Psychometric Evaluation of the Persian Version of the Traumatic Injuries Distress Scale

Shirin Modarresi,[a,*] Maryam Farzad,[b,c] Golale Modarresi,[d] Enayatollah Bakhshi,[e] Seyed Ali Hosseini,[c] Erfan Shafiee,[b] Mahshad Maleki,[c] Joy Christine MacDermid,[a,b,f,g,h] & David Mark Walton[g]

[a]School of Rehabilitation Sciences, McMaster University, Hamilton, ON, Canada; [b]Department of Health and Rehabilitation Sciences, Western University, London, ON, Canada; [c]Department of Occupational Therapy, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran; [d]Lunenfeld-Tanenbaum Research Institute, Bridgepoint Collaboratory for Research and Inovation, Sinai Health, Toronto, Ontario, Canada; [e]Department of Biostatistics and Epidemiology, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran; [f]Department of Orthopedic Surgery, Western University, London, ON, Canada; [g]School of Physical Therapy, Western University, London, ON, Canada; [h]Roth|McFarlane Hand and Upper Limb Centre, St. Joseph's Health Care, London, ON, Canada

*Address all correspondence to: Shirin Modarresi, 1201 Western Road, Health & Rehabilitation Science, Western University, N6G 1H1, London, ON, Canada; Tel.: +519 661-2111, E-mail: smodarre@uwo.ca

ABSTRACT: Purpose: The traumatic injuries distress scale (TIDS) is a tool to assess acute emotional distress after post-musculoskeletal injuries. The purpose of this study was to evaluate the psychometric properties of the Persian version of the TIDS (TIDS-P).

Methods: Participants ($n = 100$, mean age = 32.5, 82% male) with acute musculoskeletal injuries of any etiology completed the TIDS-P and the Persian version of the Brief Pain Inventory (BPI-P) on a single occasion, with 15 completing a re-test in seven days. Structural validity (confirmatory factor analysis), criterion validity (Spearman's rho), internal consistency (Cronbach's alpha), and test–retest reliability (intra-class correlation coefficient, $ICC_{2,1}$) were assessed.

Results: TIDS-P demonstrated excellent criterion validity as the correlation values were similar to the English version (r = 0.73, 0.56 versus 0.73 and 0.47, respectively). Adequate statistical criteria were demonstrated for the three-factor structure of TIDS-P ($X^2 = 88.15$, $df = 51$, $P < 0.001$, CFI = 0.95, TLI = 0.96, and RMSEA = 0.086). The internal consistency was acceptable with Cronbach's alpha of 0.61 for the hyperarousal/intrusion subscale, 0.83 for the negative affect subscale, and 0.78 for the uncontrolled pain subscale. The $ICC_{2,1}$ values demonstrated excellent test–retest reliability (0.92).

Conclusion: Evaluation of the psychometric properties of the TIDS-P provide excellent reliability and appropriate structural validity for assessment of emotional distress post-musculoskeletal injuries in Persian populations.

KEY WORDS: traumatic injuries distress scale, psychometric properties, musculoskeletal injuries, prognosis

I. INTRODUCTION

Non-catastrophic musculoskeletal (MSK) injuries are one of the most common sources of global disability.[1] Development of chronic pain and disability following MSK injuries

is common.[2,3] A recent systematic review reported that chronic pain after traumatic MSK injuries occurs in 22–93% of people and that it can last several years.[4] Chronic pain can lead to a substantial negative impact on the sufferer and the healthcare system and this burden is projected to increase as the population ages.[5] Preventing the transition of patients from acute to chronic pain has been a challenge for clinicians.[6] Therefore, understanding the factors that can identify people at risk of this transition is of high importance. Better insight into these factors can lead to the development of more appropriate management strategies and facilitate the care pathway.

Several modifiable and non-modifiable risk factors for the transition from acute to chronic pain have been identified including high levels of initial pain,[7] low levels of education,[8] low socioeconomic status,[9] smoking,[10] and sedentary lifestyle.[11] In addition, psychological factors are among the most consistent predictors of chronic pain.[12] This is in line with the fear-avoidance model of pain in that psychological factors play an important contributing role in the development of chronic pain.[13] A recent study reported that depression is the most significant factor distinguishing people that experience full rapid recovery and those that experience chronic pain and disability after a wrist fracture.[14] The negative impact of psychological factors has been reported in other patient populations such as back pain,[15] whiplash-associated disorder,[16] and Morton's neuroma.[17]

Other psychological pathologies such as anxiety have also been shown to be predictors of chronic pain following MSK injuries.[18] However, aside from pre-existing psychopathologies, emotional distress that follows acute MSK injuries has also been associated with chronic pain,[18] even after injuries as benign as an ankle sprain.[19] One drawback of previous research is that the majority of studies that assessed distress following MSK injuries have used tools that focus on a single symptom such as post-traumatic stress disorder (PTSD),[20] whereas psychological features can cross multiple constructs. Further, a focus on single symptoms can potentially lead to misidentification or misdiagnosis,[21] or may not help patients get the supports they need.

