

Pain, perceived injustice and the persistence of post-traumatic stress symptoms during the course of rehabilitation for whiplash injuries

Michael J.L. Sullivan^{a,*}, Pascal Thibault^a, Maureen J. Simmonds^b, Maria Milioto^c, André-Philippe Cantin^d, Ana M. Velly^a

^a Department of Psychology, McGill University, Canada

^b School of Physical and Occupational Therapy, McGill University, Rm D26, 3654 Promenade Sir William Osler, Montreal, Quebec, Canada H3G 1Y5

^c Clinique d'évaluation et de réadaptation de l'est, 6494 Beaubien est, bureau 102, Montreal, Quebec, Canada H1M 1A9

^d Clinique de physiothérapie Ste-Anne, 324, boul. Antonio-Barrette N.D.P., Joliette, Quebec, Canada J6E 1G2

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ABSTRACT

The present study assessed the role of pain and pain-related psychological variables in the persistence of post-traumatic stress symptoms following whiplash injury. Individuals ($N=112$) with whiplash injuries who had been admitted to a standardized multidisciplinary rehabilitation program were asked to complete measures of pain, post-traumatic stress symptoms, physical function and pain-related psychological variables at three different points during their treatment program. The findings are consistent with previous research showing that indicators of injury severity such as pain, reduced function and disability, and scores on pain-related psychological were associated with more severe post-traumatic stress symptoms in individuals with whiplash injuries. Contrary to expectations, indicators of pain severity did not contribute to the persistence of post-traumatic stress symptoms. Univariate analyses revealed that self-reported disability, pain catastrophizing and perceived injustice were significant determinants of the persistence of post-traumatic stress symptoms. In multivariate analyses, only perceived injustice emerged as a unique predictor of the persistence of post-traumatic stress symptoms. The results suggest that early adequate management of pain symptoms and disability consequent to whiplash injury might reduce the severity of post-traumatic stress symptoms. The development of effective intervention techniques for targeting perceptions of injustice might be important for promoting recovery of post-traumatic stress symptoms consequent to whiplash injury.

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1. Introduction

Research suggests that post-traumatic stress symptoms are prevalent in individuals who have sustained whiplash injuries following motor vehicle accidents [9,10,17,37]. Although prevalence rates vary widely, it has been suggested that as many as 1 in 4 individuals who sustain whiplash injuries in motor vehicles accidents might show evidence of clinically significant post-traumatic stress symptoms [9,10,34,37]. Post-traumatic stress symptoms are characterized by three major symptom clusters including re-experiencing symptoms (e.g., thought intrusion, nightmares), avoidance symptoms (e.g., avoidance of stimuli associated with the traumatic situation, social withdrawal) and arousal symptoms (e.g., hyper-vigilance, heightened startle reactions) [10]. It has been suggested

that post-traumatic stress symptoms add to the burden of disability following whiplash injury and might contribute to the heightened risk of chronicity [4,16,45,48].

Increasingly, attention has been drawn to the role of persistent pain in the maintenance of post-traumatic stress symptoms consequent to whiplash injury [3,47]. 'Mutual maintenance' models have been put forward to explain high rates of co-morbidity of pain and post-traumatic stress symptoms. It has been suggested that ongoing pain might contribute to the persistence of PTSD symptoms by acting as a "trigger" for memories of the traumatic incident [3,38,47]. Clinical and anecdotal evidence supports the view that the symptoms of PTSD can be aggravated by stimuli that resemble aspects of the precipitating traumatic event [60]. Although not specifically addressed within mutual maintenance models of the persistence of post-traumatic stress symptoms, it is also possible that the functional limitations ensuing from injury might also act as triggers for memories of the traumatic incident.

It has been suggested that pain-related psychological variables might also contribute to the maintenance of post-traumatic stress

* Corresponding author. Address: Department of Psychology, McGill University, 1205 Docteur Penfield Ave., Montréal, Que., Canada H3A 1B1. Tel.: +1 514 398 5677; fax: +1 514 343 4896.

E-mail address: michael.sullivan@mcgill.ca (M.J.L. Sullivan).

symptoms [3,38,47]. For example, cognitive and affective variables such as catastrophic thinking, fear of movement/re-injury, and depression have been associated with heightened pain and disability in individuals who have sustained whiplash injuries [13,42]. Recently, it has also been shown that the perceptions of injustice contribute to ongoing pain and disability in individuals with whiplash injuries [52]. These variables might contribute to the persistence of post-traumatic stress symptoms either through their impact on the severity of pain symptoms, or through processes that are independent of pain severity. To date, the role of ongoing pain, functional limitations, or the role of pain-related psychological variables, in the persistence of post-traumatic stress symptoms consequent to whiplash injury has not been systematically investigated.

