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Changes in Pain Catastrophizing Following Physical Therapy for Musculoskeletal Injury: The Influence of Depressive and Post-traumatic Stress Symptoms

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Abstract *Purpose*: The aim of the present study was to investigate the factors that influence the change in pain catastrophizing during the course of a physical therapy intervention for musculoskeletal injury. *Methods*: 187 clients enrolled in a 7-week physical therapy intervention were divided into four mutually exclusive groups on the basis of a pre-treatment assessment: (1) clients whose pre-treatment catastrophizing scores and measures of mental health problems were below clinical threshold, (2) clients whose pre-treatment catastrophizing scores were above clinical threshold but who scores on measures of mental health problems were below clinical threshold, (3) clients whose pre-treatment catastrophizing scores were above clinical threshold and whose scores on measures of mental health problems were also above clinical threshold, and (4) clients whose pre-treatment catastrophizing scores were below clinical threshold but whose scores on measures of mental health problems were above clinical threshold. *Results*: The most prevalent risk profile consisted of clients with high levels of pain catastrophizing and high mental health problems (37 %), followed by the low catastrophizing and low mental health problems profile (35 %), the high catastrophizing and low mental health problems profile (16 %), and low catastrophizing and high mental health problems profile (10 %). Clients were considered non-responders if their post-treatment catastrophizing score remained above clinical threshold following treatment. Chi square analyses revealed a significantly higher proportion of non-responders in the high catastrophizing and mental health problem group than in any other group. *Conclusions*: The presence of mental health symptoms markedly reduces the effectiveness of physical therapy for reducing catastrophizing scores. The 'risk value' of high catastrophizing scores thus appears to vary as a function of the presence or absence of mental health symptoms. The findings argue for the inclusion of measures of mental health problems in the routine screening of individuals treated in physical therapy.

Keywords Musculoskeletal pain · Pain catastrophizing · Depression · Physical therapy · Post-traumatic stress symptoms · Mental health problems

Introduction

In recent years, considerable research has shown that pain-related psychological variables can impact negatively on recovery outcomes following musculoskeletal injury [1–3]. Pain catastrophizing has emerged as one of the most robust psychological predictors of adverse rehabilitation outcomes [4, 5]. Pain catastrophizing has been defined as an exaggerated negative orientation toward actual or anticipated pain [4]. Treatment-related reduction in pain catastrophizing has been shown to be significantly associated with successful rehabilitation outcomes for individuals with musculoskeletal problems [6, 7].

In light of findings linking high levels of pain catastrophizing to problematic rehabilitation outcomes, clinical researchers have emphasized the importance of targeting pain catastrophizing in interventions offered to individuals with musculoskeletal problems [5, 6]. To date, a range of psychosocial interventions have been shown to yield significant reductions in pain catastrophizing. These interventions include emotional disclosure [8], exposure [9],

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neurophysiological education [10], goal setting and activity mobilization [11], cognitive-behavioural interventions [12], and multidisciplinary rehabilitation programs [13].

Research also suggests that physical therapy alone contributes to significant reductions on catastrophizing [6, 11, 14]. A number of studies have reported reductions in catastrophizing ranging from 12 to 24 % in individuals with musculoskeletal conditions participating in physical therapy interventions [6, 11]. Although physical therapy is not considered to be a psychosocial intervention, there are likely "common factors" in both physical therapy and psychosocial interventions that may contribute to the general effects of treatment. Elements of physical therapy such as goal setting, support, encouragement, education, positive expectancies and therapist demeanor are examples of common factors that might contribute to reductions in catastrophizing [15, 16].

Although physical therapy has been shown to yield statistically significant reductions in catastrophizing, it remains unclear whether the reductions in catastrophizing achieved through physical therapy are of sufficient magnitude to impact in a meaningful manner on key outcome indicators in rehabilitation. In previous research, it has been suggested that a post-treatment score of 20 on the Pain Catastrophizing Scale (PCS) best distinguished between clients who returned to work and those that remained work-disabled [17]. It has been suggested that a score of 20 on the PCS can be considered as a clinical threshold for catastrophizing in individuals with musculoskeletal conditions [11]. No research has yet examined the proportion of clients completing a physical therapy intervention whose post-treatment PCS scores fall below clinical threshold.

