

RESEARCH ARTICLE

Cross-cultural Adaptation and Psychometric Evaluation of the Persian Version of the Satisfaction and Recovery Index (SRI): Structural Validity, Construct Validity, Internal Consistency, and Test-retest Reliability

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Abstract

Background: The Satisfaction and Recovery Index (SRI) is a generic importance-weighted health satisfaction tool to measure the process and state of recovery following musculoskeletal injuries. The objectives of this study are (1) to translate and cross-culturally adapt the SRI to Persian and (2) evaluate its psychometric properties.

Methods: The forward-backward translation technique was used for translation, and two rounds of cognitive interviews were conducted to assess cultural appropriateness. Participants (n=100, mean age=32.5, 82%male) had acute (i.e., <30 days) musculoskeletal injuries of any etiology. Structural validity, construct validity, internal consistency, and test-retest reliability were evaluated.

Results: Participants identified issues in 3/6 areas of a coding system during the cognitive interviews: comprehension/clarity, relevance, and inadequate response definition. These issues informed subsequent changes to arrive at the final version of the SRI-P. The SRI-P had adequate construct validity ($P<0.001$), the confirmatory factor analysis demonstrated a two-factor structure, the internal consistency was acceptable (Cronbach's $\alpha=0.83$), and it was deemed reliable ($ICC_{2,1}=0.72$).

Conclusion: The psychometric evaluation revealed that the SRI-P has adequate construct validity, internal consistency, and test-retest reliability. Unlike the original English version, the SRI-P has a two-factor structure, which appears to be related to cultural differences in interpreting some of the items. The clinical importance of this study is that the SRI (which captures the state of recovery and how important the various items of the tool are to each patient and how satisfied they are with their recovery) can now be available to surgeons and therapists in the orthopedic and rehabilitation realms in Persian populations.

Level of evidence: II

Keywords: Cross-cultural adaptation, Musculoskeletal injuries, Patient-reported outcome measure, Psychometric evaluation, Satisfaction and recovery Index

Introduction

Patient-centered care is considered a key component of high-quality health care.¹ Patient-centered care requires that patients' opinions, needs, and desires

be considered when making clinical decisions.¹ Patient-reported outcomes measures (PROMs) are a standardized way of capturing patient opinions and perspectives,

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defined as “any report of the status of a patient’s health condition that comes directly from the patient without interpretation of the patient’s response by a clinician or anyone else”.² There are numerous PROMs, many of which can be broadly classed as ‘generic’ with applicability across clinical conditions and populations or ‘condition or region-specific’ designed to capture health status in a more narrowly defined clinical group. These two types of PROMs are used and advantageous for different purposes.

Despite their benefits, there are many drawbacks to implementing PROMs in clinical practice. For instance, they might be too time-consuming, difficult to access, or have complicated scoring systems.³ Traditionally, both generic and more specific PROMs comprise a set of standardized items that are believed to be indicators of a patient’s position along a latent continuum of disability or health. Additionally, the responses to which are usually summed with the assumption that all items on a scale are of equal importance to all people and should therefore all contribute equally to the total score. Walton et al. posed two fundamental questions about this concept: “What does recovery mean in the clinical realm?” and “Based on whose opinion should it be defined?”⁴ While the construct of recovery has commonly been operationalized as some sort of “return to pre-injury or pre-disease normal” or absence of symptoms,⁵ it has been argued that a more patient-centered approach would reflect the patient’s goals and values.⁴ Therefore, PROMs would benefit from capturing the extent to which an item is important for a particular respondent. Additionally, many such health status or disability measures require respondents to indicate whether they can perform an activity or function. Still, the ability does not intuitively indicate satisfaction.⁶

