



BRIEF REPORT

Evaluation of Candidate Items for Severe PTSD Screening for Patients With Chronic Pain: Pilot Data Analysis With the IRT Approach

Dokyoung S. You , PhD; Maisa S. Ziadni , PhD; Gadi Gilam , PhD;
Beth D. Darnall , PhD; Sean C. Mackey , MD, PhD

Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University School of Medicine, Palo Alto, California U.S.A.

■ Abstract

Objectives: Post-traumatic stress disorder (PTSD) commonly co-occurs with chronic pain. Although PTSD symptoms are associated with negative health outcomes in patients with chronic pain, PTSD is typically under-detected and under-treated in outpatient pain settings. There is a need for rapid, brief screening tools to identify those at greatest risk for severe PTSD symptoms. To achieve that goal, our aim was to use item response theory (IRT) to identify the most informative PTSD symptoms characterizing severe PTSD in patients with chronic pain.

Methods: Fifty-six patients (71% female, 61% White) with mixed etiology chronic pain completed the PTSD Checklist-Civilian Version (PCL-C) as part of their appointment with a pain psychologist at a tertiary outpatient pain clinic. We used an IRT approach to evaluate each item's discriminant (*a*) and severity (*b*) parameters.

Results: Findings revealed that "feeling upset at reminders" (*a* = 3.67, *b* = 2.44) and "avoid thinking or talking about it" (*a* = 3.61, *b* = 2.17) as being highly discriminant for severe PTSD.

Conclusions: We identified 2 candidate items for a brief PTSD screener as they were associated with severe PTSD symptoms. These 2 items may provide clinical utility in outpatient pain treatment settings to identify those suffering from severe PTSD, enabling physicians to refer them to trauma-specific evaluation or therapy. Future research is needed to further validate and confirm these candidate PTSD items in a larger clinic sample.

Lay Summary: The current study used the IRT approach to identify candidate items for a brief screener for severe PTSD. We examined 17 items of the PCL-C, and identified 2 items that were highly discriminant for severe PTSD. The 2 items were "feeling upset at reminders" and "avoid thinking or talking about it." These 2 items may provide clinical utility, since they may enable physicians to screen and make a referral for further assessment or treatment for PTSD. ■

Key Words: PTSD symptoms, a brief screener, item response theory, chronic pain

INTRODUCTION

Post-traumatic stress disorder (PTSD) commonly co-occurs with chronic pain. Among community-dwelling individuals with chronic pain, the prevalence of PTSD ranges from 8% to 46%,¹⁻⁵ which is substantially higher than among the general population (3% to 6%).⁶⁻⁸ Among adults diagnosed with PTSD, about a third suffer from severe PTSD.⁷ PTSD and pain are hypothesized to have a bidirectional relationship and mutual maintenance of symptoms, thereby underscoring

Address correspondence and reprint requests to: Dokyoung S. You, Division of Pain Management, Department of Anesthesia, Stanford University School of Medicine, 1070 Arastradero Road, Suite 200, Palo Alto, CA 94304, U.S.A. E-mail: dsyou@stanford.edu.

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the need to assess and treat these conditions in tandem.⁹ The overlap between PTSD and chronic pain is not fully accounted for by traumatic etiology of chronic pain.^{1,10,11} Greater PTSD symptoms are associated with greater pain severity, emotional distress, and disability.^{12–15} Therefore, it is recommended that trauma history and PTSD symptoms be routinely assessed among patients with chronic pain.⁹ However, patients are increasingly burdened with completing forms and surveys, so efficient assessment tools are needed. We were motivated to develop a brief, rapid screening tool for severe PTSD symptoms in chronic pain that would confer a low response burden on patients.

To screen PTSD symptoms at a primary care clinic, the Primary Care-PTSD screen (PC-PTSD) was developed using the item response theory (IRT) approach, which considers that responses to items are linked to the latent trait of interest.¹⁶ Therefore, with the IRT approach, a brief measure can be developed to effectively screen target symptom severity because it has the advantage of estimating the association of each item with an overall symptom severity (theta) score and discriminability.¹⁷ The IRT approach is different from classical test theory, where the symptom severity is calculated based on the number of symptoms endorsed, with each symptom considered to be of equal severity, and longer instruments considered to be more reliable.¹⁷

