Observational Studies

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Distress intolerance and pain catastrophizing as mediating variables in PTSD and chronic noncancer pain comorbidity

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Abstract

Objectives: Several studies have demonstrated posttraumatic stress disorder (PTSD) and chronic pain comorbidity. However, there is a lack of research on the psychological variables that might explain their co-occurrence. We investigated the mediating role of distress intolerance and pain catastrophizing in this relationship.
Methods: A moderated mediation model was tested. The sample comprised 114 individuals with chronic noncancer pain (90 women and 24 men; mean age, of 60.04 years [SD=9.76]).
Results: Catastrophizing had a significant effect on PTSD. Distress intolerance mediated catastrophizing and PTSD, and pain intensity moderated this relationship.
Conclusions: New insights are provided into the psychological variables that may explain PTSD and chronic noncancer pain comorbidity.

Keywords: chronic noncancer pain; distress intolerance; pain catastrophizing; pain intensity; posttraumatic stress disorder.

Introduction

The comorbidity of PTSD and chronic noncancer pain (CNCP) is widely recognised showing PTSD prevalence rates of 12–19% in clinical pain populations [1, 2]. Several theoretical models have been proposed in an attempt to provide an explanatory framework for this comorbidity, such as the Mutual Maintenance Model [3], the Shared Vulnerability Model [4], or the Perpetual Avoidance Model [5]. However, there is little research on the factors that could explain the association between PTSD and chronic pain (CP).

Transdiagnostic variables play a key explanatory role in emotional experience by modulating responses to emotional stimuli and states [6]. This aspect is relevant in relation to PTSD and CNCP patients because the regulation of their emotions is not only associated with PTSD symptom severity [7], but may also be relevant to adaptation to CP [8, 9]. Among the transdiagnostic variables, catastrophizing seems relevant as a cognitive vulnerability and maintenance factor for both CNCP and PTSD [10], and distress intolerance is a transdiagnostic risk marker associated with various psychological disorders, including PTSD [11–13].

Pain catastrophizing refers to the interpretation of pain as harmful, uncontrollable, or never-ending [14]. This variable has recently become the main target of the cognitive-behavioural treatment of CNCP (e.g., ref. [15]). However, catastrophic evaluations of traumatic events may trigger fear and avoidance of trauma-related stimuli, which interferes with the effective processing of trauma memories and maintains PTSD symptoms [16]. Pain catastrophizing also mediates PTSD symptoms and pain outcomes, in terms of pain interference and pain severity [17].

Distress intolerance, conceptualised as the perceived or real inability to tolerate negative experiential states [18], is a key cognitive-affective risk factor for PTSD symptomatology [19] and a factor in the maintenance of PTSD symptoms [11]. Although few studies have investigated the role of distress intolerance in the pain experience, the evidence suggests that this variable may be relevant in understanding this experience [6]. Nevertheless, to our knowledge, there is no research on the role of this variable in patients with concurrent CNCP and PTSD.

Catastrophizing and distress intolerance in pain settings are different but interrelated factors that are associated

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with the pain stress response [14], and thus could be relevant treatment targets in CNCP patients. Furthermore, there is empirical evidence of an association between low distress tolerance and increased catastrophizing [20]. However, we are unaware of any research linking these two variables in the setting of PTSD. Nevertheless, a cognitive model of PTSD [21] suggests that catastrophic appraisals may maintain the disorder due to a perceived inability to control negative emotions.

Research on pain perception in CNCP patients with PTSD has shown mixed results depending on whether there is a predomination of habituation (i.e., dissociation), which is related to a hypoalgesic effect, or sensitization (i.e., anxiety), which is related to a hyperalgesic effect [22]. It is also noteworthy that, although there is a large literature on the relationship between catastrophizing and pain (e.g., ref. [23]), which has demonstrated that higher levels of catastrophizing are associated with higher pain perception, research on the relationship between pain and distress tolerance remains scarce. However, some findings have shown a significant relationship between distress tolerance and severity of pain [6].

