

The relationship between PTSD and chronic pain: Mediating role of coping strategies and depression

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ABSTRACT

People with chronic pain and comorbid posttraumatic stress disorder (PTSD) report more severe pain and poorer quality of life than those with chronic pain alone. This study evaluated the extent to which associations between PTSD and chronic pain interference and severity are mediated by pain-related coping strategies and depressive symptoms. Veterans with chronic pain were divided into 2 groups, those with ($n = 65$) and those without ($n = 136$) concurrent PTSD. All participants completed measures of pain severity, interference, emotional functioning, and coping strategies. Those with current PTSD reported significantly greater pain severity and pain interference, had more symptoms of depression, and were more likely to meet diagnostic criteria for a current alcohol or substance use disorder (all p -values $< .01$). Participants with PTSD reported more use of several coping strategies, including guarding, resting, relaxation, exercise/stretching, and coping self-statements. Illness-focused pain coping (i.e., guarding, resting, and asking for assistance) and depressive symptoms jointly mediated the relationship between PTSD and both pain interference (total indirect effect = 0.194, $p < .001$) and pain severity (total indirect effect = 0.153, $p = .004$). Illness-focused pain coping also evidenced specific mediating effects, independent of depression. In summary, specific pain coping strategies and depressive symptoms partially mediated the relationship between PTSD and both pain interference and severity. Future research should examine whether changes in types of coping strategies after targeted treatments predict improvements in pain-related function for chronic pain patients with concurrent PTSD.

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1. Introduction

A growing body of research has examined pain-related coping strategies on adaptation to chronic pain. Pain-related coping may be defined as individuals' attempts to manage problems associated with their pain state [14]. Pain coping strategies have been characterized as adaptive or maladaptive based on their ability to impact symptoms. Adaptive coping responses (e.g., staying active, pacing, problem solving) are often considered active, whereas maladaptive coping responses tend to be passive (e.g., resting, avoiding activity) [25]. Maladaptive coping strategies are hypothesized to play a more important role and are more strongly related to chronic pain outcomes than adaptive coping strategies [19]. Several studies

have subsequently examined this hypothesis. For example, increased use of passive coping responses after multidisciplinary pain treatment has been associated with increased disability and depression [24]. In a study of 106 military veterans with chronic pain, maladaptive responses were most strongly associated with pain interference and depression, while adaptive coping styles were significantly related to pain intensity [51].

Recently, research has focused on the prevalence and role of posttraumatic stress disorder (PTSD) in chronic pain. Patients with PTSD have more risk factors for pain, including higher rates of psychiatric and substance use disorders [29,40], as well as general medical conditions [41]. Indeed, patients with PTSD have high rates of chronic pain [6,35,47] and patients with chronic pain also have disproportionately high rates of PTSD [7,15,21,44]. Relative to patients with chronic pain alone, patients with chronic pain and comorbid PTSD report greater pain severity [20] and pain-related impairment [39]. They are also more likely to be prescribed opioid

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medications for pain control [39] and to have high-risk opioid use [45].

The mutual maintenance and shared vulnerability models suggest that chronic pain and PTSD symptoms interact or that patients have shared vulnerability to both conditions [2,3,46]. For example, patients with chronic pain and PTSD report significantly higher levels of maladaptive coping strategies and beliefs about pain, relative to patients with chronic pain alone [1]. Individuals with PTSD also have high rates of comorbid depression, and the biopsychosocial model posits that depressive symptoms can exacerbate or lead to increased pain and impaired function [18,52]. No study to our knowledge has explored maladaptive coping and depression as mediators of the relationship between PTSD and chronic pain.

The purpose of this study was to build on prior research by examining whether pain-related coping mechanisms and depression mediate the relationship between PTSD and pain interference and severity. Given prior empirical research documenting the role of illness-focused pain coping and depressive symptoms on pain-related outcomes [4,13,24,51,53], we conducted a multiple mediation analysis that examined the combined roles of pain coping strategies and depressive symptoms on pain interference and pain severity in a veteran patient population. We hypothesized that illness-based coping strategies and depressive symptoms would jointly mediate the relationship between PTSD and both pain interference and pain severity. We also hypothesized that patients with comorbid PTSD would have more impaired function, severe pain intensity, and psychiatric and substance abuse comorbidity.