The PC-PTSD comprises 4 items to screen for moderate PTSD, and the theta scores of the 4 items range from 0.94 to 1.40 for veterans at a primary care clinic.¹⁸ To screen for PTSD in patients in our outpatient pain clinic, we included the PC-PTSD as part of our initial assessment ($n = 8,715$), using the same IRT approach and achieving results similar to those achieved in the study done on veterans (theta scores of our samples = 1.04–1.25, standard error [SE] = 0.02; results were presented at the American Psychology Association 2018 Conference, see Supplement). In our outpatient sample, 11.6% screened as positive using a cutoff score of 3.^{18,19} Because all 4 items on the PC-PTSD were associated with moderate PTSD symptom severity,¹⁸ the PC-PTSD is less optimal in identifying severe PTSD because from the IRT standpoint the items repeatedly evaluate symptoms associated with moderate PTSD severity.

Our current pilot study administered the 17-item PTSD Checklist-Civilian Version (PCL-C) to a subsample of patients with chronic pain who were scheduled for a pain psychology evaluation at a tertiary pain clinic. With the goal of developing a brief screening tool for

risk and treatment stratification, we aimed (1) to identify items that offered the greatest discriminative value and prediction of severe PTSD and (2) to examine the link between PTSD symptom severity as measured by individual theta scores and psychosocial functions in patients with chronic pain.

METHODS

All study procedures were approved by the institutional review board at the Stanford University School of Medicine and adhered to the intent and principles of the Declaration of Helsinki. Fifty-six patients with mixed etiology noncancer chronic pain conditions completed demographic information and the PCL-C at their pain psychology evaluation visit between November 2016 and August 2017 at a specialty pain management center within an academic medical institution. As part of their clinical care, all patients were enrolled in a learning healthcare system platform Collaborative Health Outcomes Information Registry (CHOIR: <http://choir.stanford.edu>), which administered a battery of patient-reported outcomes assessing physical, psychological, and social functioning. CHOIR uses both legacy measures and the Patient-Reported Outcome Measurement Information System (PROMIS) item banks.

Measures

The PCL-C is a 17-item measure to evaluate PTSD symptoms.^{20,21} Each item was rated on a scale of 1 (not at all) to 5 (extremely). The suggested optimal cutoff score in primary care settings is between 30 and 34.¹⁸ For the current study, responses were recoded into a binary response (1 = yes, 0 = no) for endorsement of each symptom. The rationale for recoding items was to address the need to inform the development of a brief PTSD screener with a binary response set, similar to the PC-PTSD. Therefore, total scores range from 0 to 17, with higher scores indicating more PTSD symptoms.

The Brief Pain Inventory-Short Form is an 11-point numeric rating scale (NRS), ranging from 0 to 10.²² The higher NRS ratings indicate greater pain intensity, and the current study used ratings for worst and average pain intensity over the preceding 7 days.

PROMIS is a publicly available IRT-informed bank of measures used to assess multiple health domains on the general population and individuals with chronic conditions.²³ The current study used the PROMIS item

banks for depression, anxiety, anger, physical function, pain interference, pain behaviors, fatigue, sleep disturbance, sleep impairment, emotional support, social isolation, and social role satisfaction scores. The current study used a computer-adaptive testing approach to assess the PROMIS domains, which allows for more precise assessment of each domain with a small number of items.²³ This measure provides T scores (mean = 50, standard deviation [SD] = 10). The higher scores indicate more symptoms in the domain for the preceding 7 days.

Statistical Analysis

First, the IRT approach was used to calculate each individual's theta score, which refers to the severity of the latent trait (ie, true PTSD). Theta scores are scaled at a mean of 0 and an SD of 1. The IRT approach was also used to calculate each item's theta score, which reflects the 50% probability of an item being endorsed by a person of a given symptom severity.²⁴ Consequently, the items with higher theta scores refer to severe or difficult items, since they are endorsed by individuals with more severe PTSD symptoms. Then, Pearson's correlations were computed to examine the relationship of individual PCL-C theta scores to pain ratings and the PROMIS T scores.