Given the foregoing aspects, this study analysed the association between catastrophizing, distress intolerance, and PTSD symptoms as a function of pain intensity in CNCP patients. We formulated the following hypotheses: (1) There would be a positive association between catastrophizing and PTSD symptoms; (2) distress intolerance would mediate the association between catastrophizing and PTSD symptoms (simple mediation model); and (3) pain intensity would moderate the indirect effect of catastrophizing on PTSD symptoms through the mediating effect of distress intolerance, thus affecting the association between distress intolerance and PTSD symptoms (moderated mediation model). To our knowledge, this is the first study to investigate the relationships between all these variables.

Methods

Participants

The initial sample comprised 201 participants. Of these, 149 individuals had experienced a traumatic event. Inclusion criteria were as follows: (a) at least 18 years of age; (b) diagnosed with CNCP; (c) with PTSD symptomatology; and (d) able to understand spoken instructions and questionnaires in Spanish. Exclusion criteria were as follows: (a) severe injuries requiring immediate surgery; and (b) other chronic diseases involving disability; and (c) major psychiatric illness.

Measures

Ad hoc socio-demographic questionnaire: Participants provided information on their socio-demographic characteristics, pain duration, diagnosis, and prescribed analgesic treatment.

Stressful life event checklist (LEC-5): A 17-item tool assessing exposure to past traumatic events related to the DSM-5 criterion A for PTSD [24].

The PTSD checklist for DSM-5 (PCL-5): This tool scores 20 symptoms corresponding to the dimensions of PTSD on a 4-point scale ranging from 1 (not at all) to 4 (extremely) ref. [25]. In the current sample, Cronbach's alpha was 0.89.

Coping strategies questionnaire (CSQ): The 2-item catastrophizing subscale was used with a 7-point scale ranging from 0 (never) to 6 (always) ref. [26]. In this study, Cronbach's alpha was 0.89.

Distress tolerance scale (DTS): A 15-item questionnaire assessing the degree to which a person experiences and endures psychological states of emotional distress on a 6-point scale ranging from 1 (strongly agree) to 5 (strongly disagree) ref. [27]. In the current sample, Cronbach's alpha was 0.85.

Pain index: Participants rated their mildest, average, and worst pain during the past 2 weeks and their current pain on a scale ranging from 0 (no pain) to 10 (worst pain possible). A composite pain intensity score was calculated for each participant [28]. In this study, the scale had a Cronbach's alpha of 0.88.

Procedure

This study was approved by the Research Ethics Committee of the University of Málaga (Spain) (CEUMA-66-2019-H) and the Provincial Research Ethics Committee of Málaga (2066-N-20), and complies with the requirements of the Declaration of Helsinki for this type of research.

All individuals fulfilling the eligibility criteria were informed and invited to participate by their doctor. Those who agreed were fully informed of the study aim, provided signed informed consent, and had a semi-structured interview with trained psychologists. Data were collected between October 2019 and March 2020.

Data analysis

All analyses were performed using the SPSS statistical package for Windows version 25.0 (SPSS, Chicago, USA). We analysed the moderated mediation model (model 14) using version 3.5 of Hayes' SPSS macro PROCESS [29].

Descriptive statistics and Pearson correlations were calculated for each continuous variable under study, including catastrophizing and PTSD (hypothesis 1). Following recommendations [29], the indirect and direct conditional effect of distress intolerance on PTSD symptoms was tested using a two-step related process. Firstly, we conducted a simple mediation analysis to investigate whether distress intolerance mediated the association between catastrophizing and

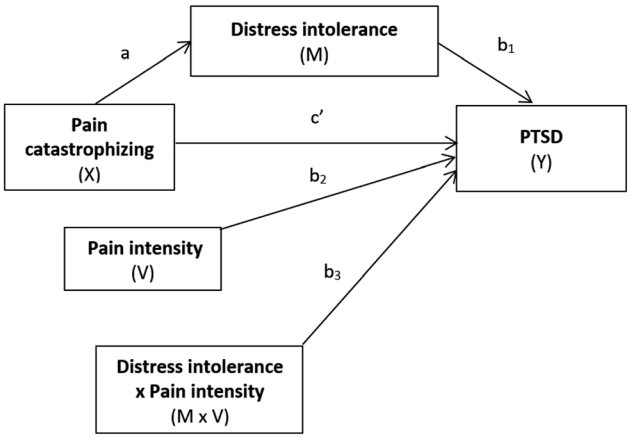

Figure 1: Conceptual and statistical diagram of the moderated mediation analysis.
PTSD, posttraumatic stress disorder; X, independent variable; M, mediator; Y, dependent variable; V, moderator; M x V, interaction between distress intolerance and pain intensity; a, *path* a; b, *path* b; b_1, *path* b_1; b_2, *path* b_2; b_3, *path* b_3; c', *path* c'.