The purpose of the present research was to assess the role of pain and pain-related psychological variables in the persistence of post-traumatic stress symptoms following whiplash injury. Individuals with whiplash injuries who had been admitted to a standardized multidisciplinary rehabilitation program were asked to complete measures of pain, post-traumatic stress symptoms, physical function and pain-related psychological variables at three different points during their treatment program. Analyses addressed the value of pain severity, functional limitations, and pain-related psychological variables, assessed at admission, for the prediction of the course of recovery of post-traumatic stress symptoms.

2. Methods

2.1. Participants

The study sample consisted of 112 individuals (76 women, 36 men) who had sustained Whiplash injuries in rear-collision motor vehicle accidents. The mean age of the sample was 35.8 years with a range of 20–60 years. The mean number of weeks since injury was 18.3 with a range of 8–48 weeks. The majority of participants (80%) had completed at least 12 years of education. Approximately half the sample (59%) was married or living common law.

At the time of the initial assessment, all participants were work-disabled and were receiving salary indemnity. In the province of Quebec, Canada, all individuals are covered under a state-run no-fault insurance system (*Société de l'assurance automobile du Québec*) that provides access to required health services and salary indemnity in the case of work disability following injury.

2.2. Procedure

Participants were recruited from one of five rehabilitation clinics in the Montreal region. At the time of recruitment, a network of rehabilitation clinics offered a standardized 7-week multidisciplinary functional restoration rehabilitation program aimed at fostering recovery from whiplash injury. The intervention team consisted of a physiotherapist, occupational therapist and psychologist. Interventions techniques used in the rehabilitation program fell broadly into three domains; exercise, education and instruction in self-management skills. Some interventions (e.g., instruction in self-management) were provided in group format, others (e.g., exercise) were individualized based on clients' needs.

Individuals were considered for referral to one of these clinics if they had received a diagnosis of Whiplash Associated Disorders, Grade 1 or 2, and remained significantly disabled at 8 weeks post-injury. Potential participants were provided with a letter describing the procedures of the study. Individuals were asked to indicate their interest in volunteering to a clinic coordinator.

Participants were asked to complete a brief measure of physical functioning (e.g., cervical range of motion) and questionnaires

assessing cognitive and affective variables related to pain, distress and disability (described in more detail below). Assessments were completed shortly following admission to the 7-week rehabilitation program, mid-way through the program, and during the last week of the program. Participants were invited to sign a consent form as a condition of enrolment in the study. The research was approved by the Ethics Review Committee of the *Centre de recherche interdisciplinaire en réadaptation de Montréal métropolitain (CRIR)*.

2.3. Measures

2.3.1. Pain severity

Participants were asked to complete the McGill Pain Questionnaire (MPQ) [39] to assess their current pain severity. The Pain Rating Index (PRI) of the MPQ is a weighted sum of all adjectives endorsed, and is considered a reliable and valid index of an individual's pain experience associated with whiplash [54,55]. Participants were also asked to rate the severity of their pain on an 11-point numerical rating scale with the endpoints (0) no pain and (10) excruciating pain. Total number of pain sites (range = 0–4) was computed from the body drawing (neck, back, upper extremity, lower extremity).

2.3.2. Neck range of motion

The maximum active Cervical Range of Motion (CROM; flexion and extension, left and right lateral flexion, and left and right rotation) was assessed with a CROM device [33]. Measurement of active CROM has high intra- and inter-rater reliability and has been shown to predict long-term outcomes in patients with whiplash injuries [31,48].

2.3.3. Self-rated disability

The Neck Disability Index (NDI) was used as a measure of self-rated disability associated with neck pain [56]. The NDI consists of 10 groups of statements describing levels of disability resulting from neck pain in different domains of daily life. Respondents choose the statements that best describe their current level of pain-related disability. Item weightings are summed to produce an overall index of disability where higher scores reflect greater disability. The NDI has been shown to be a reliable and valid index of disability associated with cervical spine disorders [46,56,59].

2.3.4. Post-traumatic stress symptoms

The Impact of Events Scale – Revised was used to assess symptoms of post-traumatic stress. On this measure respondents are asked to rate the degree of distress they experience with different cognitive and emotional aspects of post-traumatic stress on a 5-point rating scale with the endpoints (0) *not at all* and (4) *extremely*. The IES-R has been shown to be a reliable and valid index of post-traumatic symptoms [15,58]. Scores on the IES-R have been shown to discriminate between individuals with and without a diagnosis of Post-traumatic stress disorder (PTSD) [7]. A cut score of 33 has been recommended as the threshold for clinically significant post-traumatic stress symptoms [19].

