Stage of Chronicity and Cognitive Correlates of Pain-Related Disability

Michael J. L. Sullivan¹, Maureen E. Sullivan² and Heather M. Adams³

¹Departments of Psychology and Psychiatry, Dalhousie University; ²Fenwick Psychological and Health Consulting Services; ³Pain Research Centre, Dalhousie University, Halifax, Nova Scotia, Canada

Abstract. The present research examined the functional relations between the different dimensions of catastrophic thinking and pain-related disability, as a function of stage of chronicity. In the present study, 150 patients with chronic pain were grouped to form 3 different levels of chronicity: Group A (6 months to 2 years, n = 44); Group B (2–4 years, n = 55); and Group C (more than 4 years, n = 51). The 3 subscales of the Pain Catastrophizing Scale (Rumination, Magnification, Helplessness) were used as predictors of disability. Disability was assessed with the Pain Disability Index and pain was assessed with the McGill Pain Questionnaire. For Group A, regression analysis revealed that none of the PCS subscales predicted disability beyond the variance accounted for by sex, age and pain. Rumination was a significant predictor of disability in Group B, and both rumination and helplessness predicted disability in Group C. These findings provide preliminary evidence that stage of chronicity is an important moderator of psychological vulnerability for pain-related disability. Discussion addresses how the impact of pain management programs might be increased by tailoring interventions to specific patient needs. Key words: catastrophizing; occupational disability; pain; work injury.

Received October 30, 2001; Accepted March 1, 2002

Correspondence address: Michael Sullivan, Dalhousie University Pain Research Centre, 5595 Fenwick Street, Suite 314, Halifax, Nova Scotia, B3H 4M2, Canada. E-mail: sully@is.dal.ca.

In recent years, considerable research has addressed the role of psychological factors in the development of disability following musculoskeletal injury (Burton, 1997; Fordyce, 1995; Frank, Brooker, Maetzell, & Sullivan, 1998; Haland Halderson, Indahl, & Ursin, 1998). This literature has revealed that a variety of cognitive and affective variables play a significant role in determining the severity of pain-related disability (Gatchel & Gardea, 1999; Waddell, 1998). However, there has been little attention given to how contextual factors associated with persistent pain might interact with vulnerability factors in contributing to pain-related disability. The present research provides preliminary evidence suggesting that the psychology of pain-related disability may differ as a function of the number of years that an individual has been experiencing debilitating pain.

A number of investigations has also highlighted the importance of considering the social and environmental context within which pain-related disability occurs (Fordyce, 1995; Rainville, Sobel, Hartigan, & Wright, 1997). It has been suggested that social and environmental factors can be significant determinants of pain-related disability, regardless of an individual’s physical or medical status (Cats-Baril & Frymoyer, 1991; Fordyce, 1995; Sullivan & Loeser, 1992; Waddell, 1998). Social and environmental factors may impact directly on pain-related disability, or they may play a moderating role, either accentuating or attenuating the impact of psychological vulnerability factors on pain-related disability (Banks & Kerns, 1996).

Although several research investigations have addressed the potential role of psychological vulnerability factors, and the role of social and environmental factors contributing to disability, these literatures have developed independently (Banks & Kerns, 1996; Fordyce, 1995; Sullivan et
Little attention has been given to examining the manner in which contextual factors might interact with vulnerability factors in giving rise to pain-related disability. The study of contextual determinants of psychological vulnerability in persistent pain disorders holds promise of contributing to the refinement of theoretical models on the relation between psychology and pain and may also contribute to the development of interventions that can be tailored to meet specific patient needs.

The primary objective of the present research was to examine whether duration of chronicity interacted with psychological vulnerability factors in determining the severity of pain-related disability (i.e. activity limitations due to pain). For the purposes of this research, duration of chronicity was defined as the length of time the individual had suffered from debilitating pain. “Catastrophizing” was chosen as the psychological vulnerability factor for study. Catastrophizing has been conceptualized as a multidimensional construct, reflecting a tendency to focus excessively on pain sensations (i.e. rumination), to exaggerate the seriousness of the pain condition (i.e. magnification) and to perceive oneself as unable to manage the pain condition effectively (i.e. helplessness) (Sullivan, Bishop, & Pivik, 1995). Research has shown that catastrophizing is a significant determinant of pain and pain-related disability (Martin et al., 1986; Keefe, Brown, Wallston, & Caldwell, 1989; Sullivan, Stanish, Waite, Sullivan & Tripp, 1998).