PTSD symptoms (hypothesis 2). Catastrophizing was included as the predictor, PTSD symptoms as the outcome, and distress intolerance as the mediator. The effect of moderated mediation was calculated to investigate whether the level of pain moderated the effect of catastrophizing on PTSD symptoms through the mediating effect of distress intolerance (hypothesis 3). In both analyses, sex was included as a covariate. The indirect effects and their confidence intervals were simultaneously estimated using 5,000 bootstrap samples for bias-corrected bootstrap confidence intervals (CIs), and pre-centring the predictor variables prior to analysis to control for homoscedasticity. The indirect effect was considered statistically significant if the established CI (95% CI) did not include the value 0. Figure 1 shows the conceptual diagram of the simple mediation and moderated mediation models.

Results

Demographic and clinical characteristics of the sample

Of the 149 participants who experienced a traumatic event, 114 (81.4% of the total sample) had posttraumatic stress symptomatology (90 women and 24 men; mean age=60.04; SD=9.76). In total, 76% of the participants were married or cohabiting, 53% had primary school education, and 36% were retired. A total of 49% had fibromyalgia, 28% had chronic back pain, 4% had osteoarthritis, and 3% had rheumatoid arthritis, while 16% had other pain diagnoses. The mean duration of pain was 17.10 years (SD=12.90).

Participants were considered to have a positive history of traumatic event exposure when they reported having experienced at least one of the LEC-5 items. The most frequently experienced traumatic events were a life-threatening vehicle accident (42%), a serious life-threatening illness or injury (21%), physical abuse (20%), and sexual abuse (14%). The mean number of traumas was 1.88 (SD=1.04). A cut-off of refs. [31–33] has been considered as indicative of probable PTSD across samples (e.g., ref. [30]). However, to minimize false positives, we used a more conservative cut-off of score of ≥36.

Table 1: Descriptive statistics and correlations between PTSD symptoms, distress intolerance, pain catastrophizing, and pain intensity.

	Range	Mean	SD	1	2	3
1. PTSD	36–72	51.66	9.20			
2. Distress intolerance	20–74	52.42	12.25	0.32[a]		
3. Pain catastrophizing	2–8	6.48	1.76	0.31[a]	0.34[a]	
4. Pain intensity	3–10	7.45	1.41	0.27[a]	0.05	0.09

[a]p<0.01; PTSD, posttraumatic stress disorder.

Bivariate analysis

Table 1 shows the mean and standard deviation for each variable used in the study, as well as their correlations. Positive significant correlations were found between catastrophizing and distress intolerance and PTSD symptoms (hypothesis 1), but not with pain intensity, between distress intolerance and PTSD symptoms and catastrophizing, but not with pain intensity, and between PTSD and all variables. The highest correlation was between catastrophizing and distress intolerance (r_{xy}=0.34), and the lowest correlation was between PTSD symptoms and pain intensity (r_{xy}=0.27).

Simple mediation model

Table 2 shows the results of the simple mediation model. Significant associations were found between catastrophizing and PTSD symptoms (*path* c; b=1.65, p≤0.001), between catastrophizing and distress intolerance (*path* a; b=2.39, p<0.001), and between distress intolerance and PTSD symptoms (*path* b; b=0.18, p<0.05). The indirect effect of catastrophizing on PTSD symptoms (*path* an x *path* b; b=0.43, SE=0.21; 95% CI [0.07, 0.89]) was significant, as the confidence interval did not include the value 0. The effect of sex was not significant (b=2.65; SE=1.97; t=1.35; p>0.05).

Table 2: Mediation process analysis of the indirect effect of pain catastrophizing on PTSD symptoms through distress intolerance.