2.3.5. Depression

The Beck Depression Inventory II [6] was used as a self-report measure of depressive symptom severity. The BDI consists of 21 statements describing various symptoms of depression and respondents choose the statement that best describes how they have been feeling over the past two weeks. Responses are summed to yield an overall index of severity of depressive symptoms. The BDI-II has been shown to be a reliable and valid index of depressive symptoms in chronic pain patients and primary care medical patients [2].

2.3.6. Catastrophizing

The Pain Catastrophizing Scale (PCS) [50] was used as a measure of catastrophic thinking related to pain. The PCS instructions ask participants to reflect on past painful experiences, and to indicate the degree to which they experienced each of 13 thoughts or feelings when experiencing pain, on 5-point scale with the endpoints (0) not at all and (4) all the time. The PCS has been shown to have high internal consistency and to be associated with heightened pain, disability as well as employment status [27,51].

2.3.7. Fear of movement/re-injury

The Tampa Scale for Kinesiophobia (TSK) [36] is a 17-item questionnaire that assesses fear of (re)injury due to movement. Respondents are asked to choose a number between 1 and 4 to indicate the degree to which they agree or disagree with items reflecting concerns about the dangers of activity. The TSK has been shown to be internally reliable (coefficient alpha = .77) [20]. The TSK has been shown to be associated with various indices of behavioral avoidance and self-reported disability [28,57].

2.3.8. Perceived injustice

The Injustice Experiences Questionnaire (IEQ) was used to assess perceptions of injustice [52]. The IEQ is a 12-item scale that asks respondents to indicate the frequency with which they experience different thoughts concerning the sense of unfairness in relation to their injury on a 5-point scale with the endpoints (0) *never* and (4) *all the time*. On this measure, perceived injustice is construed as an appraisal cognition comprising elements of the severity of loss consequent to injury (“Most people don’t understand how severe my condition is”), blame (“I am suffering because of someone else’s negligence”), a sense of unfairness (“It all seems so unfair”), and irreparability of loss (“My life will never be the same”). Previous research suggests that the IEQ yields two correlated factors that have been labeled severity/irreparability of loss and blame/unfairness [52]. The IEQ has been shown to be internally reliable and to predict prolonged disability following musculoskeletal injury [52].

2.3.9. Demographic and injury-related variables

Patients were asked to respond to questions concerning their age, sex, marital status, education, occupation, and medication use. Crash related characteristics (i.e., speed of collision, use of head rest, use of seat belt) were also assessed.

2.4. Data analytic approach

There were no significant differences on any of the study variables as a function of the specific clinic from which participants were recruited. As such, clinic of recruitment is not addressed further in statistical analyses. *T*-tests for independent samples and chi-square analyses were used to compare men and women on various study variables. Repeated measures analyses of variance were used to examine changes in study variables over the course of the treatment program. A cut score of 33 on the IES-R was used to classify participants as experiencing post-traumatic stress symptoms above (≥ 33) or below (< 33) clinical threshold [19]. Since cut scores on self-report instruments cannot be used as a basis for making mental health diagnoses, the term ‘post-traumatic stress symptoms’ is used instead of ‘post-traumatic stress disorder’ to refer to participants who score within the clinical range of the IES-R. Unconditional logistic regression analyses were used to identify the prognostic factors that predicted whether participants who initially obtained high scores in the IES-R, remained high when compared to participants who improved through the course of the 7-week rehabilitation program. In the regression results reported, all tolerance coefficients were greater than .60 such that no

problem of multicollinearity was indicated. All analyses were conducted with SPSS Version 16.

3. Results

3.1. Sample characteristics

Means and standard deviations on all dependent measures are presented in Table 1. Mean scores on measures of pain severity, self-reported disability, fear of movement and post-traumatic stress symptoms are comparable (e.g., within one standard deviation) to those reported in the previous studies of recovery trajectories of individuals with whiplash injuries [48,49].

