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Translation and validation of Simplified Chinese version of the Pain Catastrophizing Scale in chronic pain patients: Education may matter

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Abstract

Objective: Pain catastrophizing is linked to many aspects of pain perception and defines a unique dimension in predicting pain intensity and physical disability. Pain Catastrophizing Scale (PCS) is an effective, validated,self-report measure, commonly used in clinical trials. Here, we present a Simplified Chinese PCS (SC-PCS) version developed in Chinese patients suffering from chronic pain.

Methods: The SC-PCS was generated in five steps and tested on an initial patient cohort (N = 30). A convenience sample (N = 200) of in-hospital patients with non-malignant pain lasting for more than 12 weeks were recruited for the study, of which 81 completed 5 additional pain questionnaires. A subset (N = 24) of the patients completed an additional SC-PCS, 10 days after the initial query to assess test–retest validation.

Results: Intra-class correlations coefficient indicated high reproducibility and temporal consistency, (0.97), for the total score. Cronbach's alpha determined high internal consistency across the SC-PCS total score and its three subscales (0.87, 0.85, 0.62, and 0.65). The SC-PCS total score moderately or weakly (R = −0.2 to 0.49), but significantly, correlated with other measurements, such as pain Visual Analog Scale, Beck Depression Inventory, Pain Anxiety Symptoms Scales, Positive and Negative Affect Schedule, and education. We used exploratory factor analysis to examine the dimensionality of the SC-PCS, which indicated instability of the current three-factor model. However, a confirmatory factor analysis indicated that the three-factor model had the best goodness-fitting.

Conclusions: We demonstrate the successful translational adaptation from English to Simplified Chinese as well as the reliability and validity of SC-PCS. An important discovery was education level significantly correlated with SC-PCS, identifying a future consideration for other cross-cultural development of self-reported measures.

Keywords

Pain Catastrophizing Scale, Simplified Chinese version, chronic pain, education level

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Introduction

Pain Catastrophizing Scale (PCS)[1] is widely adopted self-report tool used to assess exaggerated negative conceptualization in response to ongoing, anticipated, or imaged pain. The original PCS is a 13-item questionnaire consisting of three subscales (helplessness, magnification, and rumination), each of which reflects a unique dimension of pain catastrophizing. Pain catastrophizing has been linked to many aspects of the pain experience including intensity, disability, anxiety, depression, and behavior.[2] The PCS defines a unique dimension in predicting pain intensity and disability beyond gender and age in children[3] and adults.[4] A High score in pain catastrophizing is usually accompanied by an increased pain sensitivity, in turn, representing cognitive and emotional processes of the subjective pain experience. As a result, pain catastrophizing is thought to be reduced in conjunction with many successful treatment interventions. PCS provides an invaluable tool for exploring pain-related outcome measures in the clinical research.

The simplicity and usefulness of PCS has led to various translations across languages and cultures, for example, German,[5] Catalan,[6,7] Turkish,[8,9] Malay,[10] Italian,[11] Portuguese,[12,13] Sinhala,[14] Korean,[15] English-, Afrikaans- and Xhosa-speaking,[16] French,[17] Spanish,[18] Dutch,[19] and Traditional and Simplified Chinese (SC).[20,21] In addition, researchers have developed a Child-version, (PCS-C)[6,22,23] and a shortened version of the PCS.[24,25] In this report, we provide a revised version of the Chinese SC-PSC, taking into consideration education and correcting misinterpretations that we have detected in a previous version.[21]

A rapid development of pain research in China asserts the need for self-reported pain outcome measures such as PCS. However, one shortcoming of conducting pain research in China is the lack of validated questionnaires. To our knowledge, eight pain-related questionnaires have been translated from English into SC which includes, Beck Depression Inventory (BDI),[26,27] Chronic Pain Acceptance Questionnaire,[28,29] the Leeds Assessment of Neuropathic Symptoms and Signs,[30,31] McGill Quality-of-Life Questionnaire (McGill),[32,33] the Oswestry Disability Index (ODI),[34,35] the Pain Anxiety Symptoms Scale (PASS),[36,37] the Pain Sensitivity Questionnaire (PSQ),[38] and the Positive and Negative Affect Schedule (PANAS).[39] Although a Traditional Chinese version of PCS[20] was created in Hong Kong, it was not adopted in Mainland China due to cross-cultural differences between Mandarin and Cantonese.