These considerations led to the development of the Satisfaction and Recovery Index (SRI).⁶ The SRI is a unique generic health-satisfaction tool that comprises ten items (nine substantive and one for attention check).⁶ Each item of the tool requires two ratings: the first is to indicate how important each domain is to the respondent’s personal sense of recovery (0 = not important at all, 10 = extremely important), second is a rating of satisfaction with current status on those same domains (0 = not at all satisfied, 10 = completely satisfied). The score for each item is then calculated as: importance x satisfaction / 10 (where 10 represents the highest possible importance), and the total score is the sum of the weighted scores/sum of the importance scores only * 100, for a percentage score from 0% importance-weighted satisfaction to 100% importance-weighted satisfaction. As a result of the importance weighting, change in domains that are of higher importance leads to an overall greater change in percent satisfaction than does change in domains of lower importance. In a prior evaluation of the SRI in the original English language, the importance-weighted scores were more responsive than another generic health tool (the Short-Form 12) and equally responsive as region/condition-specific scales, having the advantage of allowing comparisons across patient populations while maintaining the responsiveness advantage of traditional specific scales. The SRI is freely accessible,

takes less than five minutes to complete, and is easy to interpret.⁶ However, it should also be acknowledged that one limitation of the SRI is that the calculation of the total score (explained above) is relatively more time-consuming than a simple summation.

The psychometric properties of the SRI have been previously reported, including internal consistency, responsiveness, discriminative accuracy, test-retest reliability, and its ability to capture response shifts.^{6,7} The SRI is currently available in English and French. As different languages, cultural norms, and interpretations of words can lead to inaccurate responses to the original version, the objectives of the current study were: (1) to translate and cross-culturally adapt the SRI to the Persian language and culture through a rigorous process of forward-backward translation and cognitive interviewing; and (2) to evaluate the psychometric properties of the Persian version of the SRI through exploration of its structural validity, construct validity, internal consistency, and test-retest reliability.

Materials and Methods

Setting and Sample

Participant recruitment was done through consecutive (non-probability) sampling at a Physiotherapy and Orthopedic clinic in Iran. The following inclusion criteria were adopted: 1. Persian-speaking patients with recent (less than 30 days) non-catastrophic musculoskeletal injuries of any etiology, 2. 18 years of age or older. The exclusion criteria were: 1. any major systemic illness or pain condition, 2. any cognitive deficit that would interfere with understanding and completing the study.

Written informed consent was obtained from all participants. The study protocol was approved by the University of Social Welfare and Rehabilitation Sciences research ethics board before participant recruitment.

Outcome Measures

Participants’ characteristics and demographic information, including sex (female/male), age (in years), days since the injury, location, and mechanism of injury were collected at baseline using a study-specific questionnaire. The SRI was the outcome measure of interest for translation, cross-cultural adaptation, and evaluation of psychometric properties. The comparator outcome measure was the Persian version of the Brief Pain Inventory (BPI-P).⁸ The psychometric properties of the BPI-P have been previously established.⁸ The BPI-P has two subsections of pain intensity (worst pain, least pain, average pain, pain right now) and pain interference, both using a numeric rating scale with zero indicating no pain and no interference and 10 indicating worst pain imaginable and complete interference.⁹ The total score for each subscale is calculated by adding the scores.⁹

Translation

The translation was conducted through the forward-backward methodology following the guideline by Beaton et al.¹⁰ In the forward translation step, two independent translators translated the SRI from the original language (i.e., English) to Persian, resulting in

two versions of the Persian-translated scale. One of the translators was a physical therapist, and the other was a medical doctor. The two translators met to discuss the inconsistencies and obtained a single prototype Persian version. Another pair of independent translators performed the backward translation from Persian to English, obtaining two separate English versions. The two backward translators were occupational therapists. All translators were native Persian speakers and fluent in English. The developer reviewed both back-translated versions to confirm the content accuracy. Subsequently, a meeting was held with all translators to reconcile the backward translated versions with the original English version, vague phrases were discussed, adjustments were made, and the first version of the Persian-translated SRI (SRI-P-1) was constructed.

Cross-cultural Adaptation

The SRI-P-1 was first administered to a group of participants, and cognitive interviews were conducted. Cognitive interviewing is a qualitative process useful in exploring the cultural equivalency in meaning and identifying problems in the translated version.^{10,11} In the cognitive interviews, two strategies were used^{12,13}: 1. Think aloud: participants were asked to talk aloud and describe their understanding of each item of the questionnaire and its response choices, as well as their cognitive process in deciding which answer to choose. 2. Verbal probing: participants were then asked predetermined or related questions regarding their thoughts on each specific keyword and the appropriateness of the items according to Persian culture. Participants were invited to offer suggestions and general ideas on the SRI-P-1. One researcher carried out all interviews, audio-recorded, and transcribed the interviews verbatim.