The purpose of the present study was to examine the factors that might determine whether a client's post-treatment PCS score falls below clinical threshold after completing a physical therapy intervention. Clients enrolled in a physical therapy intervention were divided 4 mutually-exclusive groups on the basis of the results of a pre-treatment assessment: (1) clients whose pre-treatment PCS scores and measures of mental health problems were below clinical threshold, (2) clients whose pre-treatment PCS scores were above clinical threshold but whose scores on measures of mental health problems were below clinical threshold, (3) clients whose pre-treatment PCS scores were above clinical threshold and whose scores on measures of mental health problems were also above clinical threshold, and (4) clients whose pre-treatment scores on the PCS were below clinical threshold but whose scores on measures of mental health problems were above clinical threshold. Of interest was the proportion of clients in each group who obtained post-treatment PCS scores below clinical threshold.

Materials and Method

Participants

The study sample consisted of patients recruited from 6 physical therapy clinics across the province of Québec, Canada. Clients were eligible if they were between the ages of 18 and 65 years and had sustained a work-related soft tissue injury to their back or neck. At the time of initial consultation, all clients were in the subacute phase of recovery (i.e., 3–12 weeks since injury) and were receiving wage indemnity benefits from the provincial workers' compensation board. Clients were not eligible for the study if they had been diagnosed with a vertebral fracture, disk herniation, ankylosing spondylitis, or infectious disease.

Measures

Pain Severity

The McGill Pain Questionnaire (MPQ; [18] was used to assess current pain severity. On this measure, participants are asked to endorse adjectives that best describe their current pain experience. The Pain Rating Index (PRI) is a weighted sum of all adjectives endorsed, and is considered to be a reliable ($\alpha = 0.84$) and valid indices of an individual's pain experience in persistent pain populations [19].

Pain Catastrophizing

The pain catastrophizing scale (PCS) was used to measure participant's levels of catastrophic thinking in relation to pain. The PCS is a 13-item self-report questionnaire that asks respondents to indicate the frequency with which they experience different thoughts related to their pain experience. Higher scores on the PCS indicate greater levels of catastrophic thinking. Previous research has shown that the PCS has good reliability ($\alpha = 0.87$) and validity and that elevated scores indicate risk for poor pain-related outcomes [4, 20]. Past research has used a cutoff score of 20 to identify patients in the risk range [11, 21].

Depression

The beck depression inventory-II (BDI) was used to measure depressive symptoms [22]. The BDI-II consists of 21 statements describing various symptoms of depression. Respondents are asked to choose the statements that best describe how they have been feeling over the last 2 weeks. Higher scores on the BDI-II indicate more severe depressive symptoms. The BDI-II has been shown to be a reliable

($\alpha = 0.73$–0.95) and valid measure of depressive symptoms among patients with persistent musculoskeletal pain [23]. Previous research has indicated a cut-off score of 16 to identify patients with clinically meaningful symptoms of depression [23, 24].

Post-traumatic Stress Symptoms

The Impact of Events Scale—Revised (IES-R) was used to assess post-traumatic stress symptoms. Respondents are asked to rate the degree of distress they experience with respect to 22 statements describing different cognitive and emotional aspects of post-traumatic stress. The IES-R has been shown to be a reliable ($\alpha = 0.81$–0.93) and valid index of post-traumatic stress symptoms associated with persistent musculoskeletal pain [25–27]. Previous research has indicated a cut-off score of 35 to identify patients with clinically meaningful post-traumatic stress symptoms [28].

Clinician's Return to Work Judgments

A treatment termination, physiotherapists were asked to estimate how many hours each participant was capable of working per day. Clinicians chose from one of the following options "0 h per day", "1 h per day", "2 h per day", "3 h per day", "4 h per day", "5 or more hours per day". Clinician's judgments have been shown to significantly predict return-to-work [29].

Physical Function

A 5-min fast walk was used as a brief assessment of physical function. Participants were asked to walk at a quick pace between two markers on the floor, 10 yards apart. The total distance walked, in feet, in 5 min was recorded. This test has been shown to have high reliability (ICC1, $1 = 0.87$) and to correlate significantly with other indices of disability in patients with low back pain [30, 31]. An index of physical improvement was derived by computing the distance between the first (pre-treatment) and last (post-treatment) assessment periods on the measure of walking distance.