2. Methods

This study was approved by the local institutional review board, and all participants provided written informed consent.

2.1. Participants

Data were collected as part of a larger cross-sectional study examining the relationship between chronic pain, substance abuse, and hepatitis C virus infection at a Veterans Affairs (VA) medical center. To be included, participants must have been tested for hepatitis C (patients with both positive and negative hepatitis C test results were included). Additional inclusion criteria for this study were at least 18 years of age, current self-report of chronic pain confirmed with medical record diagnosis, and ability to read and write in English. Participants were excluded if they were older than 70 years of age, if they had pending litigation or disability compensation for pain, and if they had advanced liver disease, current suicidal ideation, or untreated bipolar disorder or schizophrenia. Participants were recruited by advertisements posted in the medical center, letters sent to patients who had pending appointments in primary care, announcements made in mental health classes, and referral from patients being treated in the hospital's hepatology clinic.

All participants signed informed consent, completed study-related tasks, and received a \$30 store gift card as compensation. A total of 284 participants were recruited into the larger study. In order to examine factors associated with chronic pain, we limited the current analyses to only those participants with chronic pain. To be included, participants self-reported current pain of greater than 6 months' duration, had treatment for a pain condition within the last 5 years documented in the medical record, and completed relevant study measures ($n = 205$) between March 2009 and August 2011.

2.2. Data collection

Demographic characteristics were gathered including participants' age, gender, number of years of education, annual income,

and marital status. On the basis of their responses to a question about race/ethnicity, we classified the sample as either white or ethnic minority (due to limited racial/ethnic diversity).

2.3. Measures

The 64-item self-report Chronic Pain Coping Inventory (CPCI) [26] assessed the ways in which participants cope with chronic pain. Respondents are asked on how many days in the past week they used each of 64 chronic pain coping strategies. The CPCI is composed of 8 scales: guarding (Cronbach's α for the current study = 0.89), resting ($\alpha = 0.77$), asking for assistance ($\alpha = 0.85$), relaxation ($\alpha = 0.74$), task persistence ($\alpha = 0.81$), exercise/stretching ($\alpha = 0.92$), use of coping self-statements ($\alpha = 0.92$), and seeking social support ($\alpha = 0.85$). Scale scores are derived by averaging items within a respective scale, with higher scores indicating greater use of the particular coping strategy. The developers of the CPCI posited that 3 scales (guarding, resting, and asking for assistance) comprise the construct of "illness-focused pain coping," while 4 scales (relaxation, task persistence, exercise/stretching, and use of coping self-statements) comprise the construct of "wellness-focused pain coping" [26]. The seeking social support scale of the CPCI was hypothesized to be separate from the illness-focused and wellness-focused pain coping constructs [26], has been inconsistently related to pain interference and pain severity in prior studies [23,24,43,50], and was thus excluded from the current study.

PTSD was assessed with the Posttraumatic Stress Disorders Checklist—Civilian (PCL-C) [55]. The PCL-C is a 17-item self-report measure that corresponds to diagnostic symptoms of PTSD. Participants were asked to indicate how much they have been bothered by each symptom in the past month using a 5-point (1 = not at all, to 5 = extremely) scale. The PCL-C has evidenced strong psychometric characteristics and reliably predicts diagnoses of PTSD [10,54]. PCL-C Cronbach's α for the current study was 0.95. Participants were operationalized as having PTSD if they met 3 specific criteria: (1) their response to a stem question about trauma was affirmative, (2) their total score on the PCL-C was ≥ 50 , and (3) consistent with diagnostic criteria, they endorsed one or more reexperiencing symptoms (PCL-C items 1–5), 3 or more avoidance symptoms (PCL-C items 6–12), and 2 or more arousal symptoms (PCL-C items 13–17) as "moderate" to "extreme" (i.e., PCL-C scores of 3–5).