The *mirt* R package was used to evaluate item function and to calculate each patient's theta score.²⁵ The IRT approach can be used to examine the item information function in 3 different ways (ie, 1-, 2-, and 3-Parameter Logistic (PL) models), which respectively compute difficulty parameters only; difficulty and discriminant parameters; and difficulty, discriminant, and guessing parameters. Because the current study aimed to identify sensitive items for severe PTSD, the 2-PL Rasch model was used to examine the discriminant (*a*) and difficulty/severity (*b*) parameters. The *b* parameter is a point on a theta scale score of an item, and refers to difficulty/severity of an item, which has a 50% chance of being endorsed by a patient with a given symptom severity. A theta score close to 0 refers to moderate (average) symptom severity; 2 or higher refers to severe symptom severity (2 + SD above the mean).²⁶ The *a* parameter is the steepness of the item characteristic curve at *b*, and reflects the capability of an item to differentiate patients at *b* (theta) value. Higher values of *a* (2 or higher) mean that the item is highly discriminating. Finally, Pearson correlations were computed to examine the relationship of PTSD symptom severity

(theta) to pain ratings and to other PROMIS measures. All analyses were 2-tailed and used an alpha value of 0.05.

For the pilot nature of the current analysis, at least 30 participants are needed for dichotomous data,^{27,28} and 56 patients completed the PCL-C in this study. No missing values were observed except for the duration of their pain conditions (12.5%).

RESULTS

Table 1 summarizes the demographic characteristics of the sample. The study sample included mostly female (71.4%), married (53.6%), and middle-aged adults (mean = 44.20, SD = 12.85) who were mainly White/non-Hispanic (60.7%), followed by Hispanic/Latino (17.9%) and Asian (8.9%). The current sample's demographics are similar to those in our previous studies, which included large patient samples.^{29,30} About 23.2% reported their chronic pain conditions were associated with traumatic life events. About 50% of patients reported their pain duration to be <6.5 years (interquartile range = 2.4–17.0 years), and up to 50% of patients received 2 International Statistical Classification of Diseases and Related Health Problems (10th revision) (ICD-10) diagnoses associated with their pain. The most common ICD-10 code was migraine (see Table 1). The current sample included 33 patients (58.9%), who screened positive for PTSD using a PCL-C total cutoff score of 34.¹⁸

Item Information Function Analysis

Of the 17 PTSD items, 5 items were identified as being highly discriminant as evidenced by *a* values of 2 or above (ie, items 4, 5, 6, 7, and 17; Table 2). Among the highly discriminant items, 2 were identified as difficult items, which means that the items were frequently endorsed by patients with severe PTSD symptoms. These 2 symptoms were “feeling very upset at reminders” and “avoid thinking about or talking about it.” One hypervigilance symptom (“feeling jumpy”) was identified as being a highly sensitive item to moderate PTSD severity (*b* = 0.60), while 1 re-experiencing symptom (“physical reactions to reminders,” *b* = −0.43), and 1 avoidance symptom (“avoid activities or situations,” *b* = −0.59) were highly sensitive to mild severity. Notably, symptoms of “feeling distant or cut off from others” and “feeling emotionally numb” were associated with moderate PTSD symptom severity.

Table 1. Demographic Information (N = 56)

	n	% of the Total Sample
Gender (Female)	40	71.4
Marital status		
Married	30	53.6
Never married	10	17.9
Divorced	8	14.3
Living together	5	8.9
Separated	2	3.6
Widowed	1	1.8
Ethnicity		
White/non-Hispanic	34	60.7
Hispanic/Latino	10	17.9
Other including multiracial	6	10.7
Asian	5	8.9
Black/African American	1	1.8
Pain associated with a traumatic event	13	23.2
Pain duration, median years (IQR)	6.5	(2.4 to 17.0)
Number of pain-related diagnoses, median (IQR)	2	(1 to 3)
Pain diagnosis (ICD-10) [†]		
G43 Migraine	20	35.7
M54 Neck and back pain	15	26.8
G89 Pain, not elsewhere classified	14	25.0
M79 Other soft tissue disorders	14	25.0
M25 Other joint disorders	7	12.5
G44 Other headache syndromes	5	8.9
R10 Abdominal and pelvic pain	4	7.1
G50 Disorders of trigeminal nerve	3	5.4
G57 Neuropathies of lower limb	3	5.4
R51 Headache	3	5.4
G62 Other and unspecified polyneuropathies	2	3.6
M22 Disorder of patella	2	3.6
M72 Fibroblastic disorder	2	3.6
Other diagnoses [‡]	19	33.9

ICD-10, International Statistical Classification of Diseases and Related Health Problems, 10th revision; IQR, interquartile range.
[†]More than 1 diagnosis per patient, so the total percentage is greater than 100%.
[‡]Other diagnoses were reported only once: A09, D86, G56, G70, G90, G95, I89, K62, L93, M47, M48, M50, M51, M62, M96, N50, R52, S92, T14.