Procedure

Eligible participants provided written informed consent as a condition of study participation. All participants were enrolled in a 7-week physical therapy intervention at one of 6 treatment centers, aimed at reducing pain and disability associated with soft tissue injuries. The treatments focused on early mobilization and activity, and primarily consisted of range of motion, progressive joint manipulation, dynamic resistance exercises and aerobic exercise. The treatment approach across clinicians and across clinics was consistent with clinical practice guidelines emphasizing activity mobilization and functional restoration after a subacute musculoskeletal injury [32–34]. Treatment provided also had to be consistent with the reimbursement guidelines of the provincial workers compensation board, such that passive or modality-based techniques were discouraged. Participants were scheduled for physical therapy 3 days a week. During the first week of treatment, participants were asked to fill out self-report questionnaires of cognitive and affective pain-related variables and demographic information. Participants were asked to fill out the same self-report questionnaires after completing the 7-week physical therapy intervention.

Data analytic Approach

Means and standard deviations were computed for all pre-treatment assessment variables and post-treatment catastrophizing scores. Mutually exclusive risk-profile groups were created using previously established clinical cut-offs on the PCS, BDI-II, and the IES-R [11, 21, 23, 24, 28]. Four risk-profile groups were constructed: (1) Low Catastrophizing and Low Mental Health Problems; participants who scored below the cut-off on all variables of interest: (2) High Catastrophizing and Low Mental Health Problems; participants who only scored above clinical threshold on the PCS ($PCS > 20$): (3) High Catastrophizing and High Mental Health Problems; participants scored above clinical threshold on the PCS ($PCS > 20$) and one (or both) of the mental health measures: (4) High Mental Health Problems and Low Catastrophizing; participants scored above the clinical threshold on either the BDI-II ($BDI\text{-}II > 16$) and/or IES-R ($IES\text{-}R > 35$) and below clinical threshold on the PCS ($PCS \leq 20$).

Participants whose post-treatment catastrophizing scores were above 20 were classified as "non-responders". Chi square tests were then used to test for significant differences among the proportion of non-responders according to risk profile group. Independent samples t-tests were computed to compare pre-treatment means on catastrophizing for responsive and non-responsive patients.

Results

Sample Characteristics and Descriptive Statistics

The study sample consisted of 187 individuals (73 men and 114 women), with a mean age of 36.85 years ($SD = 10.63$). Table 1 presents the demographic characteristics of the total sample and the resulting subgroups. The majority of

participants had some form of post-secondary education, and prior to injury, were working either as a labourer or nurse. The average duration since injury was 7.19 weeks, and the most common injury site was the back. Non-steroidal anti-inflammatory drugs were the most commonly used pain medication.

Pre- and post-treatment scores on pain-related variables are presented in Table 2. Participation in the physical therapy intervention was associated with a 30.1 % reduction in pain severity, a 37.2 % reduction in depression, a 29.8 % reduction in symptoms of post-traumatic stress, and a 40.3 % reduction in pain catastrophizing. The magnitude of these reductions is comparable (within 1 SD) to what has been reported in previous research examining the effects of physical therapy interventions on these variables [6, 11, 35, 36]. There were no differences between the 4 groups on change in physical function (i.e., walking distance) (F (3,170) = 0.191, p = .902).

Treatment Response as a Function of Risk Profile

43 participants (23.5 %) had post-treatment catastrophizing scores above 20, and were classified as non-responders. Participants classified as non-responders were rated by their clinicians as significantly less work-ready than responders, t (179) = 2.1, $p < .05$.

Table 3 shows the distribution of participants across the different risk groups. Thirty-five percent of the sample met classification criteria for the Low Catastrophizing and Low Mental Health Problems group, 16 % met criteria for the High Catastrophizing and Low Mental Health Problems group, 37 % met criteria for the High Catastrophizing and High Mental Health Problems group, and 10 % met criteria for the Low Catastrophizing and Low Mental Health Problems group.

Table 3 also shows the distribution of treatment response participants as a function of risk profile. In the Low Catastrophizing and Low Mental Health Problems group (n = 66), only 2 participants (3 %) were classified as non-responders at termination of treatment. In the High Catastrophizing and Low Mental Health Problems group (n = 30), 6 participants (20 %) were classified as non-responders at termination of treatment. In the High Catastrophizing and High Mental Health Problems group (n = 69), 34 participants (49 %) were classified as non-responders at termination of treatment. In the Low Catastrophizing and High Mental Health Problems group (n = 18), only 1 participant (5 %) was classified as a non-responder at termination of treatment.