Pain severity and pain interference were assessed with the respective subscales of Multidimensional Pain Inventory (MPI) [28]. Symptoms of depression were assessed with the Beck Depression Inventory—Second Edition (BDI-II) [5]. Each of these self-report measures has been used in numerous studies with chronic pain samples and has demonstrated good to excellent psychometric characteristics. Internal consistency for each of these measures in the current study was excellent: Cronbach's α for MPI severity was 0.90, for MPI interference was 0.91, and for BDI-II was 0.95.

Substance use disorders were assessed with the Structured Clinical Interview for DSM-IV (SCID) [17], a semistructured clinical interview that assesses diagnostic symptoms. A substance use disorder was considered current if the participant met criteria for abuse or dependence to the substance within the past month. SCID interviews were conducted by masters-level research clinicians or students in graduate-level clinical psychology or social work programs. All interviewers received extensive training by a licensed psychologist. Regular supervision of SCID interviews was conducted to reduce likelihood of coder drift.

Self-reported use of prescription opioid medications in the past 30 days was assessed with the TimeLine Follow-Back (TLFB) [48]. The TLFB is a reliable and valid tool that uses calendar prompts to track the frequency of use of alcohol, illicit substances, and prescription medications.

Pain diagnoses were extracted from the electronic medical record using the Veterans Integrated Service Network-20 (VISN-20) Data Warehouse. The VISN-20 Data Warehouse contains extracts of data from the clinical records of regional VA facilities and 2 national VA databases. Pain diagnoses were obtained using ICD-9-CM codes listed in medical encounter records for the 5 years before the study assessment.

2.4. Statistical analyses

Independent-sample *t* tests and chi-square tests of association compared demographic variables, as well as pain diagnoses, pain coping, depressive symptom severity, current substance use, pain interference, and pain severity between participants with and without a PTSD diagnosis. Bivariate correlations evaluated the associations of PTSD, illness-focused pain coping scales, wellness-focused pain coping scales, and depressive symptom severity with study outcome variables pain interference and pain severity.

Because coping was one construct hypothesized to mediate the relationship between PTSD and pain interference and pain severity, we first wanted to confirm the construct validity of illness-focused and wellness-focused pain coping in our sample. The factor structure of these constructs was assessed with two second-order confirmatory factor analysis (CFA) models. The first CFA model examined model fit of the hypothesized illness-focused pain coping construct. Individual items of the guarding, resting, and asking for assistance scales were constrained to load only on the hypothesized latent construct. The three first-order latent constructs were then loaded on a second-order “illness-focused pain coping” latent construct. A second CFA model evaluated the “wellness-focused pain coping” latent construct using similar procedures and items from the relaxation, task persistence, exercise/stretching, and coping self-statements scales of the CPCI. Model fit was assessed with a comparative fit index (CFI) of >0.90, a Tucker Lewis Index (TLI) score of >0.90, root mean square error of approximation (RMSEA) of <0.08, and standardized root mean square residual (SRMR) of <0.08 [12,22,31,33].

Two multiple mediation analyses evaluated the indirect effects of the independent variable, PTSD, on the dependent variables pain interference and pain severity, respectively, through the mediators pain coping and depression. Multiple mediation is an extension of simple mediation analyses and allows for the evaluation of 2 or more mediators simultaneously in a model [42]. Path analysis is typically used for multiple mediation models that contain only measured variables; however, structural equation models can also be used when the independent, mediating, and/or dependent variables are latent constructs [32]. We have labeled the paths in the figures depicting the mediation model *a*, *b*, and *c* to be consistent with the mediation literature, where *a* is the effect of the independent variable on the mediator, *b* is the effect of the mediator on the dependent variable, and *c* is the effect of the independent variable on the dependent variable after accounting for mediation (i.e., the direct effect). For mediation analyses, the independent variable PTSD, mediator depressive symptom severity, and dependent variables pain interference and pain severity were manifest/observed variables. Pain coping mediators were treated as a latent constructs derived from CPCI scale scores.

We followed recommendations by Preacher and Hayes [42] and assessed the total (i.e., combined) mediating effect of pain coping and depressive symptom severity and the individual (i.e., specific) mediating effect of each putative mediator. To evaluate the magnitude of the indirect effects, we used the product-of-coefficients approach [8] to calculate standard errors of the indirect effects. In this approach, the indirect effect is divided by its standard error and compared to a critical value with a *z* test. We employed bootstrapping procedures [42] with a total number of 5000 bootstrapped

samples to corroborate findings from the product-of-coefficients tests.