The Traumatic Injuries Distress Scale (TIDS) is a risk prognosis screening tool that is designed specifically to evaluate emotional distress in acute MSK injuries of any etiology in order to identify those that are at risk of developing chronic pain.[19] Recently, our group translated and culturally adapted the TIDS to the Persian language and culture through a rigorous process of forward–backward translation and cognitive interviewing.[22] The purpose of the current study is to investigate the psychometric properties of the Persian version of the TIDS (TIDS-P), more specifically, the internal consistency, test–retest reliability, construct validity, and structural validity.

II. METHODS

A. Setting and Sample

Participants were consecutive patients who presented with acute MSK injuries to the Sarallah Physiotherapy and Orthopedic Clinic in the city of Arak in Iran. The

inclusion criteria were (1) native Persian speaking adults (age ≥ 18 years) and (2) having recent (i.e., less than 30 days) non-catastrophic MSK injuries of any etiology. The exclusion criteria were (1) any major systemic illness including cancer, organ disease, blood clotting disorder, neuromuscular disorder, rheumatoid condition, or uncontrolled psychopathology; (2) any other comorbid chronic pain condition; (3) any cognitive limitation that would interfere with completing the questionnaires. After meeting the inclusion criteria, a research assistant explained all the study information to participants, answered any questions, and obtained written informed consent.

For equivalency purposes, we also included data from the Systematic Merging of Biology, Mental Health, and Environment (SYMBIOME, clinicaltrials.gov ID NCT02711085) longitudinal cohort study collected in London, Ontario, Canada. The inclusion and exclusion criteria were similar, except this cohort was recruited through an acute care medical center in Canada and included English speaking participants. As these data were used for secondary comparison only, a detailed description of the sample and the specific process for data collection can be found in a prior report.[23]

B. Outcome Measures

At baseline, a study-specific form was used to collect information such as sex, age, time (days) since the injury, location of the injury, and mechanism of injury. The TIDS is a risk prognosis screening tool that has been developed to evaluate post-injury emotional distress in the acute MSK population.[19] It has 12 items that are rated on a frequency-based scale (0 = never, 1 = occasionally, and 2 = often or all of the time) with a maximum possible score of 24.[19] The TIDS is freely accessible for use by clinicians and researchers and is currently available in English, French, and Spanish. It is an easy-to-understand tool that takes less than three minutes to complete. It comprises three subscales: "uncontrolled pain," "negative affect," and "intrusion or hyperarousal."[19] The multi-construct nature of the TIDS leads to an important advantage in that it can be helpful in both risk stratification (high, moderate, low risk) and risk phenotyping for identification of treatment targets. The comparator outcome measure in this study was the Persian version of the Brief Pain Inventory (BPI-P), a scale that has been previously validated in this population.[24] The BPI-P has two subsections: (1) pain intensity (worst pain, least pain, average pain, pain right now) on a numeric rating scale with 0 indicating no pain and 10 indicating worst pain imaginable and (2) pain interference (general activity, mood, walking ability, normal walk, relations with other people, sleep, and enjoyment of life) using a numeric rating scale with 0 indicating no interference and 10 indicating complete interference.[25] The total score of both sections is calculated by adding the scores.[25]

The English versions of the BPI and TIDS were used in the SYMBIOME cohort, and we only used the baseline data. TIDS-P was completed at baseline by all participants

and one week later (by a subgroup for the reliability analysis). We considered this period short enough to assume participants remained stable. The BPI-P was only completed at baseline.

C. Analysis

Participant characteristics were summarized descriptively as means and standard deviation (SD) or frequencies. The floor and ceiling effects for TIDS-P total score and its subscales were determined with a tolerance level of 15%.[26] Considering the maximum and minimum possible scores for TIDS-P (0 to 24), we considered values between 0 and 4 as floor effect and values between 20 and 24 as ceiling effect.