A Chi square analysis revealed that the 4 groups differed significantly in the distribution of non-responsive participants, $\chi^2 = 48.236$, $p < .001$. Follow-up paired comparisons using Fisher's Exact Test revealed that the High Catastrophizing and High Mental Health Problems group had a higher proportion of non-responders than the High Catastrophizing and Low Mental Health Problems group, $p < .01$, the Low Catastrophizing and High Mental Health Problems group, $p < .001$, and the Low Catastrophizing and Low Mental Health Problems group, $p < .001$. The High Catastrophizing and Low Mental Health Problems group had a higher proportion of non-responsive participants than the Low Catastrophizing and Low Mental Health Problems group, $p < .01$, but was not significantly different from the Low Catastrophizing and High Mental Health Problems group, $p = .231$. The Low Catastrophizing and Low Mental Health Problems group and Low Catastrophizing and High Mental Health Problems group did not differ from each other in terms of the proportion of non-responsive participants, $p = .520$.

Discussion

The purpose of this study was to examine reductions in pain catastrophizing that occur during the course of physical therapy following musculoskeletal injury. The present results are consistent with previous research in showing that a physical therapy intervention can yield significant reductions in pain catastrophizing [11, 14, 35]. The findings of this study extend previous findings in showing that while catastrophizing scores appear to respond well to physical therapy, the number of non-responders increases dramatically when high catastrophizing is coupled with symptoms of mental health problems.

There has been little research conducted to date on the co-occurrence of pain-related psychosocial risk factors and clinically significant mental health symptoms. It is interesting to note that the probability of a participant scoring high on catastrophizing and high on measures of mental health symptoms (37 %) was more than twice as high as the probability of a participant scoring high only on catastrophizing (16 %). This finding indicates that scoring high on a measure of catastrophizing is associated with an elevated risk of scoring high on measures of mental health symptoms as well. Cognitive-behavioral models of emotional disorders have pointed to catastrophizing (i.e., negative cognitions) as a cognitive precursor to emotional distress reactions [37]. As such, it might not be surprising that a high percentage of individuals with elevated scores on catastrophizing also have elevated scores on measures of mental health problems.

One previous study has reported on the distribution of catastrophizing and depression scores in individuals with subacute musculoskeletal conditions. In their study, Linton et al. [38] reported that 50 % of their study sample scored low on depression and catastrophizing, with only 15 % of