Analysis of the Cognitive Interviewing Outcomes

A coding system designed by MacDermid (2018) was used to categorize the outcomes and integrate the findings. This coding system has six components: 1. clarity or comprehension (i.e., do they understand the intention of the items?), 2. relevance (i.e., do they understand the relevance of the overall question?), 3. inadequate response definition (i.e., does the participant's response line up with the item?), 4. reference point (i.e., which reference standard do they use to explain an item?), 5. perspective modifiers (i.e., do responses vary depending on personal life and characteristics, and if the items appropriate when participants change based on characteristics?), and 6. calibration across items (i.e., do responses to one item influence how another item is understood?). The response saturation approach (n=10) was used to determine if further modifications were required.

Reconciliation-1

In the next step, the detected issues from round one of the cognitive interviews were discussed by the same translation committee. This discussion resulted in modifying the SRI-P-1 and producing the SRI-P-2.

Second Round of Cognitive Interviews

The SRI-P-2 was administered to a different group of participants (n=4) from the same clinic to identify any further potential issues. The second round of cognitive interviews and analysis was conducted in the same manner as the first round.

Reconciliation-2

Next, all translators participated in a meeting to discuss the results of the second round of cognitive interviews. In this meeting, the final version of the SRI-P was constructed. The translation and cross-cultural process are depicted using a previously reported approach¹⁴ [Figure 1].

Psychometric Evaluation of the SRI-P

Following the translation and cross-cultural adaptation of the SRI to Persian, the SRI-P was administered to 100 participants to evaluate its psychometric properties. Participant characteristics were appropriately summarized as means and standard deviation (SD) or frequencies. The floor and ceiling effects for the SRI-P were determined with a tolerance level of 15%.¹⁵ Considering the maximum and minimum possible scores for the SRI-P (0 to 100%), values between zero and 15 were considered floor effects, and values between 85 and 100 as ceiling effects.

Construct Validity

Construct validity was assessed through cross-sectional convergent validity. It was hypothesized a priori that higher satisfaction levels would be associated with lower pain intensity and interference levels. Evidence of convergent validity was based on the theoretical constructs of each tool: for the BPI-P Pain Severity subscale, a correlation magnitude of between $r=-0.20$ and -0.40 (low but significant) was hypothesized while for the BPI-P Pain Interference subscale, a correlation of $r=-0.40$ to -0.60 , or moderate, indicated acceptable validity.¹⁶

Structural Validity – Parallel Analysis

Sampling adequacy was ensured through a Kaiser-Meyer-Olkin statistic of ≥ 0.8017 and a significant Bartlett's test of sphericity. Horn's parallel analysis with no rotation was used.¹⁸ Factors with eigenvalues greater than the mean values identified through 1000 simulated datasets of 9 items were retained.¹⁹ We examined the scree plots to confirm the retained factors.²⁰ We considered a factor loading cut-off score of 0.40 for item retention.²¹ Cross-loading factors were identified as those loaded on two or more factors at >0.32 .²² Any factor for which the observed eigenvalue was greater than the mean of the simulated eigenvalues for the same factor was retained.²³

Structural Validity – Confirmatory Factor Analysis (CFA)

Confirmatory Factor Analysis (CFA) was used to explore the equivalence of the structure of the SRI-P with the original English version or with a potentially different structure. One structure was set a priori, in which