Table 3 summarizes the clinical characteristics of the sample. On average, patients reported moderate PTSD symptoms (mean = 38.79) and about 11 symptoms (out of 17). The PROMIS physical and emotional distress T scores presented in Table 3 were within the average to moderate range of severity (T scores ranged from 41.75 to 65.82). Pearson *r*s were computed to examine the bivariate relationship of individual theta scores to pain and pain-related interference. Theta scores were positively correlated only with ratings for worst pain ($r = 0.38, P = 0.004$), but not with average pain ($r = 0.210, P = 0.119$). Additionally, theta scores were positively associated with PROMIS-Depression T scores ($r = 0.43, P = 0.001$), as well as Pain interference, Pain behaviors, Fatigue, Sleep disturbance, Sleep impairment, and Social isolation T scores (r s = 0.38 to $-0.51, P$ s < 0.01). These results demonstrate that more severe PTSD was associated with greater pain, severe depressive symptoms, worse physical health

Table 2. The 17-Item PTSD Checklist-Civilian Version (PCL-C)

Symptom Clusters	No.	PCL-C Items	a	b
Re-experiencing	1	Repeated disturbing memories, thoughts, or images	1.61	2.34
	2	Repeated disturbing dreams	1.31	1.01
	3	Suddenly acting or feeling as if a stressful experience were happening again	1.62	0.34
	4	Feeling very upset at reminders	3.67	2.44
	5	Physical reactions to reminders	2.92	-0.43
Avoidance/emotional numbness	6	Avoid thinking or talking about it	3.61	2.17
	7	Avoid activities or situations	3.00	-0.18
	8	Trouble remembering important parts	1.61	-0.59
	9	Loss of interest	0.50	0.88
	10	Feeling distant or cut off from others	0.83	1.69
Hypervigilance	11	Feeling emotionally numb	1.33	0.51
	12	Feeling as if your future will somehow be cut short	0.76	0.58
	13	Trouble falling or staying asleep	0.61	2.26
	14	Feeling irritable or having angry outbursts	0.66	1.20
	15	Difficulty concentrating	1.01	2.28
	16	Being super alert or watchful on guard	1.85	0.50
	17	Feeling jumpy or easily startled	2.26	0.60

a, Discriminant parameters (boldface values represents highly discriminating); b, severity parameters (boldface values represents severe PTSD symptom).

Table 3. Sample Characteristics and Correlations Between Theta (PTSD Severity) and Other Measures

		Pearson's <i>r</i>	M	SD
PCL-C	Raw scores		38.79	12.32
	Binary response scores		11.05	4.13
Pain intensity for past 7 days	Worst	0.38**	8.25	2.10
	Average	0.21	5.80	2.43
PROMIS T scores	Depression	0.43**	58.48	7.31
	Anxiety	0.13	60.70	7.39
	Anger	0.20	55.95	8.46
	Physical function	-0.03	41.75	10.21
	Pain interference	0.33*	65.82	7.73
	Pain behaviors	0.35**	59.86	5.00
	Fatigue	0.41**	51.11	10.38
	Sleep disturbance	0.51**	57.39	8.70
	Sleep impairment	0.38**	60.18	8.53
	Emotional support	-0.44**	47.70	9.44
	Social isolation	0.51**	53.29	8.61
	Social role satisfaction	-0.45**	41.79	9.43

PCL-C, PTSD Checklist-Civilian Version; PROMIS, Patient Reported Outcome Measurement Information System; SD, standard deviation.
 * $P < 0.05$. ** $P < 0.01$.

status, and greater pain-related interference, as expected from other study findings.¹²⁻¹⁵

DISCUSSION

The current study identified that different PTSD symptoms were associated with different levels of PTSD

symptom severity. Items related to severe PTSD symptoms were “repeated disturbing memories,” “feeling upset at reminders,” “avoid thinking or talking about it,” “sleep disturbance,” and “difficulty concentrating.” Among these 5 symptoms, having emotional reactions to reminders and avoid the trauma topics were 2 highly discriminating items for severe PTSD and therefore are candidate items for a brief PTSD screener to be used at an outpatient pain clinic. A few (physical reactions to reminders and trouble remembering important parts) were associated with mild severity, and the majority of PTSD symptoms were associated with moderate severity. It should also be noted that we found no single cluster of symptoms consistently associated with severe PTSD symptoms.