The potential importance of duration of chronicity as a contextual determinant of severity of pain-related disability can be illustrated by contrasting the experiences of an individual who has suffered from a persistent pain disorder for 1 year, to someone who has suffered from a persistent pain disorder for 5 years. In the first year post-injury, a patient is likely to undergo several diagnostic procedures, be referred to several specialists and participate in numerous rehabilitation interventions. There may be considerable uncertainty about the underlying basis of pain symptoms and the medical prognosis. The patient is likely to have concerns about the potential loss of function, independence and financial security.

A different context exists for the individual who has suffered from a persistent pain disorder for 5 years. Several years post-injury, it is likely that diagnostic procedures and referrals to specialists have decreased significantly in frequency. It is also likely that available treatment interventions have been tried, perhaps repeatedly, with minimal success. At this stage, the patient is likely to have lowered expectancies for symptom resolution or treatment outcome and, in many cases, the early concerns about potential losses will have changed to reactions about actual losses.

It is possible that individuals who have a tendency to exaggerate or magnify the threat value of pain sensations may be particularly prone to show high levels of pain-related disability in the early period post-injury. The diagnostic or prognostic uncertainty that characterizes the early period post-injury may accentuate the negative impact of exaggerated threat appraisals, perhaps contributing to the development of an overly cautious or fearful approach to physical activity. Several years post-injury, individuals who have a tendency to react to their pain symptoms with passivity and helplessness may be prone to showing high levels of pain-related disability. The repeated treatment failures and exhaustion of treatment options that characterize the late period post-injury may accentuate the impact of helplessness appraisals in pain-related disability.

The primary purpose of the present study was to examine whether the 3 components of catastrophizing (magnification, rumination, helplessness) interacted with duration of chronicity in predicting severity of pain-related disability. A sample of patients who were experiencing persistent pain consequent to occupational injury were grouped to form 3 different levels of chronicity: Group A (6 months to 2 years); Group B (2–4 years); and Group C (more than 4 years). The 3 subscales of the Pain Catastrophizing Scale (PCS; Sullivan et al., 1995) were used as predictors of pain-related disability. The Pain Disability Index was used as the primary dependent variable (Tait, Chibnall & Krause, 1990).
Method

Participants
The participant sample comprised 150 consecutive referrals (57 men, 93 women) to a multidisciplinary pain treatment center (Atlantic Pain Clinic, Halifax, NS). All participants were currently unemployed as a result of a work-related injury and were receiving wage replacement benefits. Participants were referred for evaluation by the Workers’ Compensation Boards of Prince Edward Island and Nova Scotia, by various extended health care insurers or by Canada Pension. The sample consisted mostly of patients with primary complaints of low back pain (76%). The majority of patients reported pain in more than 1 site, including leg pain (40%), shoulder pain (20%), neck pain (24%) and headaches (36%). The majority of participants were married (86%), Caucasian (92%) and had at least a high school education (70%). The mean age of the sample was 36.1 years with a range of 20–61 years.

Procedure
Patients completed measures of catastrophizing, pain and disability as part of a standardized assessment protocol. Demographic information was also collected. Patients were classified into 1 of 3 groups on the basis of the chronicity of their persistent pain disorder; Group A, less than 2 years post-injury (n = 44); Group B, between 2 and 4 years post-injury (n = 55); Group C, more than 4 years post-injury (n = 51).

Measures

Catastrophizing
The Pain Catastrophizing Scale (PCS; Sullivan et al., 1995) was used to assess catastrophic thinking in relation to pain. Respondents were asked to rate the frequency with which they experienced each of 13 different thoughts or feelings when they were in pain. Ratings were made on a 5-point scale with the endpoints “(0) not at all” and “(5) all the time”. The PCS yields 3 subscale scores for rumination, magnification and helplessness. The PCS has been shown to have good reliability and validity in clinical and experimental samples (Sullivan et al., 1995).