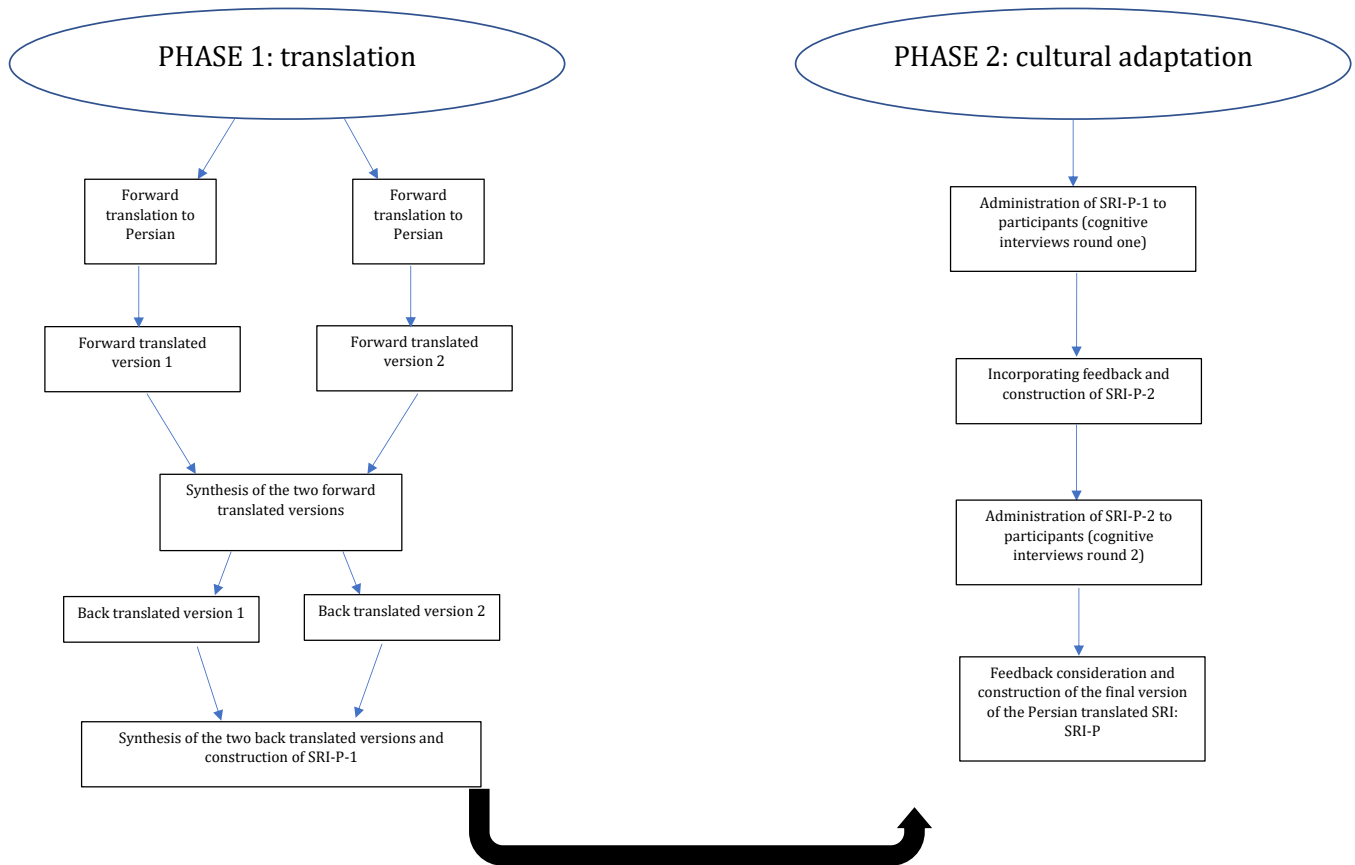


Figure 1. An overview of the translation and cultural adaptation process of the Satisfaction and Recovery Index (SRI) to Persian.

all items loaded on a single factor of 'health-related satisfaction' per the original version. Other structures were also explored. In all cases, model fit was evaluated using 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).^{24,25} The LISREL program (version 8.80) was used to conduct the CFA. All other analyses were done using SPSS (version 26.0).

Internal Consistency

Internal consistency of the final structure, both as an overall scale and for any identified subscales, was evaluated using Cronbach's α coefficient. A Cronbach's α between 0.70 and 0.95 was considered acceptable without evidence of redundancy.²⁶

Test-retest reliability

A total of 15 participants completed the SRI-P at baseline and one week later. This period was considered short enough to assume participants' health conditions remained stable but long enough to prevent memorized responses. Paired samples t-test (to identify overall mean

differences between testing sessions) was followed by the two-way random-effects model of intraclass correlation coefficient ($ICC_{2,1}$) with a 95% confidence interval (CI).²⁷ An $ICC_{2,1} \geq 0.75$ was deemed excellent²⁸ and standard error of measurement (SEM) was calculated using the formula $SEM = SD \times \sqrt{1 - ICC}$. Minimal Detectable Change (MDC) at a 95% confidence level was calculated based on the SEM to determine a real change in the score using the formula $MDC = 1.96 \times SEM \times \sqrt{2}$.