In this sample, women ($M = 15.0$, $SD = 6.5$) were more educated than men ($M = 12.0$, $SD = 6.0$), $t(110) = 2.4$, $p < .01$, more likely to be a passenger (women = 22%, men = 3%), $\chi^2 = 6.9$, $p < .01$, and were injured in accidents where the collision speed was less than that for men (42.1 km/h for women versus 57.1 km/h for men), $t(110) = 3.3$, $p < .01$. There were no significant sex differences on any of the measures of cervical range of motion or on self-reported disability. Men obtained significantly higher scores than women on pain severity, $t(110) = 2.0$, $p < .05$, fear of movement, $t(110) = -3.6$, $p < .01$, and perceived injustice, $t(110) = -2.0$, $p < .05$ (see Table 2).

3.2. Correlations among psychological and injury-related variables

Consistent with previous research, scores on the measure of post-traumatic symptoms (IES-R) were significantly correlated with indices of pain severity, self-reported disability (NDI) and 4 of 6 measures of cervical range of motion [48,49] (see Table 3). Also consistent with previous research, pain catastrophizing (PCS), depression (BDI-II) and perceived injustice (IEQ) were significantly correlated with indices of pain severity [52].

Pain catastrophizing emerged as the strongest psychological correlate of range of motion (5 of 6 significant correlations). Perceived injustice (3 of 6 significant correlations), fear of movement (2 of 6 significant correlations) and depression (1 of 6 significant correlations) were also correlated with range of motion measures to varying degrees. All psychological measures except fear of movement (TSK) were significantly correlated with self-reported disability (NDI).

Table 1

Means and standard deviations on demographic and injury-related variables at time of admission.

	Women ($n = 76$)	Men ($n = 36$)	p
Age	36.3 (9.7)	35.0 (9.3)	ns
Time since injury (weeks)	18.4 (6.5)	17.5 (8.9)	ns
Education (years)	15.0 (6.5)	12.0 (6.0)	.01
Driver/passenger	59/17	35/1	.01
Collision speed (km/h)	42.1 (21.7)	57.1 (22.6)	.01
Seat belt (yes/no)	71/5	34/2	ns
Head rest (yes/no)	52/24	29/7	ns
Pain severity (0–10)	5.1 (1.6)	5.1 (2.1)	ns
MPQ–PRI	19.6 (11.9)	25.2 (16.0)	.05
Number of pain sites	2.8 (.70)	2.8 (.70)	ns
<i>Cervical range of motion</i>			
Flexion	41.8 (14.0)	41.5 (11.9)	ns
Extension	49.3 (15.6)	44.4 (16.0)	ns
Right lateral	34.2 (8.4)	33.7 (7.8)	ns
Left lateral	36.3 (7.9)	34.7 (7.5)	ns
Right rotation	53.8 (13.9)	49.9 (12.6)	ns
Left rotation	55.1 (12.8)	50.6 (12.4)	ns
NDI	22.5 (6.2)	22.7 (7.0)	ns

Note: MPQ–PRI, McGill Pain Questionnaire–Pain Rating Index; NDI, Neck Disability Index. Values in parentheses are standard deviations.

Table 2

Means and standard deviations on psychological measures at time of admission.

	Women (n = 76)	Men (n = 36)	p
PCS	21.0 (10.4)	22.7 (7.0)	ns
TSK	40.5 (7.5)	45.8 (6.2)	.01
BDI-II	14.7 (8.4)	15.2 (11.6)	ns
IEQ	21.1 (9.7)	24.8 (9.2)	.05
IES-R	31.9 (21.8)	32.2 (23.1)	ns

Note: PCS, Pain Catastrophizing Scale; TSK, Tampa Scale for Kinesiophobia; BDI-II, Beck Depression Inventory II; IEQ, Injustice Experiences Questionnaire; IES-R, Impact of Events Scale – Revised. Numbers in parentheses are standard deviations.

Table 4 shows the correlations among psychological variables assessed at the time of admission to treatment. Post-traumatic symptoms (IES-R) were significantly correlated with pain catastrophizing (PCS), depression (BDI-II), fear of movement (TSK) and perceived injustice (IEQ).

3.3. Treatment-related changes in pain, function, disability and distress

Means and standard deviations for dependent measures at all three assessment points are presented in Table 5. All variables showed significant decreases through the course of treatment. Eta² values are presented in the right-most column of Table 5 to reflect the magnitude of change in each variable. The variables that showed the greatest change included pain catastrophizing, fear of movement, and self-reported disability. The variables that showed the least change included two ranges of motion measures (left rotation, extension), number of pain sites, and perceived injustice (IEQ).

