated with greater pain interference and poorer mental health, consistent with prior research linking catastrophizing with poor outcomes in persons with pain^{6,24,33,73}. In light of the correlational nature of the current and previous studies, we cannot address the extent to which catastrophizing merely mirrors dysfunction, as opposed to causing dysfunction. Furthermore, examination of our univariate analyses reveals that greater catastrophizing is associated with greater solicitous responding and less perceived social support. This is consistent with previous research examining catastrophizing within a social context^{5,8,21,44}. Taken together, this body of research and the current data support the need for randomized clinical trials to unravel the nature of these relationships and to more closely examine catastrophizing within a social context in persons with SCI³.

Greater perceived social support was associated with better mental health in both univariate and multivariate analyses, consistent with past research with persons with SCI and pain^{2,28} and persons with other disabilities and pain^{24,31}. This suggests that a belief in one's ability to access social support may be a protective factor for maintaining mental health in this context. Alternatively, perceived social support was associated with pain interference only at the univariate level, inconsistent with previous research that has found this construct to be uniquely and inversely associated with pain interference in samples of individuals with other disabilities^{24,31}.

Inconsistent with one of our study hypotheses and previous research^{24,31,54,77} solicitous responding was associated with mental health or pain interference only in the univariate analyses. It is possible that the multivariate analyses including the WHYMPI lacked the statistical power to identify a significant unique relationship with the outcome variables of interest, as the number of participants in these analyses was reduced to those with a significant other. It is also possible that the disproportionately high number of males in the analyses with the WHYMPI (approximately 3:1) influenced these results, given that a recent study examining gender differences in responses to solicitous responding found that spousal solicitousness predicted greater pain interference only for female participants with chronic pain¹⁶.

Perceived social support and solicitous responding represent theoretically different indices of social support, namely constructive versus detrimental factors, respectively^{24,31}. The fact that solicitous responding was associated with pain interference (in the univariate analyses), while perceived social support was associated with mental health, may speak to the potential difference between these constructs. These results highlight the complexity of social support and the importance of examining the impact of different characterizations of this construct on adjustment to pain⁶⁹.

Coping (Passive and Proactive) and appraisal/belief (Pain as Illness Beliefs and Emotion and Solicitude Beliefs) components emerged as unique predictors of our outcome variables in the regression analyses, above and beyond pain intensity, supporting the need to consider the impact of such constructs upon the experience of pain within this population. In the interest of

identifying *specific* coping strategies and appraisals/beliefs related with the outcome variables of interest, discussion will focus primarily on the results of the univariate analyses.

Six of the seven subscales of the SOPA were significantly associated with pain interference, suggesting that a belief that one is disabled because of pain (Disability), that pain signifies damage and that activity should be avoided (Harm), that medications are an appropriate treatment for pain (Medication), that a medical cure exists for pain (Medical Cure), and that others should be solicitous in their responses to pain behaviors (Solicitude) may all be associated with increased pain interference. These results are consistent with previous studies observing similar relationships between subscales and pain interference³⁹, as well as an association between changes in beliefs and concurrent changes in self-rated patient disability and pain intensity at follow-ups^{24,31,36,37}. Alternatively, perceived control over pain emerged as the only factor associated with lower pain interference, consistent with prior research with diverse chronic pain populations^{27,45,61,65}.

Although several appraisals/beliefs were significantly related with mental health, perceived control over pain was the only appraisal/belief subscale associated with *better* mental health. Subscales related with poorer mental health included Disability, Harm, Solicitude, and Emotion (the extent to which one believes emotions impact pain), consistent with previous research linking greater perceived control^{45,59,72} and solicitude⁷² with depression. These results demonstrate that a multitude of appraisals/beliefs are related to pain interference and mental health. Future research may clarify the unique roles of appraisals/beliefs upon outcomes, especially those that may have a more global impact upon functioning and mental health (i.e., Disability, Harm, Solicitude, Control). It is possible that Disability beliefs merely reflect a realistic assessment of greater functional impairment from pain, rather than negative attributions about the impact of pain. As with catastrophizing, the current findings suggest the need for longitudinal and experimental¹³ studies to help tease out potential causal effects of specific attributions on patient functioning.

Although coping strategies such as guarding painful body parts (Guarding), asking for assistance in response to pain (Asking for Assistance), and taking breaks when in pain (Resting), may be initially adaptive, especially while healing following an acute injury, persistent use of these coping responses is thought to be maladaptive. In other words, these patterns are consistent with the conceptualization of these coping subscales as illness-focused⁴⁰, as well as associated with disability⁶⁶. Moreover, several studies have linked resting with poorer functional outcomes in persons with pain and disability^{24,31,40,72}. Alternatively, Task Persistence emerged as the only variable related with better outcomes, less pain interference and better mental health, suggesting that persons who persist at activities in spite of pain may evidence better functioning. This is consistent with a recent study documenting the potential benefit of resistance training to ameliorate upper extremity pain in a sample of persons with paraplegia⁴⁸. Although no causal conclusions can be made, the current study identifies several coping strategies to explore in future experimental studies examining factors that might contribute to pain-related outcomes.