Results

Translation

The four translators held a discussion session following the forward and backward translations. They resolved all ambiguities (e.g., words that could be interpreted in more than one way or if they do not have a direct translation).

Cross-Cultural Adaptation

Cognitive Interviews-1

In the first round of cognitive interviews, participants had no difficulty understanding and answering items one, three, and eight of the SRI-P-1. The identified issues were related to comprehension/clarity (items four, five, and seven), relevance (item two), and inadequate response

Table 1. Classification of issues and frequency of each in the first round of cognitive interviewing. Gray rows are questions that were clear to the participants

Items	Clarity/Comprehension	Relevance	Inadequate response definition	Reference point	Perspective modification	Calibration across items
1						
2		20%	10%			
3						
4	10%					
5	90%					
6			40%			
7	20%	40%	50%			
8						
9	40%		10%			

definition (items four, six, and nine) [Table 1].
 After the first round of cognitive interviews, a meeting was held by all four translators to discuss the issues and ambiguities. The identified issues informed the subsequent modifications, and accordingly, the SRI-P-2 was constructed.

Cognitive Interviews-2

The SRI-P-2 was administered to another set of participants. Only one participant had difficulty understanding item nine (clarity/comprehension). At this stage, the committee constructed the final version of the Persian SRI (SRI-P) [Figure 2].

Psychometrics

Characteristics and demographic information of the 100 participants for the main analyses are summarized in Table 2. The majority of participants were males (82%) with a mean age of 32.5 years old (SD =11.4), sustained an injury to the dominant limb (68%), and were injured for an average of 13 days (SD = 8.32). The main injury mechanism was motor vehicle collision (38%), followed by being hit by an object (24%). We had no missing data. The mean and standard deviations of both SRI-P and BPI-P are presented in [Table 2].

There were no ceiling effects for the total score of SRI-P. We observed floor effects in 12% of participants.

Construct Validity

Table 3 demonstrates that the correlation values between the SRI-P and the pain severity ($r=-0.22, P<0.001$) and pain interference subscales of BPI-P ($r=0.41, P<0.001$) were negative and significant [Table 3]. Both analyses satisfied our a priori hypotheses for convergent validity.

Structural Validity – Parallel Analysis

The Kaiser–Meyer–Olkin test of sampling appropriateness was satisfactory (0.86), and Bartlett’s test of sphericity was statistically acceptable [$X^2=264.09, P<0.001$]. The parallel analysis showed that after orthogonal rotation, the eigenvalue of the first factor

in the actual data was 3.821, while it was 1.483 in the simulated dataset. The second factor’s eigenvalue in the actual data was 1.367, whereas it was 1.315 in the simulated dataset. Hence, the number of the scale factors



رضایتمندی ۰-۱۰	اهمیت ۰-۱۰
توانایی در انجام دادن کارهای روزمره زندگی (مانند: خوب غذا خوردن، خوب خوابیدن، بهداشت مناسب فردی و غیره)	
داشتن توانایی عملی (مانند: گوی بودن، یا انرژی بودن، یا تعاطف بودن) در مقایسه با سایر افراد همسن و همجنس	
تفاهم نقشهای زندگی (مانند: همسر، دوست، پدر/مادر، همکار و یا دانشجو)	
روابط مسقیمه چه از نظر جسمی و چه روابط نزدیک فراتر از سطح دوستی	
به منظور سنجیدن اعتبار، در این ریفک عدد ۴ را در ستون اهمیت و عدد ۴ را در ستون رضایتمندی قرار دهید	
عدم وابستگی (مانند گرفتن تصمیمهای شخصی و داشتن کنترل روی زندگی شخصی)	
خودجوش بودن (انجام کارها بدون برنامه یزیی قبلی)	
داشتن عواطف مثبت (مانند شادی، لذت، عزت نفس)	
احساس داشتن توانایی برای به دست آوردن چیزهای جدید و بهتر در آینده	

نمره دهی:
 وزن دهی هر مورد = (اهمیت × رضایتمندی) / ۱۰۰
 درصده رضایتمندی از سالمی = (مجموع نمرات وزن دهی / مجموع نمرات اهمیت) × ۱۰۰
 دامنه نمره: صفر نمره کملا ناراضی تا ۷۱۰۰ کملا راضی

Figure 2. Translated and cross-culturally adapted version of the Satisfaction and Recovery Index to Persian (SRI-P).