The existing Chinese SC-PCS contains two flaws that nullify its clinical utility.[21] First, it lacks instructions that are common in a majority of self-reported questionnaires. Second, the wording of some items is inaccurate, for example, item 4, "It's awful and I feel that it overwhelms me." was translated into "情况很糟糕, 我觉得被疼痛打到 (The situation is very bad and I feel that the pain overwhelms me)." Given such flaws, we sought to develop a more accurate and generalizable SC-PCS while exploring socioeconomic confounds relevant in China.

Materials and methods

Translation and cross-cultural adaptation

The translation and cross-cultural adaptation processes followed the recommendations by Beaton et al.,[40] and Wild et al.[41] In principle, the objective is to minimize any semantic language misinterpretations and adaptation if a direct (word-to-word) translation leads to misunderstanding. As shown in Figure 1, in the first stage, two independent versions (T1 and T2) were carried out by two bilingual translators, a pain clinician from China and a humanities professor at an American university from China, respectively. In the second stage, both the T1 and T2 versions were reviewed by both translators and a synthesized version (S version) was created after all discrepancies between T1 and T2 were addressed. In the third stage, the S version was reviewed by a bilingual English professor and a revised synthesized version was created. In the fourth stage, a reverse translation from SC to English was performed by two bilingual American-Born-Chinese undergraduates and any inconsistencies were addressed. In the final stage, a review committee comprising all translators reviewed the SC-PCS version and agreed on the pre-final test version prior to its implementation in the final patient cohort.

Test of the pre-final version

A total of 30 non-malignant chronic pain patients completed the pre-final version of SC-PCS. There was no significant difference between the pre-final test group and the final test group in terms of age, education, residence, gender, pain Visual Analog Scale (VAS), pain duration, or locations. Cognitive debriefing was completed by a physician with more than 10 years of experience in patient counseling and pain management to check understandability and cultural relevance of the translation .[41] All findings from this phase were evaluated by the committee prior to finalizing the SC-PCS. To be noted, the 30 patients were not included in the validation.

Participants

A total of 271 in-hospital patients with non-malignant pain were recruited over an eight-month period, among which 30 patients were exclusively used for testing the pre-final version of SC-PCS; 37 patients were removed due to exclusionary criteria and 4 due to floor and ceiling

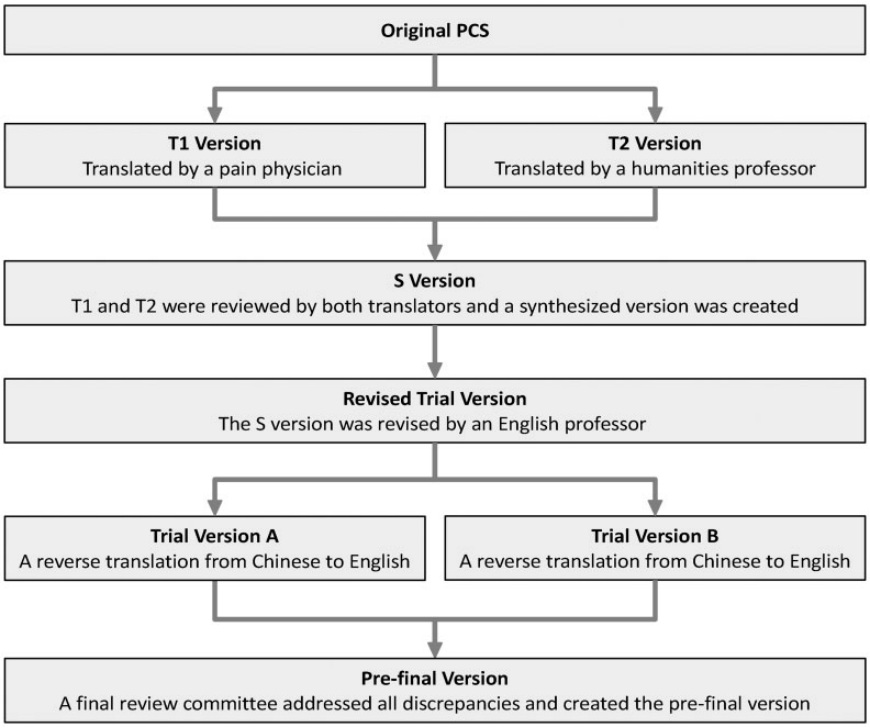

Figure 1. Chart of translation and cross-cultural adaptation flow.

effects. The remaining 200 patients were used in all analysis presented. The inclusion criteria were as follows: (1) age over 18 years, (2) ability to read and write SC and accurately understand SC-PCS and other questionnaires, and (3) pain duration greater than 12 weeks. Exclusion included tumor, inability to comprehend instructions or lack of consent for study participation. All study procedures were approved by the Institutional Review Board of the Second Affiliated Hospital and Yuying's Children Hospital, Wenzhou Medical University.