Finally, within a structural equation modeling framework, we examined the relationship between pain coping and specific PTSD symptom clusters (i.e., re-experiencing, avoidance, and arousal) among the full study sample and among the subset of participants diagnosed with PTSD. Specifically, we computed PTSD symptom cluster scores by summing PCL-C items (re-experiencing symptoms = items 1–5; avoidance symptoms = items 6–12; arousal symptoms = items 13–17). Each symptom cluster was correlated with pain coping latent constructs.

Descriptive and bivariate analyses were conducted by SPSS software, version 18, while CFA models, multiple mediation analyses, and correlations between PTSD symptom clusters and pain coping latent constructs were conducted by Mplus software, version 6. An α level of 0.05 and 2-tailed tests of significance were used for all statistical analyses.

3. Results

We were unable to determine PTSD diagnosis for 4 of 205 participants as a result of nonresponse to 1 or more PTSD questions. We excluded these 4 participants from all analyses, resulting in a final analytic sample of 201 participants with chronic pain.

Tables 1 and 2 provide descriptive statistics for demographic variables, pain diagnoses, mental health functioning, pain coping, pain interference, and pain severity for the full sample and the subsamples of participants with and without concurrent PTSD, as well as bivariate statistical comparisons between the subsamples. Sixty-five participants (32%) met study criteria for PTSD and chronic pain. Participants with and without PTSD did not significantly differ on any demographic characteristic. Participants with PTSD reported significantly greater pain severity, reported more pain interference, and had more symptoms of depression relative to participants without PTSD (all $P < .001$). In addition, a greater proportion of participants with PTSD met diagnostic criteria for a current alcohol or substance use disorder (28% vs 11%, $p = .003$).

The most common pain diagnoses in the full sample were chronic neck or joint pain (83%), chronic low back pain (63%), and rheumatism/arthritis (59%). Participants, on average, were diagnosed with a pain problem 14.1 years ago ($SD = 11.9$ years). Participants with PTSD were more likely to be diagnosed with chronic back pain (79% vs 55%, $p = .001$) but did not differ from participants without PTSD on other pain diagnoses. Participants with PTSD were more likely to report having taken prescription opioid medications in the past month, compared to participants without PTSD (51% vs 29%, $p = .003$). Participants with PTSD used a variety of both illness-focused (i.e., guarding, resting) and wellness-focused (i.e., relaxation, exercise/stretching, coping self-statements) pain coping strategies to a greater extent than participants without PTSD (Table 2).

3.1. Mediation analyses

The second-order CFA model for illness-focused pain coping fit the data well (CFI = 0.91, TLI = 0.90, RMSEA = 0.07 [95% confidence interval = 0.06 = 0.08], SRMR = 0.07). All individual CPCI items in the guarding, resting, and asking for assistance scales significantly loaded on the hypothesized latent construct (all $p < .001$, path coefficients not reported). In addition, first-order latent constructs significantly loaded on the hypothesized second-order latent construct of illness-focused pain coping (all $p < .001$, path coefficients not reported). The second-order CFA model of wellness-focused pain coping evidenced significant first- and second-order loadings (all $p < .001$, path coefficients not reported). However, the model