Pain Severity
The McGill Pain Questionnaire (MPQ; Melzack, 1975) was used as a measure of pain severity. Respondents were asked to endorse adjectives from a list of 40 pain descriptors to indicate their current pain experience. For the purposes of the present study, the Pain Rating Index was used, which is a weighed sum of all adjectives endorsed. The Pain Rating Index of the MPQ has been recommended as a reliable and valid measure of chronic pain experience (Turk, Rudy, & Salovey, 1985).

Disability
The Pain Disability Index (PDI; Tait et al., 1990) was used to measure pain-related disability. Respondents were asked to rate the degree of disability they experience in each of 7 different life domains. Ratings were made on an 11-point scale with the endpoints “(0) no disability” and “(10) total disability”. A total score was generated by summing all 7 ratings. The PDI has been shown to have good internal reliability and to be correlated with objective measures of disability (Tait et al., 1990).

Results
Table 1 presents means and standards deviations on demographic and dependent measures according to level of chronicity. Significant age differences were found between groups, F (2,
Patients in Group C (mean = 38.5, SD = 8.3) were significantly older than patients in Group A (mean = 35.5, SD = 7.5) or Group B (mean = 34.4, SD = 9.2). There were no significant group differences for the catastrophizing subscales, pain or disability. Sex differences were found only for the catastrophizing subscales. Women scored higher than men on rumination, \( t (148) = 3.3, p < 0.001 \), magnification, \( t (148) = 2.8, p < 0.01 \), and helplessness, \( t (148) = 1.9, p < 0.05 \), subscales of the PCS.

Table 2 presents the correlations among the different catastrophizing subscales and pain for each chronicity group. Of the 3 PCS subscales only magnification was significantly correlated with pain ratings. Table 2 also presents the correlations among the different catastrophizing subscales and disability for each chronicity group. Rumination and magnification were significantly correlated with ratings of disability for all 3 chronicity groups. Helplessness was correlated with disability ratings in Groups B and C, but not Group A.

In order to test the moderating effects of chronicity, 3 interaction terms (PCS subscales × chronicity) were computed (rumination, magnification, helplessness × years of pain). A hierarchical regression analysis was performed on the entire sample to determine whether the 3 interaction terms contributed significant variance to the prediction of pain-related disability beyond the variance accounted for by the individual PCS subscales. Age and sex were entered in Step 1 of the analysis, but did not contribute significant variance. Pain severity was entered in Step 2 and contributed 15% of variance to the prediction of disability, \( R = 0.44, F \) (change) = 32.5,

### Table 1. Sample characteristics.

<table>
<thead>
<tr>
<th>Group</th>
<th>Age (mean)</th>
<th>MPQ-PRI (mean)</th>
<th>PDI (mean)</th>
<th>PCS subscales</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (&lt;2 years)</td>
<td>35.8 (7.5)</td>
<td>38.6 (12.5)</td>
<td>45.8 (10.3)</td>
<td>Rumination: 10.7 (3.8), Magnification: 5.2 (2.6), Helplessness: 13.1 (5.8), PCS total: 29.1 (11.3)</td>
</tr>
<tr>
<td>B (2–4 years)</td>
<td>34.4 (9.2)</td>
<td>37.7 (14.7)</td>
<td>45.5 (11.7)</td>
<td>Rumination: 11.4 (3.9), Magnification: 5.6 (2.9), Helplessness: 14.8 (5.5), PCS total: 31.9 (11.3)</td>
</tr>
<tr>
<td>C (&gt;4 years)</td>
<td>38.5 (8.3)</td>
<td>43.0 (15.4)</td>
<td>48.7 (11.4)</td>
<td>Rumination: 10.9 (3.8), Magnification: 5.7 (2.7), Helplessness: 14.7 (5.3), PCS total: 31.3 (10.7)</td>
</tr>
</tbody>
</table>

MPQ-PRI = McGill Pain Questionnaire-Pain Rating Index; PDI = Pain Disability Index; PCS = Pain Catastrophizing Scale. Values in parentheses are standard deviations.