Table 1 Sample characteristics

	Total sample	Low catastrophizing, low mental health	High catastrophizing, low mental health	High catastrophizing, high mental health	Low catastrophizing, high mental health
n (%) or Mean (95 % CI)					
N	187	66	30	69	18
Age	36.85 (35.40–38.30)	36.95 (34.37–39.54)	38.57 (34.65–42.48)	35.42 (33.11–37.73)	37.72 (32.68–42.76)
Sex					
Male	73 (39 %)	28 (42 %)	12 (40 %)	26 (37 %)	5 (28 %)
Female	114 (61 %)	38 (58 %)	18 (60 %)	43 (63 %)	13 (72 %)
Education					
Less than high school	33 (17.6 %)	12(18.1 %)	9 (30 %)	11 (15.9 %)	1 (5.6 %)
High school	49 (26.2 %)	16 (24.2 %)	4 (13.3 %)	23 (33.3 %)	5 (27.8 %)
Trade school	43 (22.9 %)	13 (19.7 %)	6 (20 %)	17 (24.6 %)	5 (27.8 %)
College	41 (21.9 %)	15 (22.7 %)	6 (20 %)	13 (18.8 %)	6 (33.3 %)
University	21 (11/2 %)	10 (15.2 %)	5 (16.7 %)	5 (7.2 %)	1 (5.6 %)
Marital status					
Single	62 (33.2 %)	19 (28.7 %)	13 (43.3 %)	25 (36.2 %)	4 (22.2 %)
Common–law	45 (24.1 %)	14 (21.2 %)	7 (23.3 %)	19 (27.5 %)	5 (27.8 %)
Married	52 (27.8 %)	21 (31.8 %)	6 (20 %)	16 (23.2 %)	6 (33.3 %)
Widow	1 (0.53 %)	0	1 (3.3 %)	0	0
Separated/divorced	27 (14.4 %)	12 (18.2 %)	3 (10 %)	9 (13.04 %)	3 (16.7 %)
Medication					
None	7 (3.7)	4 (6.1 %)	1 (3.3 %)	1 (1.4 %)	1 (5.6 %)
NSAID/OTC	91 (48.7 %)	37 (53.7 %)	19 (63.3 %)	30 (43.5 %)	5 (27.8 %)
Narcotic	27 (14.4 %)	6 (9.1 %)	5 (16.7 %)	11 (15.9 %)	5 (27.8 %)
Anti-inflammatory	16 (8.6 %)	7 (10.6 %)	1 (3.3 %)	7 (10.1 %)	1 (5.6 %)
Occupation					
Labourer	64 (34.2 %)	16 (24.2 %)	15 (50 %)	23 (33.3 %)	8 (44.4 %)
Driver	10 (5.3 %)	4 (6.1 %)	1 (3.3 %)	3 (4.3 %)	2 (11.1 %)
Nursing	49 (26.2 %)	16 (24.2 %)	7 (23.3 %)	24 (34.8 %)	1 (5.6 %)
Trade	13 (6.9 %)	4 (6.1 %)	2 (6.7 %)	6 (8.7 %	1 (5.6 %)
Sales	10 (5.3 %)	7 (10.6 %)	1 (3.3 %)	2 (2.9 %)	0
Admin/clerical	32 (17.1 %)	15 (22.7 %)	4 (13.3 %)	7 (10.1 %)	5 (27.8 %)
Student	1 (0.53 %)	0	0	1 (1.4 %)	0
Other	9 (4.8 %)	4 (6.1 %)	0	3 (4.3 %)	1 (5.6 %)
Injury site (categories are not mutually exclusive)					
Back	175 (93.6 %)	63 (95.5 %)	27 (90 %)	68 (98.6 %)	14 (77.7 %)
Neck	137 (73.3 %)	44 (66.7 %)	21 (70 %)	57 (82.6 %)	11 (6.1 %)
Upper extremity	105 (56.1 %)	32 (48.5 %)	14 (16.7 %)	46 (66.6 %)	12 (66.6 %)
Lower extremity	48 (25.7 %)	10 (15.15 %)	7 (23.3 %)	23 (33.3 %)	7 (38.9 %)
Duration since injury	7.19 (6.77–7.62)	7.146 (6.48–7.79)	7.00 (5.78–8.22)	7.63 (6.90–8.37)	6.61 (5.14–8.08)

the sample scoring high on both catastrophizing and depression. Although the prevalence of different risk profiles differs between the two studies, the studies are consistent in showing that catastrophizing and mental health problems can occur separately or they can co-occur. The differences in prevalence of the different risk profiles might be attributable to cross-study differences in sample selection. In the Linton et al. [38] study, sample selection was based on presence of persistent pain symptoms while in the present study, sample selection was based on persistence of pain symptoms and work disability. The higher rates of mental health problems observed in the present study might be due the more severe disability that characterized the sample.

In the present study, thirty-five percent of the sample was classified as Low Catastrophizing and Low Mental Health Problems, and the majority of these participants (97 %) remained below clinical threshold on the PCS at the

Table 2 Means and 95 % confidence intervals of pre and post-treatment variables

	Total sample	Low catastrophizing, low mental health	High catastrophizing, low mental health	High catastrophizing, high mental health	Low catastrophizing, high mental health
Pre-treatment					
PCS	20.941 (19.39–22.5)	10.70 (9.34–12.04)	27.0 (24.94–29.05)	29.71 (28.24–31.19)	13.82 (912.57–15.07)
BDI	14.49 (13.15–15.83)	8.69 (7.5–9.89)	9.51 (7.83–11.19)	20.67 (18.59–22.75)	18.05 (13.71–22.40)
IES	30.59 (27.39–33.79)	13.92 (11.56–16.28)	15.55 (11.38–19.72)	51.25 (47.58–54.91)	34.64 (27.79–42.49)
MPQ	21.86 (19.88–23.84)	16.62 (13.96–19.28)	19.68 (15.11–24.26)	26.53 (23.08, 29.98)	23.82 (17.1–30.56)
5 min fast walk	361.67 (340.40–382.93)	373.26 (331.04–415.49)	310.98 (250.60–371.37)	376.72 (341.00–412.44)	318.89 (237.25–400.53)
Post-treatment					
PCS	12.12 (10.40–13.84)	5.34 (3.87–6.85)	12.31 (9.03–15.58)	19.39 (16.65–22.12)	8.58 (4.61–12.56)
BDI	10.32 (8.91–11.73)	5.91 (4.62–7.19)	7.13 (4.53–9.74)	15.07 (12.56–17.59)	15.41 (11.28–19.54)
IES	19.39 (16.49–22.29)	8.06 (6.0–10.11)	11.58 (7.68–15.48)	33.15 (28.36–37.94)	20.41 (13.85–26.96)
MPQ	14.72 (12.61–16.83)	10.39 (8.04–12.74)	13.20 (9.01–17.39)	18.46 (14.63–22.3)	20.76 (14.15–27.37)
5 min fast walk	426.53 (426.53–472.19)	446.90 (414.50–479.30)	427.08 (353.85–500.31)	459.14 (422.11–496.17)	442.68 (355.27–530.09)