Table 1
Demographic characteristics and pain diagnoses.^a

Characteristic	Full sample (n = 201)	Pain and PTSD (n = 65)	Pain only (n = 136)	P
<i>Demographic characteristics</i>				
Age	54.9 ± 7.6	53.8 ± 7.5	55.5 (7.7)	.159
Male gender	92.0% (185)	92.3% (60)	91.9% (125)	.923
White race	77.6% (156)	76.9% (50)	77.9% (106)	.871
Marital status				.561
Single	22.0% (44)	26.2% (17)	20.0% (27)	
Married	23.5% (47)	18.5% (12)	25.9% (35)	
Separated/divorced	49.5% (99)	49.2% (32)	49.6% (67)	
Widowed	5.0% (10)	6.2% (4)	4.4% (6)	
>12 years of education	77.1% (155)	76.9% (50)	77.2% (105)	.964
Annual income less than \$15,000	58.7% (118)	56.9% (37)	59.6% (81)	.723
<i>Pain diagnoses</i>				
Neck or joint pain	82.6% (166)	83.1% (54)	82.4% (112)	.899
Low back pain	62.7% (126)	78.5% (51)	55.1% (74/75)	.001
Rheumatism/arthritis	58.7% (118)	63.1% (41)	56.6% (77)	.384
Headache	20.9% (42)	27.7% (18)	17.6% (24)	.101
Neuropathy	10.9% (22)	7.7% (5)	12.5% (17)	.307
Fibromyalgia	10.4% (21)	12.3% (8)	9.6% (13)	.551

PTSD, posttraumatic stress disorder.

^a Data are presented as % (n) for categorical variables or mean ± standard deviation for continuous variables.**Table 2**
Comparison of mental health functioning, pain coping, pain interference, and pain severity.^a

Characteristic	Full sample (n = 201)	Pain and PTSD (n = 65)	Pain only (n = 136)	P
<i>Mental health functioning</i>				
Beck Depression Inventory II	17.3 ± 12.6	26.6 ± 12.2	12.9 ± 10.2	<.001
Current substance use disorder	16.4% (33)	27.7% (18)	11.0% (15)	.003
<i>Chronic pain coping</i>				
Guarding	3.3 ± 2.0	3.8 ± 1.9	3.1 ± 2.0	.015
Resting	3.6 ± 1.7	4.0 ± 1.5	3.4 ± 1.8	.020
Asking for assistance	1.7 ± 1.9	2.0 ± 2.0	1.6 ± 1.8	.100
Relaxation	1.9 ± 1.4	2.3 ± 1.5	1.8 ± 1.4	.022
Task persistence	3.7 ± 1.8	3.9 ± 1.7	3.6 ± 1.9	.233
Exercise/stretching	2.3 ± 1.9	2.7 ± 2.1	2.1 ± 1.8	.048
Coping self-statements	3.2 ± 2.0	3.7 ± 1.9	2.9 ± 2.0	.009
<i>Pain outcome variables</i>				
MPI pain interference	3.5 ± 1.7	4.3 ± 1.5	3.1 ± 1.7	<.001
MPI pain severity	3.1 ± 1.6	3.7 ± 1.4	2.9 ± 1.6	.001

PTSD, posttraumatic stress disorder; MPI, Multidimensional Pain Inventory.

^a Data are presented as mean ± standard deviation for continuous variables and % (n) for categorical variables.

did not meet minimum fit criteria (CFI = 0.85, TLI = 0.84, RMSEA = 0.07 [95% confidence interval = 0.06 = 0.08], SRMR = 0.07). Because the hypothesized construct of wellness-focused pain coping was not supported by the second-order CFA model, this latent variable was not included as a potential mediator in subsequent analyses or in analyses examining the relationship between PTSD symptom clusters and pain coping. As can be seen in Table 3, PTSD and purported mediating variables depressive symptom severity and illness-focused pain coping strategies (i.e., guarding, resting, and asking for assistance scales of the CPCI) were all positively correlated with the dependent variables pain interference and pain severity.

Fig. 1 displays the mediation model for the dependent variable pain interference. PTSD had a significant total effect on pain interference ($c = 0.334$, $p < .001$). A significant proportion of this effect occurred indirectly through illness-focused pain coping and depressive symptom severity (total indirect effect = 0.194, $p < .001$). In addition, significant indirect effects occurred for both illness-focused pain coping (specific indirect effect = 0.126, $p = .011$) and depressive symptom severity (specific indirect effect = 0.068, $p = .021$). A direct effect of PTSD on pain interference

remained statistically significant after accounting for indirect mediation effects ($c' = 0.140$, $p = .016$).