	Path	b	SE	t	p-Value
Total effect	c	1.65	0.47	3.52	0.001
Direct effect	c'	1.22	0.49	2.52	0.013
Pain catastrophizing on distress intolerance	a	2.39	0.62	3.84	0.000
Distress intolerance on PTSD	b	0.18	0.07	2.56	0.040

Indirect effect of pain catastrophizing on PTSD symptoms (*path* a x *path* b)

			95% IC		
Bootstrapping	b	Boot SE	LLCI	ULIC	Effect size (R^2)
	0.43	0.21	0.07	0.89	15.90%

PTSD, posttraumatic stress disorder; b, unstandardized coefficient; SE, standard error; LLCI, lower limit confidence interval; ULCI, upper limit confidence interval.

Because the direct effect of catastrophizing on PTSD symptoms was significant (*path* c'; b=1.22, p<0.05), 15.90% of the total effect of catastrophizing on PTSD symptoms was found to be mediated by distress intolerance (hypothesis 2).

Moderated mediation model

Table 3 shows the results of the moderated mediation analysis. The effect of catastrophizing on distress intolerance (*path* a; b=2.39, SE=0.62, 95% CI [1.16, 3.62]) and the effect of the interaction between distress intolerance and pain intensity on PTSD (*path* b_3; b=0. 11, SE=0.05, 95% CI [0.02, 0.21]) were both significant. Thus, moderate mediation was confirmed. Furthermore, there was a significant direct effect of catastrophizing on PTSD (*path* c'; b=0.96, SE=0.47, 95% CI [0.03, 1.89]), a significant effect of distress intolerance on PTSD (*path* b_1; b=0.19, SE=0.07, 95% CI [0.05, 0.32]), and of pain intensity on PTSD (*path* b_2; b=1.49, SE=0.55, 95% CI [0.40, 2.57]). The direct and indirect effects together explain 3.8% of the proportional variance (R^2) in PTSD. The effect of sex was not significant (b=1.59; SE=1.91; t=0.83; 95% CI [2.20, 5.38]).

To understand how pain intensity moderated the magnitude of the indirect effect, conditional indirect effects of pain catastrophizing on PTSD through distress intolerance were quantified for different values of pain intensity (Table 4). Results showed that the 95% confidence interval derived from the bootstrap distribution for low (mean –1SD) (95% CI [–0.15, 0.21]), medium (95% CI [0.05, 0.32]), and high (mean +1SD) (95% CI [0.15, 0.54]) levels of pain intensity were significant only for their medium or high values. Thus, as pain intensity increased, so did the effect of distress intolerance on PTSD (Figure 2). An ANCOVA was conducted to determine if there were statistically significant differences between the slopes, finding that they were homogeneous because there was no statistically significant difference between PTSD levels as a function of pain intensity levels [F (30, 113)=0.78; p=0.764].

Discussion

To our knowledge, this is the first study to investigate the relationship between catastrophizing and emotional distress in individuals with PTSD and CNCP comorbidity. Thus, we tested a moderated mediation model which hypothesised an association between catastrophizing,

Table 3: Analysis of the process of moderated mediation establishing pain as a moderator of the mediated effect of pain catastrophizing on PTSD through distress intolerance.

Antecedent	Consequent									
	Distress intolerance					PTSD				
				95% CI					95% CI	
	Path	b	SE	LLCI	ULCI	Path	b	SE	LLCI	ULCI
Pain catastrophizing	a	2.39	0.62	1.16	3.62	c´	0.96	0.47	0.03	1.89
Distress intolerance	–					b_1	0.19	0.07	0.05	0.32
Pain intensity	–					b_2	1.49	0.55	0.40	2.57
Distress intolerance x pain intensity	–					b_3	0.11	0.05	0.02	0.21
	R^2=3.8%					R^2=2.5%				
	F (1, 108)=5.43, p<0.05					F (5, 108)=7.23, p<0.001				

PTSD, posttraumatic stress disorder; b, unstandardized coefficient; SE, standard error; LLCI, lower limit confidence interval; ULCI, upper limit confidence interval.

Table 4: Conditional indirect effects of pain catastrophizing on PTSD through distress intolerance for different values of the moderator.

			95% CI		
Moderator	**Values**	**b**	**Boot SE**	**Boot LLCI**	**Boot ULCI**
Pain intensity	Low (mean −1SD)	0.03	0.09	−0.15	0.21
	Medios	0.19	0.07	0.05	0.32
	High (mean +1SD)	0.34	0.10	0.15	0.54

b, unstandardized coefficient; SE, standard error; LLCI, lower limit confidence interval; ULCI, upper limit confidence interval.

distress intolerance, and PTSD symptoms as a function of pain intensity. We expected distress intolerance to mediate the relationship between catastrophizing and PTSD symptoms, and pain to moderate this mediation.