end of treatment. The majority (95 %) of participants classified as Low Catastrophizing and High Mental Problems also remained below clinical threshold on the PCS at post-treatment evaluation. These findings indicate that catastrophizing scores are unlikely to increase through the course of physical therapy, even when they are associated with mental health problems.

In the High Catastrophizing and Low Mental Health Problems group, 80 % of participants who initially scored above threshold on the PCS, had scores below threshold the end of treatment. This finding suggests that elements of physical therapy interventions likely have therapeutic impact on levels of catastrophizing. The repeated exposure to activity that comprises many physical therapy interventions might be one vehicle through which levels of catastrophizing are reduced [39]. Education is also frequently provided within the context of physical therapy, which might represent an additional vehicle through which levels of catastrophizing are reduced [40]. Physical therapy may also act on catastrophizing through non-specific 'common factors' that may be shared with all psychosocial interventions, such as social contact, support, encouragement, and goal-setting [15, 16, 41].

If traditional approaches to physical therapy can reduce levels of catastrophizing below clinical threshold, the question arises as to whether additional targeted interventions are warranted. The answer to this question will depend largely on the costs associated with failure to reduce catastrophizing scores below clinical threshold. In the present study, 20 % of participants in the High Catastrophizing and Low Mental Health Problems group were classified as non-responders. If most of these individuals go on to follow a course of chronic disability, then the ensuing costs of extended salary indemnity and ongoing treatment might be sufficiently elevated as to justify additional treatment specifically designed to target catastrophic thinking. Previous research has shown that the addition of a targeted psychosocial intervention in addition to physical therapy yields greater reductions in catastrophizing than physical therapy alone [11].

Approximately half of the participants in the High Catastrophizing and Mental Health Problems group were classified as non-responders at the end of the physical therapy intervention. This group had a higher percentage of non-responders than any other of the risk profile groups. The high number of non-responders in this group suggests that physical therapy interventions are not sufficient when high scores on catastrophizing are combined with high scores on measures of mental health problems. As noted earlier, the costs associated with lack of treatment response can be very high. A 49 % rate of non-response to treatment is likely beyond the threshold for acceptable risk for most stakeholders in work disability and rehabilitation.

Table 3 Distribution of non-responders as a function of group

Group		Post-treatment PCS <20	Post-treatment PCS ≥20	Percentage non-responder
Low catastrophizing and low mental health problems	n = 66 (35 %)	64	2	3 %
High catastrophizing and low mental health problems	n = 30 (16 %)	24	2	20 %
High catastrophizing and high mental health problems	n = 69 (37 %)	35	34	49 %
Low catastrophizing and high mental health problems	n = 18 (10 %)	17	1	5 %

There are indications that it might be possible to augment the impact of physical therapy on pain catastrophizing. For instance, emotional disclosure interventions allow patients to communicate their perception of pain and its emotional impact. Several studies suggest that this may be an important intervention for patients with elevated levels of catastrophizing [8, 17, 42, 43]. Reassurance and activity encouragement is another brief intervention [42, 44], which has been shown to reduce a number of variables associated with catastrophizing, including pain intensity, pain-related fear, and disability [45–47]. Moseley et al. have found significant reductions on catastrophizing following a single neurophysiological educational session [10]. Graded activity and graded exposure are designed to help patients reduce pain-related fears, progressively increase their participation in pain-related activities; these interventions have also been shown to reduce catastrophizing [48, 49]. Graded activity works by establishing baseline exercise abilities and gradually increasing exercise quotas, while graded exposure targets pain-related fear through the creation of a hierarchy of feared movements and approaching them with more traditional exposure gradients [50]. Comparisons of graded activity and graded exposure suggest that their impact on pain and disability is mediated through reductions of pain catastrophizing rather than specific exercise regiments [50]. More research is needed to understand the optimal timing and content of these interventions when used during the course of physical therapy following clinical guidelines for functional restoration after subacute musculoskeletal injury. Research is also needed to examine how physical therapists might best be trained in these psychosocial intervention strategies.