Table 2. Participant characteristics and demographic information

		Mean (SD)	% Frequency
Age		32.5 (11.39)	
Sex	Male		82
	Female		18
Time since injury (days)		14 (8.317)	
Body part injured	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 collision		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
	Persian version of the Satisfaction and Recovery Index (SRI-P) mean (SD)	First evaluation	65.70 (18.70)
Retest		67.93 (13.87)	
Brief Pain Inventory	Pain severity	3.19 (2.31)	
	Pain interference	4.80 (2.49)	

is determinedly restricted to two because the eigenvalue of the third factor's simulated data was higher than that of the actual data. The extracted factors explained 60.6% of the common variance, with 45.42% and 15.18% for factors one and two, respectively. Factor one included five items with loading values between 0.47 and 0.71 labeled as "Essential Functioning". The second factor included

four items with item loadings ranging from 0.53 to 0.76 and was labeled as "Autonomy" [Table 4].

Structural Validity – Confirmatory Factor Analysis (CFA)

We performed CFA with the original one-factor solution and the two-factor solution. We compared the suitability of the one to the two-factor structure of the SRI-P using

Table 3. Correlation values between SRI-P and Brief Pain Inventory

	Mean (SD)	SRI-P (total)	Pain interference	Pain severity
Persian version of Satisfaction and Recovery Index (SRI-P)	66.07(19.52)			
Pain severity	3.19(2.31)	-0.22*		
Pain interference	4.80(2.49)	-0.41**	0.53**	0.53**

** Significant at *P*-value of 0.01 or less/ * Significant at *P*-value of 0.05 or less

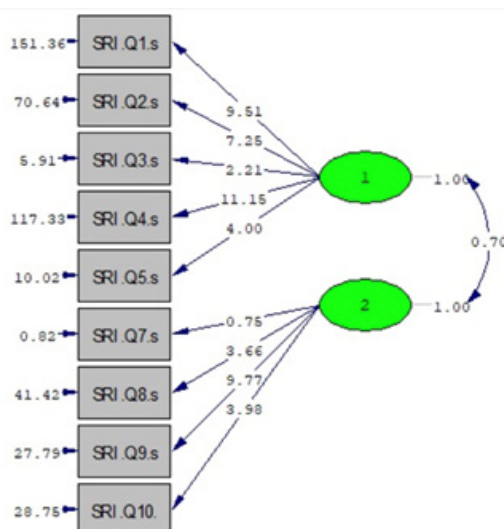
Table 4. Exploratory Factor Analysis with Factor Loadings of the Persian version of the Satisfaction and Recovery Index (SRI-P)

SRI Items	Factor Loadings	Eigenvalue	Cronbach's Alpha	Variance Explained (%)
Factor 1		3.82	0.79	42.45
Meeting your most basic needs (e.g., eating well, good sleep, good personal hygiene, etc....)	0.71			
Being mentally sharp (i.e., your ability to concentrate, remember or think quickly)	0.66			
Being physically fit (e.g., strong, energetic or flexible) compared to other people of your age and sex	0.65			
Fulfilling your 'life roles' (e.g., being a spouse, friend, parent, coworker and/ or volunteer)	0.61			
Intimate relationships, whether they be physical relationships or close personal relationships above the level of normal friendship	0.47			
Factor 2		1.36	0.74	15.18
Being independent (e.g., making your own decisions and being in control of your own life)	0.76			
Being spontaneous (doing things without having to plan)	0.64			
Feeling positive emotions (e.g., happiness, joy, self-esteem)	0.56			
Feeling like you've got the potential to achieve new or greater things in the future	0.53			

goodness-of-fit indices. Better statistical criteria were demonstrated for a two-factor structure ($X^2=36.21$, $df=26$, $P<0.001$, $CFI=0.99$, $GFI=0.92$, $TLI=0.95$, $NNFI=0.98$, and $RMSEA=0.063$) [Table 5]. The final model is presented in [Figure 3] and [Table 6].