The results supported the hypotheses. Firstly, a positive significant association was found between catastrophizing and PTSD symptoms (hypothesis 1). This result adds to the empirical evidence that catastrophic appraisals of traumatic events maintain PTSD symptoms, which is probably due to inefficient processing of memories. Thus, PTSD is characterised by dysfunctional cognitions biased toward an increased general expectancy of aversive events in which harmless bodily symptoms (i.e., painful sensations) might be linked with catastrophic thoughts [16, 31, 32]. Indeed, catastrophizing has been investigated as a variable underlying the relationship between PTSD and pain [33], given that the negative ruminations characteristic of catastrophizing may result in focusing attention on pain and traumatic memories.

Secondly, distress intolerance significantly mediated the relationship between catastrophizing and PTSD symptoms (hypothesis 2). This result is in line with those of the few studies that found an association between catastrophizing and distress intolerance [14, 34, 35]. Thus, a recent study [34] investigated whether distress intolerance could be a variable that mediated the relationship between depression and catastrophizing in individuals with physical injury pain. It found that distress intolerance partially mediated this association. All these findings suggest that distress intolerance may play a relevant role in understanding catastrophic appraisals of pain. Therefore, reducing distress intolerance may be a relevant target to minimise the level of catastrophizing, because individuals with higher levels of distress intolerance also have more catastrophic ideation; thus, their ability to cope with pain is maladaptive [34].

Thirdly, the moderated mediation model was significant, such that distress intolerance mediated the relationship between catastrophizing and PTSD, and pain intensity moderated this mediation (hypothesis 3). Similarly, pain moderated the relationship between distress intolerance and PTSD, so that as pain increased the effect of distress intolerance on PTSD increased. Most of the study participants experienced traumas related to life-threatening vehicle accidents and/or serious life-threatening illnesses. In this regard, previous studies have suggested that pain perception may differ in different subgroups of people with PTSD according to the type of traumatic event they experienced [22]. Thus, anxiety is more frequent in individuals who experienced a non-interpersonal trauma, whereas dissociation is more common in people who experienced an interpersonal trauma. Nonetheless, more research is needed in this area.

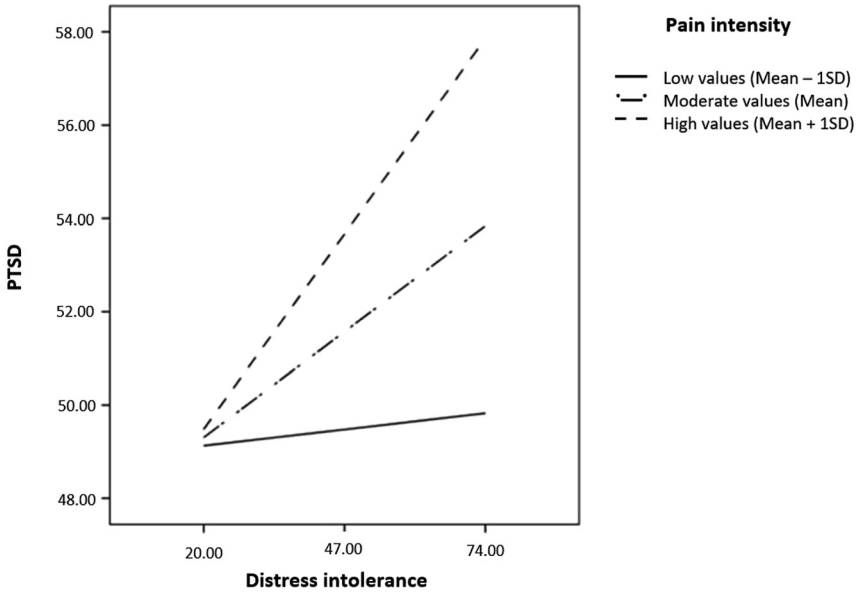

Figure 2: Conditional effects of distress intolerance on PTSD as a function of different values of the moderating variable (pain).
PTSD, posttraumatic stress disorder.