D. Validity

1. Criterion Validity (Cross-Cultural Validity)

To assess the equivalency of the TIDS-P with the original English version, we calculated Spearman's correlation coefficients (rho) with bootstrapped with 95% confidence interval (CI) for the associations between the three TIDS-P subscales and the two BPI-P subscales. Those were compared to the same coefficients calculated from the SYMBIOME database using the original English language versions. We hypothesized *a priori* that these associations would be similar by virtue of coefficients from the Persian analysis being within the 95% CI of the corresponding English analysis.

2. Structural Validity

A confirmatory factor analysis (CFA) was performed on all TIDS-P items to confirm the three-factor structure of the original English version.

The model fit was evaluated with several goodness-of-fit indices, including root mean square error of approximation (RMSEA) < 0.08, Chi-square test ($P > 0.05$), the goodness of fit index (GFI) > 0.95, the comparative fit index (CFI) > 0.90, and Tucker–Lewis index (TLI > 0.95).[27,28] The CFA was conducted with LISREL version 8.80. All other analyses were conducted with the Statistical Package for the Social Sciences program version 26.0 (SPSS, Inc., Chicago, IL).

E. Reliability

1. Internal Consistency

Internal consistency was assessed using Cronbach's α coefficient for all subscales of the TIDS-P. For comparison and equivalency purposes, the same analysis was conducted using the SYMBIOME data for the original version of the TIDS. A Cronbach's α of 0.70 was considered acceptable for internal consistency.[29]

2. Test–Retest Reliability

Test–retest reliability was evaluated using the two-way random-effects model of intra-class correlation coefficient ($ICC_{2,1}$) with 95% confidence interval (CI) for all subscales and the total score.[30] An $ICC_{2,1} \geq 0.75$ was considered excellent.[31] Paired samples *t*-test was used to examine any statistically significant change indicating a systematic difference between the test-retest scores for TIDS-P.

The standard error of measurement (SEM) was then calculated using the formula ($SEM = SD.\sqrt{1-ICC}$) to determine whether the change in the score on the second occasion reflects a measurement error or a true change in clinical status. Minimal detectable change at 95% confidence level was calculated based on SEM to determine a real change in the score with a given level of confidence ($MDC = 1.96.SEM.\sqrt{2}$).

III. RESULTS

In total, 100 participants with a mean age of 32.5 (SD 11.4) years were included in the study. Participant characteristics are summarized in Table 1. The majority of participants

TABLE 1: Demographic information and participant characteristics

		Mean (SD)	% Frequency
Age		32 (11.39)	
Sex	Male		82
	Female		18
Time since injury (days)		14 (8.3)	
Location of injury	Hand and/or wrist and/or forearm		51
	Elbow		1
	Shoulder and/or upper arm		9
	Hip and/or thigh and/or knee		22
	Foreleg and/or ankle and/or foot		17
	Trunk		0
Mechanism of injury	Motor vehicle accident		38
	Trip or slip		4
	Fall down a hill or stairs		3
	Fall from height		9
	Hit by object (not vehicle)		24
	Hit by another person		3
	Awkward lift		1
	Awkward twist		3
	Other		15

TABLE 1: (*continued*)

		Mean (SD)	**% Frequency**
TIDS-P	First evaluation	9.47 (5.61)	
	Retest	9.60 (4.82)	
BPI-P	Pain severity	3.19 (2.31)	
	Pain interference	4.80 (2.49)	

SD, standard deviation; BPI-P, Persian version of the brief pain inventory; TIDS-P, Persian version of the traumatic injuries distress scale.

were male (82%), sustained an injury to the dominant limb (68%), and were injured for an average of 13 days (SD 8.3). Motor vehicle collision was the most frequent (38%) mechanism of injury followed by getting hit by another object (24%). The most frequent location of injury was the hand and wrist (51%). There were no missing data. There was no ceiling or floor effect for the TIDS-P total score.

A. Validity

1. Criterion Validity

We included 114 participants from the SYMBIOME cohort. The correlation value between TIDS total score and BPI interference is rho = 0.73 (95% CI 0.62, 0.81) and between TIDS total score and BPI pain severity is rho = 0.56 (95% CI 0.40, 0.70). Table 2 demonstrates the correlation values between TIDS and its subscales and pain interference and pain severity subsections of the BPI.