Table 5. Goodness-of-fit statistics for all models

	$X^2(df)$	CFI	GFI	NNFI	RMSEA
One factor Solution	68.98 (27)	0.92	0.84	0.89	0.15
Two factor solution	36.21 (26)	0.99	0.92	0.98	0.06



Chi-Square=36.23, df=26, P-value=0.08756, RMSEA=0.063

Figure 3. Two-factor structure of the Persian Version of the Satisfaction and Recovery Index (SRI-P) based on the confirmatory factor analysis results.

Table 6. Confirmatory factor analysis of the Persian version of the Satisfaction and Recovery Index (SRI-P)

Items	Standardized estimate	Nonstandard estimate	Error	T	Explained variance (R ²)
Factor 1					
Meeting your most basic needs (e.g., eating well, good sleep, good personal hygiene, etc...)	0.61	9.51	1.52	6.24	0.37
Being mentally sharp (i.e., your ability to concentrate, remember or think quickly)	0.65	7.25	1.07	6.78	0.43
Being physically fit (e.g., strong, energetic or flexible) compared to other people of your age and sex	0.67	2.21	0.31	7.05	0.45
Fulfilling your 'life roles' (e.g., being a spouse, friend, parent, coworker and/or volunteer)	0.72	11.15	1.46	7.66	0.51
Intimate relationships, whether they be physical relationships or close personal relationships above the level of normal friendship	0.78	4.00	0.46	8.64	0.62
Factor 2					
Being independent (e.g., making your own decisions and being in control of your own life)	0.64	0.75	0.12	6.54	0.41
Being spontaneous (doing things without having to plan)	0.49	3.66	0.76	4.84	0.24
Feeling positive emotions (e.g., happiness, joy, self-esteem)	0.88	9.77	1.01	9.70	0.77
Feeling like you've got the potential to achieve new or greater things in the future	0.60	3.90	0.66	6.01	0.36

Internal Consistency

The internal consistency of the SRI-P was acceptable, with Cronbach's alpha of 0.83. Cronbach's alpha for the first factor was 0.79 and 0.74 for the second factor [Table 4].

Test-retest reliability

There was no significant difference in mean SRI-P scores between the two testing periods (test one mean=65.70 (SD 18.69); test two mean=67.93 (SD 13.87); mean difference=2.41 (95% CI=5.89 to 10.73). The ICC_{2,1} was 0.72 (95% CI=0.17 to 0.90). The values of the SEM and MDC95 were 10% and 29%, respectively.

Discussion

This study supports acceptable internal consistency, test-retest reliability, measurement error, and construct validity of a cross-culturally adapted SRI-P for measuring the constructs of satisfaction and recovery in Persian people with acute musculoskeletal injuries of any etiology. To the authors' knowledge, the SRI-P is the first measure of satisfaction and recovery after acute musculoskeletal injuries in Persian.

Due to the high degree of diversity of languages, it is essential to use correspondingly appropriate assessment tools in healthcare across cultures. However, most measures are in the English language.¹⁰ A rigorous translation process is needed to translate a PROM to a different language.¹⁰ Furthermore, due to differences in cultural norms, values, and behaviors, the cross-cultural adaptation process is a way to resolve any potential disparities that stem from cultural differences. Word-by-word translation can be

misleading in interpreting and measuring subjective concepts such as satisfaction or recovery. In some cases, the construct being measured significantly varies across cultures due to cultural differences. Asking patients to aid and refine the translated versions can be a constructive way to indigenize the tool into the target population.²⁹ In this study, we ran two rounds of cognitive interviews with patients after the process of forward-backward translation and cultural adaptation to resolve any potentially vague statements. Three of the nine items in the first round seemed clear, comprehensive, and easy to understand. Participants had issues with comprehension/clarity of three items, "fulfilling life roles", "intimate relationships, whether they be physical relationships or close personal relationships above the level of normal friendship", and "being independent". These participants struggled with interpreting the word intimate relationship, independence, and role. We assume that these issues stem from cultural and lingual differences. For example, talking about personal relationships in the Persian population is often considered a stigma, and patients are less inclined to talk about their intimate relationships. The item "being mentally sharp" was an issue regarding relevance. The sample suffered from non-catastrophic musculoskeletal injuries, and some participants could not understand how that kind of trauma could have affected them not to be mentally sharp. Another cultural and lingual difference was terms we did not find an exact equivalent for, such as being spontaneous. We had to describe this term in more detail using more words to be clearer for the Persian-speaking population. Therefore, this issue could potentially