Fig. 2 depicts the mediation model for the dependent variable pain severity. PTSD had a significant total effect on pain severity ($c = 0.243$, $p < .001$), and combined illness-focused pain coping and depressive symptom severity accounted for a significant indirect effect (total indirect effect = 0.153, $p = .004$). An examination of specific indirect effects indicated that illness-focused pain coping significantly mediated the effect of PTSD on pain severity (specific indirect effect = 0.119, $p = .012$); however, depressive symptom severity did not (specific indirect effect = 0.034, $p = .319$). The direct effect of PTSD on pain severity after accounting for the total indirect mediating effects was no longer statistically significant ($c' = 0.090$, $p = .174$).

Table 4 provides sample statistics for indirect effects of both mediation models computed through product-of-coefficient and bootstrapping procedures. Bootstrapping procedures corroborated the findings of product-of-coefficient analyses. All 95% confidence intervals of the indirect effect point estimates excluded zero, with the exception of the indirect effect of depressive symptom severity,

Table 3

Bivariate correlation matrix for PTSD diagnosis, PTSD symptom clusters, hypothesized mediators, and pain-related dependent variables ($n = 201$).^a

	1	2	3	4	5	6	7	8	9	10
<i>Independent variable</i>										
1. PTSD diagnosis	1									
2. PTSD reexperiencing	0.770**	1								
3. PTSD avoidance	0.766**	0.783**	1							
4. PTSD arousal	0.776**	0.780**	0.775**	1						
<i>Mediators</i>										
5. Depressive symptom severity	0.510**	0.580**	0.709**	0.648**	1					
6. CPCI guarding	0.172*	0.179*	0.320**	0.217**	0.346**	1				
7. CPCI resting	0.164*	0.176*	0.235**	0.250**	0.262**	0.561**	1			
8. CPCI asking for assistance	0.116	0.154*	0.227**	0.181**	0.182**	0.467**	0.383**	1		
<i>Dependent variables</i>										
9. MPI pain interference	0.334**	0.347**	0.452**	0.393**	0.447**	0.664**	0.402**	0.383**	1	
10. MPI pain severity	0.243*	0.267**	0.268**	0.296**	0.340**	0.578**	0.355**	0.343**	0.805**	1

PTSD, posttraumatic stress disorder; CPCI, Chronic Pain Coping Inventory; MPI, Multidimensional Pain Inventory.

^a Thirty-one participants did not endorse prior trauma and thus did not respond to PCL-C items. Correlations between PTSD symptom clusters (i.e., PTSD reexperiencing, avoidance, and arousal) and other variables thus represent a sample size of 170.

* $P < .05$.
** $P < .01$.

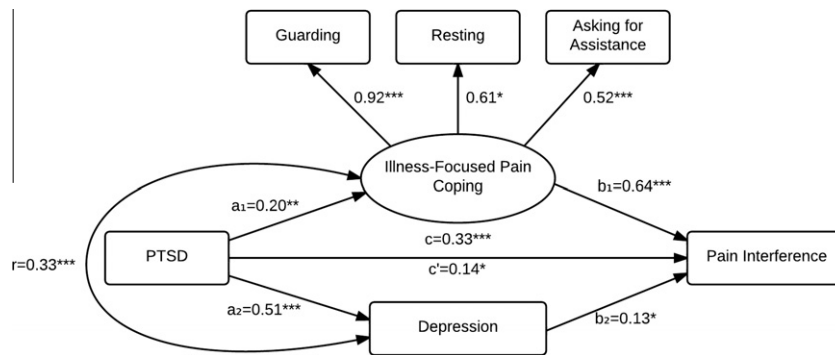


Fig. 1. Mediation model for PTSD and pain interference. * $p < .05$, ** $p < .01$, *** $p < .001$.