The current study found that higher PTSD symptom severity (theta) was associated with poorer health status across multiple domains, specifically in sleep ($r_s = 0.38$ and 0.51), social ($r_s = -0.45$, -0.44 , and 0.51), depression ($r = 0.43$), and fatigue or other health issues ($r_s = 0.33$ to -0.41), which are consistent with previous findings.^{12–15,31,32} Additionally, theta scores were positively associated with ratings for worst pain. Therefore, patients being treated for chronic pain should be systematically screened for PTSD symptoms; those who endorse comorbid severe PTSD symptoms should be referred for further PTSD evaluation and treatment to reduce the impacts of PTSD on pain and health outcomes. Unfortunately, PTSD typically goes undetected in more than 50% of patients presenting at primary care clinics,³³ and undetected PTSD may have more significant clinical implications for patients with chronic pain. Therefore, a brief and effective screening tool for severe PTSD may increase systematic screening as well as risk and treatment stratification. Our current study is the first step toward improving the screening process for severe PTSD with reduced response burden.

Optimal treatment approaches and targets for patients with chronic pain and comorbid PTSD have not been systematically investigated. As such, future studies should examine whether trauma-specific therapy should be implemented prior to or in conjunction with pain cognitive and behavioral therapy (CBT), and whether trauma-specific therapy would alter outcomes of pain CBT in patients with varying degrees of PTSD symptom severity.

The underlying mechanisms of chronic pain and comorbid PTSD disorder remain to be elucidated. Proposed mechanisms are shared vulnerability and mutual maintenance models,^{9,34} which explain that

certain cognitive, affective, and behavioral components contribute to and maintain or exacerbate symptoms of PTSD and chronic pain.³⁴ Such components include attentional biases towards threatening and painful stimuli, greater anxiety sensitivity, hypervigilance, and avoidant coping. Additionally, PTSD may be associated with altered pain processing. Experiments with quantitative sensory testing on patients with PTSD have shown exaggerated responses to suprathreshold pain, with elevated pain threshold³⁵ and prolonged capsaicin-evoked pain.³⁶ Investigators have reported that increased pain threshold may be associated with a PTSD symptom of dissociation, which may delay the response to the first painful stimulus, but once nociceptors are activated, patients with PTSD may show hyper-responsiveness to suprathreshold pain³⁵ and persistent capsaicin-evoked pain.³⁶ In fact, our results are in line with these experimental findings, since PTSD severity was positively associated with ratings for worst pain.

Our current pilot study has several limitations. A predominantly female sample limits generalizability of the findings to male patients. However, because patients visiting an outpatient pain clinic are mostly female (about 63%),^{29,30,37} our findings may be generalizable to patients seeking medical treatments for chronic pain. Additionally, our sample included patients with heterogeneous pain conditions and therefore was not representative of patients with any specific pain conditions. However, our sample was representative of patients with any type of chronic pain condition who were seeking treatments at a tertiary pain clinic and were referred for pain psychology evaluation. Hence, we are targeting an important at-risk population. Finally, the clinical diagnosis of PTSD was based solely on self-report questionnaires and was not verified or confirmed with a clinician’s structured interview (eg, the PTSD Symptom Scale-Interview Version³⁸ or Clinician-Administered PTSD Scale³⁹). Our next study will further explore and confirm the current study findings with a clinical diagnosis of PTSD in a larger sample. Despite these limitations, the strength of this work is the item level analysis of the PCL-C measure in patients with chronic pain, with results revealing the utility of a brief and sensitive screening tool that targets symptom severity in an at-risk patient population.

In conclusion, we observed severe PTSD as being associated with worse patient-reported pain and psychosocial health outcomes and identified a subset of PTSD symptoms that are associated with varying levels

of PTSD severity, ranging from mild to severe symptoms, in a sample of patients with chronic pain. Therefore, a brief PTSD measure may be developed to efficiently identify individuals with severe PTSD symptoms, as they would benefit from trauma-specific interventions compared to individuals with less severe PTSD. In screening severe PTSD at an outpatient pain clinic, we propose the 2 candidate items “feeling upset at reminders” and “avoid thinking or talking about the trauma,” which warrant further investigation for their validity, reliability, and clinical utility.

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CONFLICTS OF INTEREST

The authors state that they don't have any conflict of interest.

Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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