affect the response pattern of our participants compared to the English population. However, confirming this assumption needs further studies in different cultures to realize whether this result is due to cultural factors. After discussing the issues in the expert panel, all difficulties due to ambiguities or complexity were resolved. Then, by consulting with the developer of the SRI, to be more explicit, we provided some extra detail in the translation and addressed this concern. After the second round of the cognitive interview, the only issue left was understanding item nine (Feeling positive emotions) by one participant. This participant reported that this item was not clear enough and found it difficult to understand what they were being asked. By providing more explanation of what is meant by this item in the questionnaire, we solved this issue. Overall, the items on the final SRI-P were well received by the participants.

The Cronbach's alpha value for the total score of the SRI-P and the subscales indicated that the nine items appear to be tapping a similar latent construct. Cronbach's alpha in the original English version was higher (0.95) due to the noncomparable factor structure of these two versions (i.e., the SRI-P was found to have two subscales under one construct). The Cronbach's alpha value for both versions is within the acceptable threshold.

The value of ICC as the index of test-retest reliability, the degree to which the test scores of the same participants remain consistent over a short period, indicated that the SRI-P has a high test-retest reliability. We chose one week as the time interval for test-retest administrations to ensure that our participants would be stable during test-retest and also to prevent recall bias during the retest administration.³⁰ Test-retest reliability of the English version was evaluated in 22 stable patients with a one-month interval, and it was reported to be 0.88.⁷ The test-retest reliability results in these two versions indicate that the SRI and SRI-P are both reliable tools with short-(one week) or longer-term (one-month) intervals.

The validity of a tool, or the extent to which an instrument measures the construct that it purports to measure, is relatively associated with the reliability of that tool. In other words, reliability is a prerequisite for validity.³¹ This study provides evidence for the content (cognitive interview), structural (factor analysis), and construct validity (comparison with the BPI-P) of the SRI-P. Regarding validity against the BPI-P, although the correlation between the SRI-P and the pain severity and pain interference subscales of BPI-P was low, this correlation was significant and supported the convergent validity of the SRI-P. The correlation between these two measures was in line with our a priori hypothesis that when pain severity and interference increase, satisfaction and recovery would decrease. Based on this logic, we expected a negative correlation between these two measures.

Regarding structural validity, the original English version of the SRI has a single factor structure, called 'health-related satisfaction', with an explained variance of 71.1% and factor loading ranging from 0.81 to 0.90. However, the results for SRI-P demonstrated a two-factor structure. Performing parallel analysis and CFA further

confirmed that a two-factor structure demonstrates more optimal statistical criteria. Therefore, we can be more certain that the SRI-P has a two-factor structure, which we called "Essential Functioning" and "Autonomy". Essential Functioning is defined by experiences of physical and mental fitness, performing basic self-care, and being connected with others. The second factor of Autonomy comprised more aspirational items and included feelings of being independent, spontaneous, and able to make important plans for the future. We assume that the difference in the factor structure between the original English version of the SRI and SRI-P could be due to the cultural and lingual differences described above.

This study had certain strengths and limitations. The main strength of this study is that we did not exclude participants based on any demographic factor or injury. This factor leads to better external generalizability. However, this aspect can also be considered a limitation, potentially leading to lower internal validity. Another limitation is that we only recruited patients from one center, which could have potentially increased our concerns regarding a higher risk of sampling bias. As Iran is a multicultural country with a population of more than 80 million, a multi-center recruitment strategy would be able to better account for the cultural variation.

The SRI was translated and cross-culturally adapted to the Persian language and culture (SRI-P). The psychometric adequacy of the SRI-P was established, including construct validity, internal consistency, and test-retest reliability. The SRI-P was found to have a two-factor structure (unlike the original version, which was a one-factor structure), which is potentially due to cultural differences in interpreting some of the items. The SRI-P can now be available to surgeons and therapists in the orthopedic and rehabilitation realms in Persian populations.

Patient consent: Written informed consent was obtained from all participants before participation in this study.

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