3.4. Determinants of the persistence of post-traumatic stress symptoms

In order to examine the determinants of the persistence of post-traumatic stress symptoms, the sample was divided into three groups: (1) participants who scored below clinical threshold (<33) on the IES-R at admission and discharge (low–low, n = 62), (2) participants who scored above clinical threshold on the IES-R at admission but fell below clinical threshold at discharge (high–low, n = 22), and (3) participants who scored above clinical threshold on the IES-R at admission and at discharge (high–high, n = 28). There were no cases of participants scoring below clinical thresh-

Table 3

Correlations between psychological variables and injury-related variables at time of admission.

	PCS	TSK	BDI-II	IEQ	IES-R
Collision speed	.08	.16	-.03	.08	.05
Time since injury	.10	.16	.04	.11	.08
Pain severity (0–10)	.26**	.01	.26**	.12	.28**
MPQ–PRI	.24**	.12	.39**	.19*	.28**
Number of pain sites	.20**	.18*	.28**	.25**	.24**
<i>Cervical range of motion</i>					
Flexion	-.22*	-.06	-.30**	-.12	-.21*
Extension	-.33**	-.19*	-.13	-.25**	-.19*
Right lateral	-.17	-.05	-.07	-.12	-.08
Left lateral	-.24**	-.11	-.07	-.12	-.12
Right rotation	-.36**	-.18	-.18	-.25**	-.28**
Left rotation	-.27**	-.23**	-.12	-.27**	-.24**
NDI	.43**	.17	.50**	.31**	.40**

Note: MPQ–PRI, McGill Pain Questionnaire – Pain Rating Index; NDI, Neck Disability Index.

* p < .05.

** p < .01.

Table 4

Correlations among psychological variables at time of admission.

	1	2	3	4
1. PCS				
2. TSK	.52**			
3. BDI-II	.47**	.23*		
4. IEQ	.67**	.62**	.43**	
5. IES-R	.65**	.45**	.61**	.60**

Note: PCS, Pain Catastrophizing Scale; TSK, Tampa Scale for Kinesiophobia; BDI-II, Beck Depression Inventory II; IEQ, Injustice Experiences Questionnaire; IES-R, Impact of Events Scale – Revised.

* p < .05.

** p < .01.

old on the IES-R at initial assessment and above threshold at post-treatment. Oneway analyses of variance (ANOVA) were computed on all dependent variables (Chi square was computed for sex) to identify univariate determinants of the persistence of post-traumatic stress symptoms. Table 6 shows the results of these analyses. Post hoc tests were computed using the Student Newman Keuls procedure.

At the time of admission, the three groups differed significantly on numerical ratings of pain severity, $F(2, 109) = 3.9, p < .05$, MPQ–PRI scores, $F(2, 109) = 4.0, p < .05$, number of pain sites, $F(2, 109) = 5.8, p < .01$, CROM extension, $F(2, 109) = 6.9, p < .001$, CROM rotation right, $F(2, 109) = 4.5, p < .01$, CROM rotation left, $F(2, 109) = 6.2, p < .001$, and self-reported disability (NDI), $F(2, 109) = 12.1, p < .001$. Significant group differences were also found for pain catastrophizing (PCS), $F(2, 109) = 43.7, p < .001$, fear of movement (TSK), $F(2, 109) = 9.4, p < .001$, depression (BDI-II), $F(2, 109) = 21.2, p < .002$, and perceived injustice (IEQ), $F(2, 109) = 35.0, p < .001$.

Results showing significant differences between the high–low and high–high groups point to potential candidate variables for the persistence of post-traumatic stress symptoms. As shown in Table 6, of the injury-related variables, only self-reported disability distinguished between participants whose post-traumatic stress symptoms resolved and those whose symptoms persisted. Of the psychological variables, pain catastrophizing and perceived injustice distinguished between participants whose post-traumatic stress symptoms resolved and those whose symptoms persisted.

Table 5

Repeated measures analyses of variance examining changes in clinical variables through the course of treatment.

Injury-related variables	Pre-treatment	Mid-treatment	Post-treatment	Eta ²
Pain severity (0–10)	5.0 (1.7)	4.7 (1.6)	3.9 (1.8)	.17
MPQ–PRI	21.4 (13.5)	19.2 (12.1)	14.9 (12.7)	.18
Number of pain sites	2.8 (.7)	2.5 (.9)	2.3 (1.0)	.11
NDI	22.6 (6.4)	19.6 (7.2)	15.8 (8.1)	.39
<i>Cervical range of motion</i>				
Flexion	41.7 (13.3)	45.9 (12.0)	48.7 (11.3)	.15
Extension	47.7 (15.8)	50.8 (15.8)	54.7 (15.8)	.12
Right lateral	34.1 (8.2)	37.1 (8.0)	38.6 (9.0)	.15
Left lateral	35.8 (7.8)	38.5 (8.2)	40.3 (8.3)	.16
Right rotation	52.6 (13.5)	57.8 (10.1)	58.9 (13.7)	.14
Left rotation	53.6 (12.8)	55.4 (12.7)	57.4 (13.7)	.07
<i>Psychological variables</i>				
PCS	21.9 (10.1)	15.8 (11.1)	12.9 (10.6)	.40
TSK	42.2 (7.5)	39.1 (7.8)	36.5 (8.0)	.30
BDI-II	14.9 (9.5)	12.3 (8.6)	11.0 (9.1)	.13
IES-R	32.0 (22.1)	26.0 (20.0)	22.2 (19.8)	.18
IEQ	22.3 (9.7)	21.2 (11.0)	18.7 (10.6)	.11