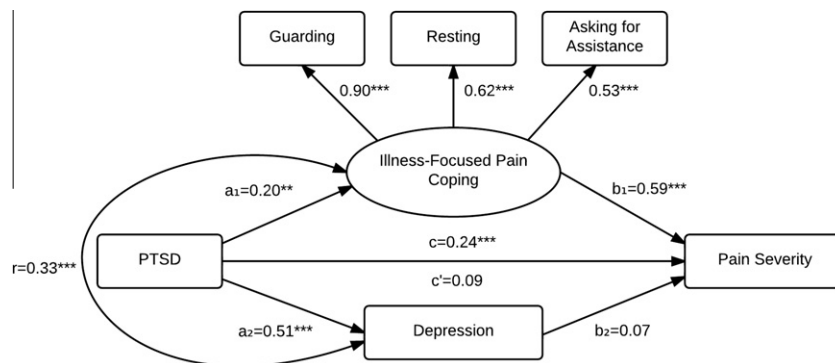


Fig. 2. Mediation model for PTSD and pain severity. * $p < .05$, ** $p < .01$, *** $p < .001$.

on the relationship between PTSD and pain severity, which was also nonsignificant in product-of-coefficient analyses.

3.2. Association between illness-focused pain coping and PTSD symptom clusters

Thirty-one participants did not endorse any prior trauma and thus did not respond to PCL-C items. Of the 170 participants who completed the PCL-C, PTSD reexperiencing, avoidance, and arousal symptoms were all significantly related to illness-focused pain coping ($r = 0.244$, $p = .004$ for reexperiencing; $r = 0.382$, $p < .001$

for avoidance; $r = 0.311$, $p < .001$ for arousal). Among the 65 participants who met criteria for PTSD, avoidance symptoms were significantly related to illness-focused pain coping ($r = 0.304$, $p = .020$). However, PTSD reexperiencing and arousal symptoms were unrelated to illness-focused pain coping ($r = 0.014$, $p = .931$ for reexperiencing symptoms; $r = 0.113$, $p = .461$ for arousal symptoms).

4. Discussion

Maladaptive coping strategies have been hypothesized to lead to poorer pain-related outcomes [19], and past research has

Table 4
Indirect effects of PTSD on pain interference and pain severity via illness-focused pain coping and depressive symptom severity.

Effect	Point estimate	Product of coefficients		Bootstrapping, 95% confidence interval	
		Standard error	Z	Lower 2.5%	Upper 2.5%
<i>Pain interference</i>					
Total indirect effects	0.194	0.051	3.801	0.094	0.294
Illness-focused coping	0.126	0.049	2.556	0.029	0.222
Depressive symptom severity	0.068	0.029	2.314	0.010	0.125
<i>Pain severity</i>					
Total indirect effects	0.153	0.053	2.890	0.049	0.257
Illness-focused coping	0.119	0.048	2.512	0.026	0.212
Depressive symptom severity	0.034	0.034	0.996	-0.033	0.101

PTSD, posttraumatic stress disorder.

indicated that patients with PTSD and chronic pain make greater use of maladaptive pain coping strategies than patients with chronic pain alone [1]. The present results build on prior research by indicating that the use of maladaptive pain coping styles in patients with PTSD and chronic pain contribute to more pain interference and greater pain severity. This finding is consistent with previous research that has implicated maladaptive coping styles in the exacerbation of pain-related dysfunction in patients with a variety of chronic pain conditions [24,27,37,43].

Our results suggest that illness-focused pain coping styles mediate the relationship of PTSD with pain interference and pain severity. Our findings are consistent with mutual maintenance and shared vulnerability models of PTSD and chronic pain. The possibility of mutual maintenance has been supported by data indicating that pain has a mediating influence on re-experiencing and hyperarousal symptoms in PTSD, and PTSD-related hyperarousal mediates pain symptoms [30]. Shared emotional and physiological responses to stress, including hyperarousal, may predispose individuals to maladaptive coping and avoidance behaviors [3]. For example, anxiety sensitivity, which encompasses fear of anxiety reactions and fear of somatic sensations, is elevated in people with PTSD and some patients with chronic pain [2,3]. Our data indicate that PTSD symptoms, particularly avoidance symptoms, may predispose individuals to use analogous chronic pain coping strategies, such as guarding and resting. This finding is consistent with prior research, which found that PTSD avoidance symptoms predicted pain disability [34]. Prospective studies are needed, however, to determine causal directions between PTSD symptoms, chronic pain, and coping strategies.