### Table 2. Correlations between (a) PCS subscales and pain, (b) PCS subscales and disability.

<table>
<thead>
<tr>
<th>Group</th>
<th>Rumination</th>
<th>Magnification</th>
<th>Helplessness</th>
<th>Total PCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A (&lt;2 years)</td>
<td>0.04</td>
<td>0.31*</td>
<td>0.12</td>
<td>0.15</td>
</tr>
<tr>
<td>B (2–4 years)</td>
<td>0.24</td>
<td>0.34*</td>
<td>0.25</td>
<td>0.30*</td>
</tr>
<tr>
<td>C (&gt;4 years)</td>
<td>0.09</td>
<td>0.34*</td>
<td>0.24</td>
<td>0.24</td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A (&lt;2 years)</td>
<td>0.32*</td>
<td>0.38**</td>
<td>0.17</td>
<td>0.29*</td>
</tr>
<tr>
<td>B (2–4 years)</td>
<td>0.54**</td>
<td>0.38**</td>
<td>0.44**</td>
<td>0.50**</td>
</tr>
<tr>
<td>C (&gt;4 years)</td>
<td>0.38**</td>
<td>0.42**</td>
<td>0.55**</td>
<td>0.48**</td>
</tr>
</tbody>
</table>

Group A (n = 44), Group B (n = 55), Group C (n = 51). PCS = Pain Catastrophizing Scale * p < 0.05, ** p < 0.01.
The PCS subscales were entered in Step 3 of the analysis and contributed 11% to the prediction of disability, $R = 0.55$, $F$ (change) = 7.2, $p < 0.001$. The 3 interaction terms were entered in the final step of the analysis and contributed an additional 8% of variance to the prediction of disability, $R = 0.62$, $F$ (change) = 6.48, $p < 0.001$.

The nature of moderating effects of chronicity was explored further by examining the relative predictive power of the different components of catastrophizing for each level of chronicity. Age and sex were used as covariates. Pain severity was also used as a covariate in order to address whether the components of catastrophizing contributed to the prediction of disability beyond the variance accounted for by pain.

The results of regression analyses predicting disability in the 3 chronicity groups are presented in Table 3. For Group A, age and sex were entered in Step 1 of the analysis and contributed to 24% of the variance in ratings of disability, $F(2, 41) = 6.6, p < 0.01$. In Step 2 of the analysis, pain was entered but did not contribute significant variance. The 3 subscales of the PCS were allowed to compete for entry in the next step of the analysis. None of the subscales met minimum criteria for entry in the regression equation. In the final regression equation, only age was found to contribute significant unique variance to the prediction of disability.

For Group B, age and sex were entered in Step 1 but did not contribute significant variance. Pain was entered in Step 2 of the analysis accounting for 15% of the variance in disability ratings, $F$ (change) = 9.8, $p < 0.001$. When the 3 PCS scales were allowed to compete in the next step of the analysis, only the rumination subscale met minimum criteria for entry in the regression equation, $F$ (change) = 15.5, $p < 0.001$. Rumination accounted for 18% of the variance in ratings of disability beyond that accounted for by age, sex and pain. In the final regression equation, only pain and rumination contributed significant unique variance to the prediction of disability ratings.

### Table 3. Prediction of pain-related disability for each stage of chronicity.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Beta</th>
<th>$R^2$</th>
<th>Pearson $r$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>$-0.42^{**}$</td>
<td></td>
<td>$-0.47^{**}$</td>
</tr>
<tr>
<td>Sex</td>
<td>$-0.15$</td>
<td>0.24</td>
<td>$-0.16$</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>0.17</td>
<td>0.27</td>
<td>0.27*</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>0.36*</td>
<td>0.29</td>
<td>0.51**</td>
</tr>
<tr>
<td>Helplessness</td>
<td>0.74**</td>
<td>0.47</td>
<td>0.55**</td>
</tr>
<tr>
<td>Rumination</td>
<td>0.39*</td>
<td>0.51</td>
<td>0.38</td>
</tr>
</tbody>
</table>