Note: MPQ–PRI, McGill Pain Questionnaire–Pain Rating Index; NDI, Neck Disability Index. PCS, Pain Catastrophizing Scale; TSK, Tampa Scale for Kinesiophobia; BDI-II, Beck Depression Inventory II; IES-R, Impact of Events Scale – Revised; IEQ, Injustice Experiences Questionnaire. Numbers in parentheses are standard deviations.

Table 6

Oneway analyses of variance examining potential determinants of the persistence of post-traumatic stress symptoms.

	Post-traumatic stress symptoms			<i>p</i>
	Low-low (<i>n</i> = 62)	High-low (<i>n</i> = 22)	High-high (<i>n</i> = 28)	
Sex (F/M)	48/18	15/7	17/11	ns
Age	36.1 (9.2) _a	35.6 (9.3) _a	35.6 (10.7) _a	ns
Time since injury	16.9 (5.9) _a	19.4 (8.9) _a	20.3 (7.8) _a	ns
Education	15.5 (6.5) _a	13.0 (6.0) _a	12.5 (6.0) _a	ns
Collision speed	44.6 (22.0) _a	49.7 (29.7) _a	49.8 (19.2) _a	ns
Pain severity (0–10)	4.7 (1.7) _a	5.1 (1.9) _{a,b}	5.9 (1.7) _b	.05
MPQ–PRI	18.6 (11.6) _a	22.3 (14.1) _{a,b}	27.1 (15.6) _b	.05
Number of pain sites	2.6 (.7) _a	3.1 (.7) _b	3.0 (.7) _b	.01
<i>Range of motion</i>				
Flexion	44.1 (13.0) _a	40.8 (14.1) _a	37.2 (12.5) _a	ns
Extension	50.3 (15.7) _a	52.0 (13.3) _b	38.6 (14.7) _b	.001
Right lateral	34.7 (8.1) _a	34.9 (8.1) _a	32.1 (8.6) _a	ns
Left lateral	37.0 (7.6) _a	35.6 (8.0) _a	33.2 (7.4) _a	ns
Right rotation	55.4 (12.7) _a	52.5 (11.2) _{a,b}	46.3 (15.2) _b	.01
Left rotation	56.3 (11.3) _a	55.1 (11.5) _{a,b}	46.6 (14.5) _b	.01
NDI	20.4 (5.5) _a	23.0 (6.8) _a	27.0 (5.9) _b	.001
PCS	16.1 (8.2) _a	25.7 (6.7) _b	31.7 (6.6) _c	.001
TSK	39.7 (7.7) _a	43.9 (6.2) _b	46.3 (6.0) _b	.001
BDI-II	10.4 (6.7) _a	19.1 (8.0) _b	21.4 (10.6) _b	.001
IEQ	17.3 (7.9) _a	24.5 (7.8) _b	31.6 (6.7) _c	.001

Note: All dependent variables are from the initial assessment. PCS, Pain Catastrophizing Scale; TSK, Tampa Scale for Kinesiophobia; BDI-II, Beck Depression Inventory II; IEQ, Injustice Experiences Questionnaire. For each variable, means with different subscripts differ significantly at $p < .05$. Values in parentheses are standard deviations.

The results of a logistic regression assessing the unique contribution of each of these variables are presented in Table 7. The overall model was significant ($\chi^2 = 15.8, p < .001$) accounting for 36% of the variance in group classification. Only perceived injustice contributed significant unique variance to the prediction of the persistence of post-traumatic stress symptoms. A follow-up logistic regression was conducted to assess the contribution of the two subscales of the IEQ to the prediction of the persistence of post-traumatic stress symptoms. This analysis revealed that only the blame/unfairness subscale of the IEQ contributed significant unique variance to the prediction of the persistence of post-traumatic stress symptoms, OR = 1.2, 95% CI = 1.1–1.4, $p < .01$. The blame/unfairness subscale of the IEQ alone accounted for 30% of the variance in group classification.