The minimum number of participants for evaluating factor analysis and internal consistency, for assessing concurrent validity, and for testing temporal reliability is 100, 52, and 30, respectively.[42,43] We anticipated to recruit 150, 75, and 30 patients who would complete SC-PCS, SC-PCS with five other questionnaires, and additional SC-PCS 10 days after the initial query, respectively. Since participants were recruited from a hospital setting, the first two numbers were easily exceeded (N = 200 and 81). However, because most patients were hospitalized for less than one week, the number of patients for assessing temporal reliability was slightly below the anticipation (N = 24).

All patients completed a battery of questionnaires including a 10-item demographic survey regarding age, gender, residence (urban/rural), marriage, education, and employment status as well as pain VAS, pain duration, and the SC-PCS. Eighty-one patients were chosen to complete five additional five questionnaires (BDI, PANAS, PASS, PSQ, and ODI) in order to construct an internal validity of the SC-PCS. A total of 24 patients were chosen to complete the SC-PCS a second time 10 days after the initial completion to assess temporal stability. In order to minimize pain influence in the temporal stability analysis, only patients whose pain VAS remained invariant over a 10-day period completed a second SC-PCS. All questionnaires were collected on an electronic tablet device and were collected using Research Electronic Data Capture (REDCap).[44] REDCap is a secure, convenient, and efficient online/offline web application for capturing electronic survey data and is recommended by the National Institutes of Health for data collection in clinical trials.

Missing data and removal of floor and ceiling effects

Due to the effort made by our staff and the convenience of using a tablet device, the rate of missing data was very low: 7 patients missed 10 questions of BDI, most of which covered the item 21 of BDI with regard to sexual activity and 2 patients missed 2 questions of PANAS. The above missing data were replaced by the mean value of variables corresponding to that questionnaire or subscale. A total of 12 patients did not provide residence information .

The effects of floor and ceiling on the data were also addressed. The floor and ceiling is the limit under and above which variance in SC-PCS would no longer be

accurately estimated, a total of four patients were removed at this stage.

Data descriptive statistics

The descriptive statistics were performed on the full 200 patients, which included the mean, standard deviation, skewness, kurtosis, Kolmogorov–Smirnov test for the total score and each subscale.

Internal consistency, reproducibility, and concurrent validity

Internal consistency was assessed with Cronbach's alpha, which measures the strength of inter-item homogeneity. Cronbach's alpha of the total score and of the three subscales was calculated. A commonly accepted rule for describing internal consistency using Cronbach's alpha is as follows: alpha $\geq$0.9, excellent; 0.8$\leq$ alpha $<$ 0.9, good; 0.7$\leq$ alpha $<$ 0.8, acceptable; and alpha $<$ 0.5, unacceptable.[45]

Reproducibility validity, i.e. the extent of the agreement of scores between the two time points, was tested by the intra-class correlation coefficient (ICC). Usually, ICC $\geq$0.7 is regarded as acceptable for test-retest reliability and $\geq$0.9 as excellent.[46]

Concurrent validity was assessed by Pearson's correlation coefficients (R) with other pain-related measurements. PCS measures unique aspects of a patient's pain experience and perception such that pain catastrophizing theoretically should be moderately or weakly correlated to other pain-related questionnaires. In order to validate the effectiveness and correlative assumptions of SC-PCS, a battery of questionnaires was administered, which included pain VAS, SC-PSQ, SC-BDI, SC-PANAS, SC-PASS, and SC-ODI questionnaires. Usually, the correlation is regarded as positive weak, moderate, or strong when R $<$ 0.30, 0.30 $<$ R $<$ 0.60, and R $>$ 0.60, respectively.[47]

Factor structure analysis

Principal component analysis (PCA) with the varimax rotation method by Kaiser normalization was used to find latent dimensions. Overall, the PCA converts a set of possibly correlated components into linearly uncorrelated, orthogonal, principal components, which correspond to the latent dimensions of the data. In our study, only components with an eigenvalue greater than one were determined as principal components or factors. Following this, structural equation modeling was performed with AMOS software,[48] a confirmatory factorial analysis with maximum-likelihood estimation was carried out to test the adequacy of the model and was tested against five models, a null model in which all the 13 observed items are uncorrelated, one-factor model in which all 13 items are indicated by one latent factor, two-factor model from our exploratory factor analysis above, two-factor model,[49] and original three-factor model.[1] The chi-square/degree of freedom (df), normalized fit index (NFI), comparative fit index (CFI), and the root-mean-square error of approximation (RMSEA) were used to quantify the goodness-of-fit for the five-factor models. A best-fit model was expected to have the following indices: chi-square/df $<$ 2.0, NFI $>$ 0.90, CFI $>$ 0.90, and RMSEA $<$ 0.08.[50]