*Since the different components of the PCS were highly correlated, they were entered in a stepwise fashion in order to avoid problems of multi-collinearity in the regression equation. For each regression analysis, beta weights are from the final regression equation.*

$p < 0.001$. The PCS subscales were entered in Step 3 of the analysis and contributed 11% to the prediction of disability, $R = 0.55$, $F$ (change) = 7.2, $p < 0.001$. The 3 interaction terms were entered in the final step of the analysis and contributed an additional 8% of variance to the prediction of disability, $R = 0.62$, $F$ (change) = 6.48, $p < 0.001$. The nature of moderating effects of chronicity was explored further by examining the relative predictive power of the different components of catastrophizing for each level of chronicity. Age and sex were used as covariates. Pain severity was also used as a covariate in order to address whether the components of catastrophizing contributed to the prediction of disability beyond the variance accounted for by pain.

The results of regression analyses predicting disability in the 3 chronicity groups are presented in Table 3. For Group A, age and sex were entered in Step 1 of the analysis and contributed to 24% of the variance in ratings of disability, $F(2, 41) = 6.6, p < 0.01$. In Step 2 of the analysis, pain was entered but did not contribute significant variance. The 3 subscales of the PCS were allowed to compete for entry in the next step of the analysis. None of the subscales met minimum criteria for entry in the regression equation. In the final regression equation, only age was found to contribute significant unique variance to the prediction of disability.

For Group B, age and sex were entered in Step 1 but did not contribute significant variance. Pain was entered in Step 2 of the analysis accounting for 15% of the variance in disability ratings, $F$ (change) = 9.8, $p < 0.001$. When the 3 PCS scales were allowed to compete in the next step of the analysis, only the rumination subscale met minimum criteria for entry in the regression equation, $F$ (change) = 15.5, $p < 0.001$. Rumination accounted for 18% of the variance in ratings of disability beyond that accounted for by age, sex and pain. In the final regression equation, only pain and rumination contributed significant unique variance to the prediction of disability ratings.
For Group C, age and sex were entered in Step 1 but did not contribute significant variance. In Step 2 of the analysis, pain accounted for an additional 26% of variance, \( F(\text{change}) = 17.0, \ p < 0.001 \). The helplessness subscale of the PCS entered next, accounting for an additional 15% of variance in ratings of disability, \( F(\text{change}) = 15.8, \ p < 0.001 \). Finally, the rumination subscale entered the regression equation, accounting for 4% of variance beyond that accounted for by age, sex, pain and helplessness, \( F(\text{change}) = 4.4, \ p < 0.05 \). In the final regression equation, pain, helplessness and rumination contributed significant unique variance to the prediction of disability.

**Discussion**

The findings of the present study provide preliminary evidence that the psychological correlates of pain-related disability change over time. Specifically, regression analysis revealed that stage of chronicity (i.e. number of years since onset of pain) moderated the relation between PCS subscales and pain-related disability. Follow-up analyses revealed that in the group of patients who had been off work for less than 2 years, none of the PCS subscales predicted pain-related disability over and above the variance accounted for by age, sex and pain severity. Rumination accounted for significant unique variance in pain-related disability for patients who had been off work for 2–4 years, and helplessness was the strongest predictor of pain-related disability in the group of patients off work for more than 4 years.

These findings are consistent with a pattern of results that has emerged in previous research. For example, Sullivan et al. (1998) reported that the rumination subscale of the PCS was the best predictor of severity of disability in patients who had been experiencing chronic pain for approximately 3 years. Vienneau, Clark, Lynch and Sullivan (1999) reported that the helplessness subscale of the PCS was the best predictor of severity of disability in patients who had been experiencing for approximately 9 years. Although differences in sample composition limit the conclusions that can be drawn from these studies, the pattern of results is nevertheless consistent with the present findings and supports the view that chronicity may be an important moderator of psychological vulnerability for pain-related disability.