4. Discussion

The present study examined the role of injury-related and psychological variables in the persistence of post-traumatic stress symptoms consequent to whiplash injury. The findings of the present study are consistent with previous research showing that indicators of injury severity such as pain, reduced function and disability are associated with more intense post-traumatic stress symptoms in individuals with whiplash injuries [11]. The results extend previous findings in showing that, at the time of initial assessment, prior to treatment, high levels of perceived injustice

contribute to the persistence of post-traumatic stress symptoms consequent to whiplash injury.

In the study sample, 45% of participants scored above clinical threshold on the measure of post-traumatic stress symptoms at the time of admission. In previous research with individuals assessed one month post-injury, prevalence rates of post-traumatic stress disorder have been lower than those reported here, in the range of 20–30% [34,43]. Research suggests that approximately 60–70% of individuals with whiplash injuries will have resumed occupational activities at 2 months post-injury [1,5]. Given that a substantive proportion of individuals with less severe symptoms would have resumed occupational involvement at 8 weeks post-injury, post-traumatic stress symptoms might be over-represented in individuals with whiplash injuries who are still work-disabled at 8 weeks post-injury.

In other domains of trauma research, the severity of trauma (e.g., threat of death, violent assault) has been associated with more intense post-traumatic stress symptoms [14,35]. In two previous investigations [11,21], high scores on a self-report measure of injury severity were associated with greater likelihood of experiencing post-traumatic stress symptoms following motor vehicle accidents. In individuals with whiplash injuries, indicators of trauma severity might include the severity and distribution of pain symptoms, loss of physical function and disability. In the present study, indices of pain severity, range of motion restrictions and self-reported disability distinguished between participants with and without clinically significant post-traumatic stress symptoms.

The correlations between pain-related psychological variables (i.e., pain catastrophizing, fear of movement) and post-traumatic stress symptoms (at admission) are consistent with the view that certain psychological variables might predispose individuals to the development of post-traumatic stress symptoms following injury [3,47]. The significant correlation between BDI-II and IES-R scores at admission is also consistent with research showing high rates of co-morbidity of depression and post-traumatic stress conditions [10,29]. It is important to note, however, that the cross-sectional nature of these analyses precludes strong statements about the causal status of pain catastrophizing and fear of movement in the development of post-traumatic stress symptoms.

Table 7

Logistic regression examining predictors of the persistence of post-traumatic stress symptoms. Dependent variable = IES-R (1 = high-low, 2 = high-high).

	Wald	<i>B</i>	OR	95% CI
NDI	1.68	.08	1.0	.95–1.2
PCS	1.35	.07	1.0	.95–1.2
IEQ	4.52	.13	1.2*	1.0–1.3

Note: NDI, Neck Disability Index; PCS, Pain Catastrophizing Scale; IEQ, Injustice Experiences Questionnaire; OR, Odds ratio; 95% CI, 95th percentile confidence interval.

* $p < .05$.

Approximately half the participants who scored above clinical threshold for post-traumatic symptoms at the time of admission, also scored above clinical threshold at the time of the discharge evaluation. There was no evidence that pain symptoms (VAS, MPQ-PRI, number of pain sites) were associated with the persistence of post-traumatic stress symptoms. However, univariate analyses revealed that high scores on measures of self-reported disability, pain catastrophizing and perceived injustice distinguished between participants whose post-traumatic stress scores remained above clinical threshold, and participants whose scores fell below clinical threshold.

The relation between self-reported disability and the persistence of post-traumatic symptoms has not been previously reported. As suggested by 'mutual maintenance' models, it is possible that high levels of disability might act as a reminder or 'trigger' of the losses that have been sustained as a result of whiplash injury. It is also possible that the stimulus impoverished context of inactivity might provide a cognitive environment that fosters a high frequency of thought intrusions or other re-experiencing phenomena that might contribute to the persistence of post-traumatic stress symptoms.

Although the relation between pain catastrophizing and the persistence of post-traumatic stress symptoms has not been reported in previous research, this finding is consistent with theoretical models that propose that alarmist appraisals, and rumination might be predisposing factors for chronic post-traumatic stress symptoms [23–25,44]. Research suggests that efforts to suppress trauma-related thoughts or memories actually contribute to increased thought intrusions and heightened anxiety in individuals experiencing post-traumatic stress symptoms [24,30]. Interestingly there is also research to suggest that catastrophizing is associated with spontaneous (and unsuccessful) efforts to suppress pain-related cognitions [53]. Alarmist thinking, rumination and the use of suppression strategies might represent three of the processes by which pain catastrophizing might contribute to the persistence of post-traumatic stress symptoms.