Despite the absence of research on the role of catastrophizing and distress intolerance in the joint analysis of PTSD and chronic pain, some results have shown a relationship between these disorders and each of these variables. That is, there is evidence for the role of distress intolerance on PTSD [11, 13] and on chronic pain adjustment [6, 36–38].

There is also evidence suggesting an association between both distress intolerance and catastrophizing and increased behavioural avoidance and functional impairment in chronic pain patients [39–41]. A study [40] in a sample of individuals with chronic pain found an association between catastrophizing and increased anxiety during pain induction, and between distress intolerance and decreased tolerance to psychosocial stress. These aspects could be related to avoidance behaviours, which could negatively affect functioning. Thus, catastrophizing and distress intolerance may amplify the experience of pain in chronic pain patients and therefore represent relevant treatment targets for these individuals [14]. However, our results did not clarify whether an intervention targeting one of the two variables could affect the other. This aspect could be an interesting focus of future research.

Finally, we highlight that a direct association was found between PTSD and distress intolerance, which is in line with findings of an association between higher PTSD scores and lower levels of distress intolerance [11, 19]. Furthermore, a direct association was found between pain and PTSD symptoms (*path* b_2). These results add to the ample literature demonstrating not only comorbidity between CP and PTSD [42], but also the existence of common mechanisms that account for such comorbidity [1, 43, 44].

In relation to the foregoing, the findings of the current study partly support the assumptions of the Mutual Maintenance Model [3], as this framework postulates that both disorders share cognitive (e.g., catastrophizing), behavioural (e.g., disability), and affective (e.g., distress intolerance) mechanisms that drive and maintain the interdependence of PTSD and CP. According to this model, pain may serve as a persistent reminder of the traumatic event and anxiety may exacerbate pain perception. Therefore, in an individual with PTSD, the pain sensation could be interpreted as a reminder of the trauma. This could trigger an arousal response and cognitive and behavioural avoidance, which, in turn, would lead to distress. Moreover, all these aspects would contribute to the maintenance of both disorders [3].

This study has a number of limitations. Firstly, the transversal nature of the study precludes drawing conclusions on the direction of cause-effect between variables. Secondly, the sample size was small because the declaration of the CV_{19} State of Alarm interrupted data collection. Thus, the study should be replicated with more participants. Another related aspect is the few male participants. Although the analyses showed no significant differences between sexes in the study variables, the composition of the sample should be balanced to take this into account. Thirdly, all variables were assessed through self-report instruments, and thus the data collected may have been affected by some uncontrolled contextual factors. Therefore, further research is needed to assess the generalizability of the results.

Conclusions

Despite the aforementioned limitations, this study provides novel data on variables that could account for PTSD and CNPC comorbidity. Two factors emerge as relevant in this setting: Catastrophizing as a variable that may partially explain the maintenance of PTSD symptoms in chronic pain patients, and distress intolerance as a mediator of the relationship between catastrophizing and PTSD. Although further research is needed, the results support the relevance of taking into account the transdiagnostic nature of variables such as catastrophizing and distress intolerance, and point to the need to consider these variables in the development of interventions for individuals with both disorders.

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Author contributions: GST conceived and designed the study, led data collection, interpreted the results, drafted the manuscript, and received feedback from the co-authors; RE conceived the study, interpreted the results, and revised the manuscript; CRM helped to design the study and revised the manuscript; AELM conceived the study, conducted statistical analyses, interpreted the results, and revised the manuscript. All authors have accepted responsibility for the entire content of this manuscript and approved its submission.
Competing interests: Authors state no conflict of interest.
Informed consent: Informed consent has been obtained from all individuals included in this study.
Ethical approval: This research complied with all relevant national regulations, institutional policies and is in accordance with the tenets of the Helsinki Declaration

(as amended in 2013), and has been approved by the authors' Institutional Review Board (CEUMA-66-2019-H) and by the Provincial Research Ethics Committee of Málaga (2066-N-20).

Summary of the study's contribution to the scientific literature: First study on the relationship between catastrophizing and distress intolerance in patients with comorbid posttraumatic stress symptoms and chronic noncancer pain.

Summary of how the study's findings relate to previous research: Catastrophizing and distress intolerance are interrelated factors that could be relevant treatment targets in individuals with concurrent posttraumatic stress and chronic noncancer pain.

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