Limitations

Methodological limitations include the use of self-report data which introduces potential biases, including social desirability and common method variance. The correlational nature of this study also precludes conclusions concerning the causality of relationships between variables. Next, the return rate (50%) may be considered low when compared with the return rates of other comparable studies of persons with chronic pain (54% - 72%)^{9,37,72,73}. This introduces potential problems with the generalizability of these data and the potential for self-selection. Furthermore, the use of component scores versus individual subscales of the SOPA and CPCI in the multivariate analyses represents another limitation. Consolidating the

subscales into components reduces the risk of a Type I error. However, including individual subscales would have permitted the examination of their unique relationship with the outcomes. Considering the advantages and disadvantages of each approach, we chose to consolidate our data for the multivariate analyses, and comment on the strength of associations between individual psychosocial variables and pain interference and mental health in our univariate analyses, as we have done in previous studies^{37,72}. Next, we did not examine pain subtypes, which may call for different coping responses and interventions. For example, musculoskeletal pain, versus neuropathic pain, tends to be made worse by movement. Thus, interventions to promote task persistence may be easier for persons with neuropathic pain compared to musculoskeletal pain. On the other hand, patients with all types of pain may respond similarly to interventions that target psychological responses (e.g., cognitive restructuring). Finally, in this study, we did not include all relevant biological and psychosocial variables. Future studies may examine additional biological markers including spasticity, pain source (e.g., pressure ulcers), pain type, and pain medication use (e.g., opioid medications).

Clinical Implications & Conclusions

The most compelling finding is the evidence supporting a biopsychosocial framework for understanding the impact of process and clinical variables on adjustment to chronic pain in persons with SCI. These findings suggest that responses to pain are complex and interventions may need to target more than pain intensity. The pattern of these data suggest that maladaptive appraisals/beliefs, coping, and catastrophizing may be more strongly associated with negative outcomes than are adaptive strategies with positive outcomes, consistent with previous observations^{37,71}. Finally, although we cannot identify causal relationships between variables, our results suggest that efforts to improve mental health might focus on enhancing task persistence and perceived control over pain and reducing catastrophizing, while efforts to reduce pain interference might focus on challenging illness-focused coping. In sum, these are preliminary findings identifying coping strategies, beliefs/appraisals, and other psychosocial variables that may impact individuals with SCI and chronic pain.

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Table 1
Demographic and Descriptive Information for Participants Reporting Pain (n = 127)

<u>Ethnic group (%)</u>	
Caucasian	113 (89.0)
Native American	8 (6.3)
African American	2 (1.6)
Hispanic	5 (3.9)
Asian/Pacific Islander	4 (3.1)
Missing Data	2 (1.6)
<u>Marital Status (%)</u>	
Married	47 (37.0)
Never married	39 (30.7)
Divorced	22 (17.3)
Living with partner	10 (7.9)
Widowed	7 (5.5)
Separated	1 (.8)
Did not respond	1 (.8)
<u>Education (%) (highest level)</u>	
Grade 11 or lower	8 (6.2)
High school/GED	13 (10.2)
Vocational/technical/business School	15 (11.8)
Some college	39 (30.7)
College graduate	31 (24.4)
Graduate/professional school	21 (16.5)
<u>Employment (%)</u>	
Unemployed due to disability	49 (38.6)
Unemployed for other reason	11 (8.7)
Unemployed due to pain	13 (10.2)
Employed full time	34 (26.8)
Employed part time	17 (13.4)
School/vocational training	9 (7.1)
Retired	22 (17.3)
Homemaker	7 (5.5)
<u>Cause of SCI (%)</u>	
Motor vehicle accident	55 (43.3)
Fall	20 (15.7)
Sports injury	9 (7.1)
Diving	11 (8.7)
Gunshot wound	4 (3.1)
Other	28 (22.0)
<u>Everyone (%):</u>	
High Tetraplegia (C1-4)	23 (14.6)
Low Tetraplegia (C5-8)	54 (34.4)
High Paraplegia (T1-5)	15 (9.6)
Paraplegia (T6-12)	51 (32.5)
Low Paraplegia (L1-S4/5)	12 (7.6)
Missing Data	2 (1.3)

Table 2

Means, Standard Deviations, and Range of Independent Variables (Mental Health and Pain Interference; BPI) and Dependent Variables (SOPA Subscales; CPCI Subscales; CSQ Catastrophizing subscale, WHYMPI, and MSPSS)