Incorporating techniques to reduce catastrophizing within physical therapy interventions might also reduce the severity of mental health symptoms experienced by individuals who have sustained musculoskeletal injuries. Research indicates that measures of catastrophizing are significantly correlated with measures of depression and post-traumatic stress [4, 26]. Furthermore, cognitive-behavioral approaches to the management of mental health conditions such as depression and post-traumatic stress emphasize the importance of reducing catastrophizing as a means of decreasing the severity of mental health problems [37, 51, 52]. Enhancing the potential of physical therapy to yield reductions in catastrophizing might have the added benefit of also contributing to better recovery from mental health consequences of work-injury.

The development of practice guidelines advocating for greater collaboration between primary care physical therapists and behavioral or mental health practitioners might also be warranted. Mental health problems continue to be under-detected and under-treated in individuals with musculoskeletal conditions [53]. Assessment of mental health problems is not a routine part of primary medical care. As well, insurers are often reluctant to refer clients for psychiatric or psychological treatment due to concerns about increases in claim costs. However, findings suggest that claim costs might increase substantively when referral for treatment of mental health problems is delayed until chronicity has been established [54]. Claim costs might actually be reduced if treatment for mental health problems is implemented early. Delays in addressing mental health problems might mean missing a window of opportunity for promoting recovery and rehabilitation in injured workers.

The present study joins a growing literature indicating that psychosocial risk factors will tend to co-occur with mental health problems and that the presence of both represents a cumulative risk for poor rehabilitation outcomes [38, 39, 55]. It is becoming standard practice in primary care physical therapy to include screening measures for psychosocial risk factors such as catastrophizing, as well as measures of mental health symptoms related to depression or post-traumatic stress. There are few guidelines, however, addressing the pattern of scores on these measures that should trigger a referral for an intervention specifically designed to target psychosocial risk factors or mental health symptoms. The findings of the present study suggest that a combination of high catastrophizing and high mental health symptoms would warrant a referral for psychosocial or psychological intervention. In light of research suggesting that mental health problems associated with pain become more resistant to treatment as the period of chronicity extends over time, such referral should be initiated as soon as possible [56].

Caution must be exercised in the interpretation of the present findings. First, only self-report measures of mental

health problems were used. The presence of mental health problems was operationalized as high scores on the BDI-II or the IES as opposed to diagnostic interview. To date, the bulk of research on mental health problems associated with musculoskeletal conditions has been conducted with self-report measures [57, 58]. Considerable research attests to the validity of these measures as indices of mental health symptoms associated with pain [58, 59]. However, there is research to suggest that self-report measures of mental health symptoms have high sensitivity but low specificity [23, 60]. There are also indications that anxiety may play a role in negative outcomes following physical therapy [61, 62]. Future research should examine anxiety-related mental health conditions when examining the impact of mental health symptoms on physical therapy outcomes.

An additional limitation is that end-of-treatment PCS scores were used as the criterion for treatment response. There would have been advantages to including more objective measures of treatment response such as claim duration, claim costs, or return to work. Unfortunately, these measures were not available for the present sample. Interpretation of the findings concerning the relation between pain-related psychosocial variables and physical function must also be made with caution since the 5-minute fast walk was the only physical function measure used. The 5-minute fast walk test might not be the most sensitive measure of function for individuals with musculoskeletal symptoms of the upper spine or upper extremities. Finally, physical therapy interventions, though designed along clinical guidelines for functional restoration, were not standardized between treatment centers or participating physiotherapists.

Despite these limitations, this study provides important information to aid clinicians in the interpretation of pre-treatment assessments on psychosocial and mental health variables related to pain. Clients with high levels of both catastrophizing and mental health symptoms prior to entering treatment were least likely to obtain clinically meaningful reductions of catastrophizing during the course of physical therapy. From a practice perspective, screening only for psychosocial risk factors may underestimate a client's treatment needs. The present findings highlight the importance of screening for mental health symptoms as well as psychosocial risk factors since scores on both will need to be considered to identify clients who might require additional treatment services. Streamlining clients in the early stages of recovery to appropriate treatments might reduce the probability of negative long-term outcomes for at-risk individuals recovering from musculoskeletal injury.

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