TABLE 2: Correlations between TIDS and BPI (original English versions) and between TIDS-P and BPI-P

	TIDS (total)	**Negative affect**	**Uncontrolled pain**	**Intrusion/ hyper arousal**	**BPI-Pain severity**
Negative affect	0.89**				
Uncontrolled pain	0.88**	0.62**			
Intrusion/hyperarousal	0.45**	0.38**	0.21*		
Pain severity	0.58**	0.40**	0.64**	0.17	
Pain interference	0.73**	0.66**	0.67**	0.31**	0.67**
Negative affect	0.85**				
Uncontrolled pain	0.84**	0.50**			
Intrusion/hyperarousal	0.61**	0.32**	0.47**		
Pain severity	0.47**	0.26**	0.57**	0.23*	
Pain interference	0.73**	0.51**	0.73**	0.47**	0.53**

**P-value of 0.01 or less. *P-value of 0.05 or less.

    The correlation value between TIDS-P total score and the pain interference subsection of BPI-P is r = 0.73 (95% CI 0.61, 0.81) and between TIDS-P total score and the pain severity subsection of BPI-P is r = 0.47 (95% CI 0.31, 0.62). Table 2 demonstrates the correlation values between TIDS-P and its subscales and pain interference and pain severity of the BPI-P. In all analyses, the correlation coefficient of the Persian scales was within the 95% CIs of the corresponding original English versions.

2. Structural Validity

The goodness-of-fit statistics demonstrated reasonable statistical criteria for three-factor structures ($X^2 = 88.15$, $df = 51$, $P < 0.001$, CFI = 0.95, TLI = 0.96, and RMSEA = 0.086). All standardized coefficients significantly represented hypothesized dimensions. The final path diagram model is presented in Fig. 1. Table 3 represents the factor loadings of the TIDS-P.

C. Reliability

1. Internal Consistency

The internal consistency was acceptable. Cronbach's alpha was 0.61 for the hyperarousal/intrusion subscale (cf. α = 0.62 English), 0.83 for the negative affect subscale
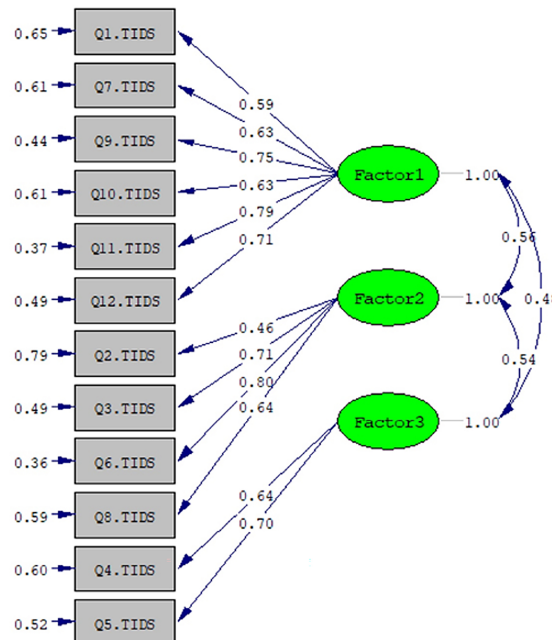

FIG. 1: The final model for confirmatory factor analysis of the TIDS-P. Chi-square = 88.15, df = 51, P-value = 0.00096, RMSEA = 0.086.

TABLE 3: Confirmatory factor analysis of the TIDS-P

Items	Factor 1	Factor 2	Factor 3
11: Feeling numb or disengaged, as if you were watching the world through a window	0.62		
9: Loss of interest in your appearance	0.59		
12: Anger directed at others	0.58		
7: Loss of motivation to get up and start a new day	0.50		
10: Difficulty doing the things that you would normally enjoy	0.46		
1: Difficulty maintaining your concentration	0.41		
6: Frustration at your inability to control your pain		0.62	
3: A feeling of being overwhelmed by pain or other symptoms		0.54	
8: Pain that lasts an entire day without easing		0.43	
2: Difficulty thinking about anything other than the pain		0.33	
5: Feeling "wound up," agitated, or scared when in a place that reminds you of the accident (e.g., in car, at work, or on a slippery surface)			0.57
4: Flashbacks of the accident while you are awake that feel very real			0.50
Alpha	0.83	0.78	0.61

(cf. $\alpha = 0.82$ English), and 0.78 for the uncontrolled pain subscale (cf. $\alpha = 0.80$ English). In no case did alpha differ by > 0.02 points.

2. Test–Retest Reliability

Fifteen participants filled out the questionnaires twice, and their data were considered for test–retest analysis. The $ICC_{2,1}$ for the total score was 0.92 (95% CI 0.77, 0.97), indicating excellent reliability. There was no statistically significant difference in the test–retest scores of the TIDS-P total and subscales ($P > 0.05$) between the two administrations (Table 4). The SEM and MDC for the overall scale score were 4.93 and 13.62, respectively.