A novel finding of the present study was the relation between high levels of perceived injustice and the persistence of post-traumatic stress symptoms. Perceived injustice was operationally defined as a multidimensional construct comprising elements of the severity of loss, irreparability of loss, blame, and sense of unfairness. There is a growing literature highlighting the negative impact of perceptions of injustice on pain outcomes [52]. Previous research has shown that high scores on a measure of perceived injustice were related to less rehabilitation progress and lower probability of return to work following musculoskeletal injury [52]. Perceptions of injustice have also been shown to be significantly associated with pain catastrophizing and self-reported disability raising the possibility of shared mechanisms of influence on the persistence of post-traumatic stress symptoms.

Logistic regression revealed that only perceived injustice contributed a significant unique variance to the prediction of the persistence of post-traumatic stress symptoms. It is possible that processes specific to perceptions of injustice, possibility unrelated to disability and pain catastrophizing, might contribute to the persistence of post-traumatic stress symptoms. For example, the blame/unfairness subscale of the IEQ accounted for the bulk of model variance in group classification. In other domains of research, perceptions of injustice have been discussed in terms of blame attributions and revenge motives [18,41]. Anger reactions have also been discussed as central to the experience of perceived injustice [8,41]. Emotional reactions to negative events persist for longer periods of time when the events are appraised as unjust [40]. These features of perceived injustice, which appear to be independent of disability and pain catastrophizing, are candidates

for processes that might augment the probability that post-traumatic stress symptoms will persist.

Although previous research has not specifically addressed the relation between perceived injustice and post-traumatic stress symptoms, there are findings consistent with the view that the perceptions of injustice might contribute to the persistence of post-traumatic stress symptoms. For example, cognitive content concerning the irreparability of loss has been associated with the persistence of post-traumatic stress symptoms [22,23]. Blame attributions and anger have also been associated with the persistence of post-traumatic stress symptoms following motor vehicle accidents [24,32]. There is research to suggest that the pursuit of litigation, which can be construed as a proxy for perceived injustice, might contribute to the persistence of post-traumatic stress symptoms [12]. Perceived injustice might be the overarching construct that links these different variables to ongoing post-traumatic stress symptoms.

The results of the present study suggest that the perceptions of injustice might need to be specifically targeted in order to maximize the probability of resolution of post-traumatic stress symptoms. Cognitive-behavioral interventions are currently considered the treatment of choice for post-traumatic stress conditions [26]. However, perceptions of injustice have not been systematically addressed in intervention approaches for post-traumatic symptoms associated with whiplash injuries. Given that post-traumatic stress symptoms have been shown to contribute to chronicity of whiplash symptoms, the development of more effective intervention approaches to the management of post-traumatic stress symptoms might also impact positively on timely recovery from whiplash injuries [16].

Some degree of caution must be brought to bear in the interpretation of the findings of this study. First, post-traumatic stress symptoms were assessed by self-report questionnaire as opposed to structured diagnostic interview. As such, it is unclear whether participants who scored within the clinical range on the IES-R met diagnostic criteria for post-traumatic stress disorder (PTSD). Confidence in the pattern of results reported here must await replication in a sample of individuals with whiplash for whom a diagnosis of PTSD has been confirmed. Another issue that must be considered is that the sample was recruited from a region that operated under a no-fault system. It is unclear whether the same pattern of findings would emerge in a system where individuals with whiplash injuries can take legal action against the driver of the vehicle responsible for the motor vehicle accident. Finally, the data were collected within the context of a standardized multidisciplinary intervention and might not characterize the recovery trajectories typical of whiplash-related post-traumatic stress symptoms.

In spite of these limitations, the results of the present study suggest that pain and pain-related psychological variables play a role in the persistence of post-traumatic stress symptoms following whiplash injury. The results showed that pain symptoms do not appear to contribute to the persistence of post-traumatic stress symptoms. The findings suggest that the perceptions of injustice might represent a risk factor for the persistence of post-traumatic stress symptoms consequent to whiplash injuries. The development of effective intervention techniques for targeting the perceptions of injustice might be important for promoting recovery of post-traumatic stress symptoms, and in turn, foster more timely resolution of whiplash symptoms.

Conflict of interest

The authors have no financial interests related to the content of this paper.

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