Participants with PTSD and chronic pain in this study reported more frequent use of both illness-focused and wellness-focused pain coping styles. The increased use of both types of coping strategies by patients with PTSD may indicate general help-seeking behaviors [11] or increased distress, or they may have been acquired coping skills learned through specialty PTSD treatment (though past PTSD treatment was not assessed in the current study). Our results suggest that illness-focused pain coping is significantly associated with pain interference and pain severity. Although wellness-focused coping is hypothesized to be associated with improved adjustment to pain, we did not include wellness-focused pain coping as a potential mediator in these analyses because the latent variable was not supported by the confirmatory factors analysis, indicating that in this sample the effects of wellness-focused pain coping could not be assessed. Prior findings on relationships between wellness-focused pain coping and pain-related outcomes have been inconsistent [16,23,24,27,37,43,49–51], suggesting that further research on the definition and components of this construct is needed to confirm its clinical relevance. Future clinical investigations may also emphasize competence and self-control, or self-efficacy for managing pain, with less focus on the specific coping strategies.

In addition to pain coping, we also examined the impact of depressive symptoms on both pain interference and pain severity. Depressive symptoms had an independent mediating effect on pain interference, but contrary to our hypotheses, not on pain severity. Symptoms of depression such as anhedonia and fatigue may lead to disengagement from activities of daily living, and patients with PTSD and chronic pain who experience these symptoms may perceive greater pain interference that is related, at least in part, to depressive symptoms. Thus, depression may be an active contributor to pain-related interference in patients with PTSD and comorbid chronic pain. Although prospective studies would be needed to verify the temporal relationships between these variables, our findings suggest that the treatment of depression may improve pain-related functioning, despite having modest to little impact on perceived severity of pain. This is consistent with a psychological treatment approach within a biopsychosocial model of pain management [18].

In this sample of US military veterans with chronic pain, 32% had comorbid PTSD. Participants with PTSD reported more severe pain and poorer pain-related function, had more symptoms of depression, and were more likely to meet diagnostic criteria for a current alcohol or substance use disorder. Participants with PTSD were also more likely to have taken prescription opioid medications for pain in the past month. These data are consistent with prior research [39,45,47] and indicate that patients with chronic pain and comorbid PTSD present with a constellation of clinical concerns.

Cognitive-behavioral therapy based interventions have independently been demonstrated to be effective for chronic pain [52] and for PTSD [9]. Integrated cognitive and behavioral techniques that simultaneously address symptoms of PTSD and chronic pain may help maximize effectiveness. A program that combines cognitive processing therapy, a cognitive-behavioral evidence-based treatment for PTSD, with cognitive-behavioral therapy for chronic pain has some preliminary support [38]. The US military is testing an integrated treatment that combines functional restoration for chronic pain with prolonged exposure, another evidence-based cognitive-behavioral approach for PTSD [36]. Additional research is needed to determine the overall impact of a combined intervention, relative to an active control, and to evaluate its essential components.

There are several limitations that should be considered in the interpretation of study results. The cross-sectional design prevents causal inference, and prospective research is needed to confirm our findings. In addition, sample characteristics may limit generalizability of the results. In particular, all participants had a history of being tested for the hepatitis C virus and likely have higher rates of current and past risky alcohol and substance use behaviors than samples of patients recruited from primary care or specialty pain clinics. Substance use may be a maladaptive coping mechanism for pain, which we did not assess. We also did not obtain data on

the characteristics of or cause of PTSD-related trauma (such as duration or cause), which could have an impact on the presentation of PTSD symptoms. Our sample comprised US military veterans and was predominately male. Replication of the results in other samples would add confidence in study findings.

In summary, we found evidence that patients with PTSD and chronic pain had more severe pain and poorer pain-related functioning than patients with chronic pain alone. We also found evidence that illness-focused pain coping styles mediate the effect of PTSD on both pain interference and pain severity among patients with PTSD and chronic pain. Depressive symptoms mediated the effect of PTSD on pain interference, but not pain severity. Illness-focused coping styles and depressive symptoms in patients with chronic pain and comorbid PTSD may be a useful target for treatment through multimodal PTSD symptom and pain management approaches.

Conflict of interest statement

The authors report no conflict of interest. The content of this article is solely the responsibility of the authors and does not necessarily represent the official views of the Department of Veterans Affairs or the National Institute on Drug Abuse.

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