	Mean (SD)	Range
Mental Health	69.39 (18.98)	20-100
Pain Interference	3.53 (2.62)	0-9.40
<u>CPCI subscales</u>		
Guarding	2.32 (1.70)	0-7.0
Resting	2.84 (1.63)	0-7.0
Asking for Assistance	2.66 (2.52)	0-7.0
Relaxation	1.76 (1.66)	0-7.0
Coping Self-Statements	2.51 (2.03)	0-7.0
Seek Social Support	1.78 (1.79)	0-7.0
Task Persistence	4.96 (1.77)	0-7.0
Exercise/Strength	2.52 (1.95)	0-7.0
Pacing	2.93 (2.32)	0-7.0
<u>SOPA subscales</u>		
Disability	2.02 (.87)	0.20-4.0
Harm	1.80 (.75)	0-3.75
Medication	2.60 (.94)	0.83-4.0
Medical Cure	1.51 (.71)	0-3.44
Emotion	1.43 (.82)	0-3.13
Solicitude	1.21 (.87)	0-3.33
Control	1.79 (.95)	0.2-3.80
Catastrophizing	1.57 (1.41)	0-6.0
WHYMPI	2.39 (1.55)	0-6.0
(Solicitous Responding Subscale)		
MSPSS	5.31 (1.27)	1.92-7.0

Table 3
 Correlation coefficients between predictor variables (SOPA Factor Scores; CPCI Factor Scores; CSQ Catastrophizing subscale, WHYMPI, and MSPSS)

	CSQ	MSPSS	WHYMPI	Pain as Illness Beliefs	Emotion & Solicitude Beliefs	Passive Coping
CSQ	1.0					
MSPSS Social Support	-.30**	1.0				
WHYMPI	.32**	.11	1.0			
(Solicitous Responding Subscale)						
Pain as Illness Beliefs	.54**	-.27**	.22*	1.0		
Emotion & Solicitude Beliefs	.28**	-.30**	.12	.00	1.0	
Passive Coping	.31**	.08	.48**	.27**	.28**	1.0
Proactive Coping	-.19*	.14	-.01	-.42**	.04	-.42**

* $p < 0.05$

** $p < 0.01$

Table 4

Multiple Regression Analyses Predicting Mental Health from Coping, and Social Environmental Variables (n = 125)^A

Step and Variables	Total R^2	R^2 change	F change	Beta
1. Pain Intensity	.09	.09	12.91**	-.31**
2. Cognitions, Coping, and Social Environment	.52	.43	17.47**	
Catastrophizing				-.30**
MSPSS Social Support				.26**
Pain as Illness Beliefs				-.10
Emotion and Solicitude Beliefs				-.26**
Passive Coping				-.08
Proactive Coping				.11

* $p < 0.05$

** $p < 0.01$

^ATotal n < 127 due to missing data

Table 5

Zero-Order Correlation Coefficients between Subscale Scores of the Psychosocial Variables with Mental Health and Pain Interference (BPI Score)

Belief/coping scores	Brief Pain Inventory	Outcome Measures
		SF-36 Mental Health Scale
<u>CPCI subscales</u>		
Guarding	.45*	-.16
Resting	.43*	-.22
Asking for Assistance	.37*	-.16
Relaxation	.26	-.05
Coping Self-Statements	.25	-.08
Seek Social Support	.24	.00
Task Persistence	-.36*	.33*
Exercise/Strength	.09	.09
Pacing	.28*	-.07
<u>SOPA subscales</u>		
Disability	.72*	-.55*
Harm	.32*	-.28*
Medication	.35*	-.26
Medical Cure	.30*	-.10
Emotion	.15	-.34*
Solicitude	.32*	-.41*
Control	-.36*	.33*
Catastrophizing	.67*	-.58*
WHYMPI (Solicitous Responding Subscale)	.36*	-.23
MSPSS	-.28*	.46*

Note. These correlations and significant levels are presented for descriptive purposes. Given the large number of correlations performed on related variables, (18 psychosocial predictor variables per criterion measure), we used a Bonferroni correction for each criterion measure (.05/19 = .0026) to determine whether each association was significantly different from zero. SOPA = Survey of Pain Attitudes; CPCI = Chronic Pain Coping Inventory.

* $p < 0.0026$, one-tailed.

Table 6

Multiple Regression Analyses Predicting Pain Interference (BPI score) from Coping, and Social Environmental Variables (n=119)^Δ

Step and Variables	Total R^2	R^2 change	F change	Beta
1. Pain Intensity	.41	.41	82.57**	.64**
2. Cognitions, Coping, and Social Environment	.72	.31	20.22**	
Catastrophizing				.23**
MSPSS Social Support				-.11
Pain as Illness Beliefs				.20**
Emotion and Solicitude Beliefs				.12
Passive Coping				.33**
Proactive Coping				-.01

* $p < 0.05$

** $p < 0.01$

^ΔTotal n < 127 due to missing data