It has been suggested that catastrophizing might represent a pre-existing vulnerability factor for heightened pain and disability associated with pain (Sullivan et al., 2001). There are at least 2 ways in which catastrophizing may operate as a vulnerability variable; catastrophizing may be manifest (i.e. measurable without the presence of pain) or latent (i.e. observable only when challenged by pain). Although correlational data on clinic samples of pain patients are not well suited to test these distinctions, the findings emerging in recent research point to catastrophizing as a manifest vulnerability variable. For example, 2 studies have shown that catastrophizing, measured in a pain-free state, predicts responses to a future pain stimulus (Sullivan et al., 1995; Sullivan and Neish, 1999). In the present study, catastrophizing remained constant in spite of increases (albeit non-significant) in disability over time. This pattern of findings is more consistent with a manifest as opposed to latent conceptualization of catastrophizing.

The view that characteristics of the individual interact with characteristics of a stress situation to yield pain-related outcomes has been discussed by several investigators (Banks & Kerns, 1996; Kerns & Jacob, 1997; Rudy, Kerns & Turk, 1988). Typically referred to as “diathesis-stress” formulations, these models suggest that vulnerability factors (i.e. diatheses) are most likely to yield negative outcomes when challenged by vulnerability-relevant contextual factors (i.e. stresses) (Banks & Kerns; 1996; Beck, 1976; Kerns & Jacob, 1997; Lazarus & Folkman, 1984; Rudy et al., 1988; Monroe & Simons, 1991). Although considerable research has been conducted to elucidate the vulnerability factors associated with pain-related disability, the role of vulnerability-relevant contextual factors has not been systematically investigated. Kerns and Jacob (1992) have argued that explanatory models of the psychology of pain and pain-related outcomes will need to pay greater attention to the life context of chronic pain, including patients’
treatment experiences, interactions with clinicians and evaluators, patients’ life stage and family role (see also Banks & Kerns, 1996).

Zero order correlations revealed that the magnification subscale of the PCS was significantly related to pain ratings and pain-related disability for all 3 groups of patients. Magnification did not emerge as a significant predictor of pain-related disability in regression analyses, when controlling for age, sex and pain severity. These findings suggest that magnification may exert its impact on pain-related disability only indirectly through its influence on heightening pain experience. Rumination and helplessness predicted pain-related disability even when controlling for pain, suggesting that their influence on pain-related disability is independent of pain. It is noteworthy that in patients who had been off work for more than 2 years, catastrophizing subscales were stronger predictors of pain-related disability than pain itself.

The present findings suggest that interventions that consider stage of chronicity as a moderator of vulnerability for pain-related disability may yield more positive outcomes than standardized approaches to the management of chronic pain. Other clinical investigators have drawn attention to the possibility that individually tailored treatment approaches may have advantages over standardized interventions (Kerns & Jacob, 1992; Turk & Rudy, 1988). Research is accumulating indicating that patients with chronic pain cannot be considered a homogeneous group. Chronic pain patients differ with respect to the aetiology and course of their pain symptoms and, more importantly, they differ with respect to the areas of psychological and social functioning that are likely to be affected by their pain condition (Turk & Rudy, 1988, 1992). The time may be approaching where assessment protocols can be developed to yield profiles of psychological vulnerability and dysfunction in chronic pain patients that will permit the administration of individually tailored intervention programs.

There are a number of limitations of the current study that must be considered. In cross-sectional research designs, direction of causality among correlated variables remains ambiguous. Although psychosocial models of pain and disability ascribe causal status to psychological vulnerability variables, cross-sectional designs are limited in their ability to address direction of causality (Gatchel, 1996; Turk, 1996; Turk & Rudy, 1992). It is important to recognize that psychological variables, such as catastrophizing, may be reactive to pain-related disability as opposed to being the cause of pain-related disability (Sullivan et al., 2001). A more compelling test of the predictive value of catastrophizing must await replication within a longitudinal design.

Acknowledgements

We thank Erin Hall and Rosita Bartolacci for their assistance in data coding and data entry. We also thank the two anonymous reviewers who provided helpful comments on a previous version of this paper. Portions of the research were presented at the Annual Meeting of the Canadian Pain Society, Banff, Alberta, May 11–13, 2000. This research was supported by grants from the Social Sciences and Humanities Research Council of Canada and the Canadian Institutes of Health Research.

References