IV. DISCUSSION

This study demonstrates that the TIDS-P has adequate psychometric properties specifically criterion validity, structural validity, internal consistency, and test–retest reliability. Therefore, we can endorse use of the TIDS-P as a measure of emotional distress following acute MSK injuries in Persian populations. The TIDS-P is a risk prognosis tool that

TABLE 4: Test–retest reliability of the TIDS-P

	Test (mean-SD)	**Re-test (mean-SD)**	**P-value**	**ICC$_{2,1}$ (95% CI)**
Total score	9.47 (5.61)	9.60 (4.82)	0.74	0.92 (0.77–0.97)
Negative affect	3.95 (3.02)	5 (2.59)	0.13	0.91 (0.74–0.97)
Uncontrolled pain	4.05 (2.63)	2.87 (2.29)	0.25	0.86 (0.60–0.95)
Intrusion/hyper arousal	1.47 (1.36)	1.73 (1.03)	0.21	0.87 (0.63–0.95)

ICC$_{2,1}$ intra class correlation coefficient; SD, standard deviation.

can be used to identify people at risk of developing chronic pain when they are still in the acute phase. The subscales can further provide more detailed information on optimal treatment targets with the intension of mitigating the burden of post-trauma chronic pain.

The first result of this study was regarding criterion (concurrent) validity of the TIDS-P, which was assessed by comparing the magnitude of association between correlation values of TIDS and BPI and those of TIDS-P and BPI-P. Our results indicate that these associations are sufficiently similar to accept that the TIDS-P is an adequate reflection of the original English version. The high correlation value between TIDS and BPI interference subsection potentially implies that the interference that physical pain causes in daily activities is highly correlated with the magnitude of emotional distress caused by an injury. The correlation values were lower for BPI pain severity in both the English and the Persian versions. The lower correlation values may suggest that the emotional distress is not only related to the severity of pain, but that other factors play a role as well. This is illustrated by a higher correlation between pain severity and the "uncontrolled pain" subscale of the TIDS and TIDS-P.

The second result of this study was that the statistical fit indices confirmed the three-factor structure of the TIDS-P according to the referenced cut-points. All factor loadings in this study were significant, which indicates that the items were interpreted as valid components of the relevant subscale or factor. This indicates that the three-factor structure of the TIDS is not culturally bound. Meaning, the emotional distress that follows acute MSK injuries can be assessed using the three factors that are inherent in evaluation of this construct and they are not dependent on culture or language, at least for Persian.

The results of the internal consistency of the TIDS and TIDS-P indicate that they are adequately similar to assume that the Persian version is a true reflection of the original version. Both the original and the TIDS-P had higher values for the total, negative affect, and uncontrolled pain subscales, and lower-than-desirable values for the hyperarousal/intrusion subscale. The developers of the tool propose that this is potentially due to having only two items in this subscale, making it useful as a quick screen of post-traumatic distress but alpha is well-known to be limited in scales with few items.[19]

The ICC$_{2,1}$ values that correspond to the test–retest reliability of the TIDS-P total and subscales indicate that this tool is an adequately reliable clinical measure of

emotional distress and may be useful for evaluation of change over time. In addition, it provides support for the absence of systematic bias in our data.

A. Strengths and Limitations

One of the strengths of this study is that we did not exclude participants based on sex, age, and education level, which ensures its applicability across different populations. One limitation of this study is that we considered one week to be a short enough amount of time to assume the participants have remained stable and during this time some participants may have experienced recovery. Although a plausible concern, the selection of this time-frame was based on previously published studies that have used Global Rating of Change to assess change over time in acute MSK injury population.[32] In addition, the excellent ICC values indicate that no significant change has occurred. Another limitation of this study is that the sample was from a single clinic in one city and may not be a true representation of the entire Persian population. However, it should be noted that within the sample, a variety of participants in different age groups and with various levels of education and jobs were included. This variety lowers the risk of the sample not being a true representation of the population. In addition, it is worth mentioning that the translation and cross-cultural processes were performed by researchers that were not from that region.

V. CONCLUSION

This study evaluated the psychometric properties of the TIDS-P, specifically the structural validity, criterion validity, internal consistency, and test–retest reliability. The results indicate that the TIDS-P is an adequately valid and reliable tool to assess emotional distress following traumatic MSK injuries in Persian populations. We recommend TIDS-P to be used in conjunction with other prognostic tools to identify individuals at risk of developing chronic pain when the patient is still in the acute phase. Future research is recommended to assess the inter-rater reliability and its applicability in various clinical settings.

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