Other analysis

We evaluated the effects of demographic variables (age, gender, pain duration, residence, and education) on the total and three subscales of SC-PCS, determining potential confounds and to increase the generalizability and accuracy of this version. A multiple linear regression model predicted pain intensity (VAS) from the total of SC-PCS and all demographic variables (age, gender, pain duration, residence, and education), which provides sound statistical evidence that our SC-PCS version can be used to identify clinical pain intensity.

Results

Socioeconomic background and pain characteristics

Table 1 summarizes demographics of the patient cohort. Figure 2 shows pain properties of the cohort. Mean VAS (0–10; 0 = no pain, 10 = worst pain imaginable) was 4.5/10 with a standard deviation (SD) of 1.5; mean pain duration was 215 weeks with SD of 300 weeks. Pain intensity was gender dependent (VAS scores, F = 5.3 and p = 0.022 from one-way analysis of variance

Table 1. Socioeconomic background and pain characteristics.

Age	Mean (52.1 years), Standard Deviation (13.9 years)
Gender	Male (53%), Female (47%)
Education	Elementary (43%), Middle (35.5%), High (7.5%), College (14%)
Marriage	Married (96.5%), Unmarried (3.5%)
Residence	Urban (28.5%), Rural (65.5%), N/A (6%)
Job	Employee (30%), Employer (6.5%), Self-employed (35%), Retired (28%), Students (0.5%)
Number of pain position	One (59.5%), Two (34.5%), Three (4%), Above Three (2%)
Pain location	Back (40.7%), Leg (33.4%), Neck (7.6%), Arm (5.5%),Head (3.5%), Shoulder (2.9%), Pelvic (2.9%), Foot (1.7%), Sacrococcygeal (1.5%), Abdomen (0.3%)

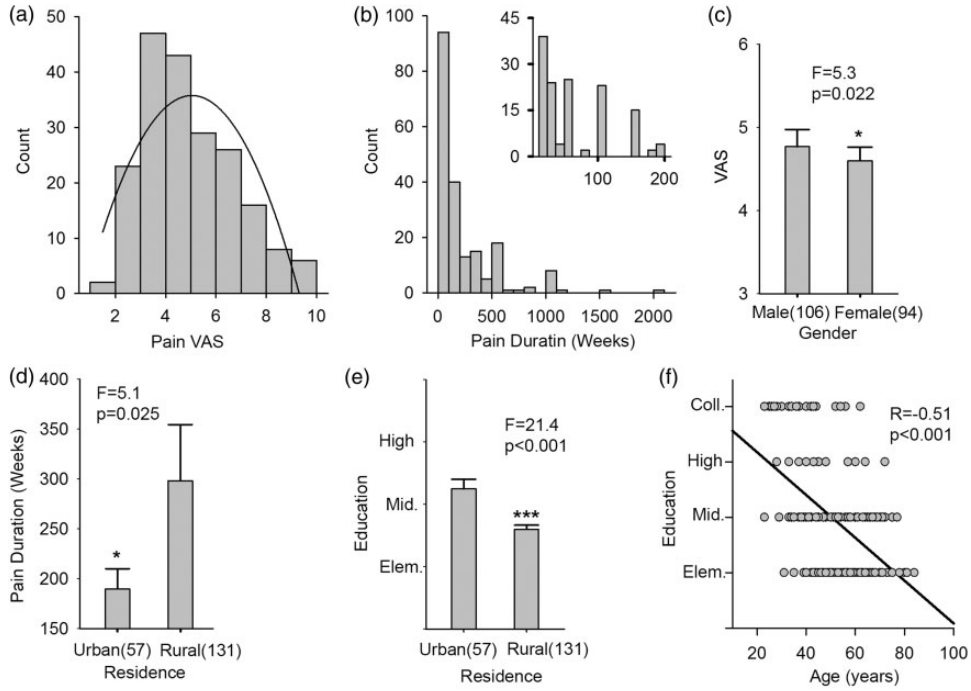

Figure 2. Pain-related and socioeconomic information about participants. (a) A histogram of pain Visual Analogue Scale (0–10; no pain to worst imaginable pain) of all participants, the mean and standard deviation = 4.5 ± 1.5. (b) A histogram of pain duration in the right corner is an expanded version of the histogram in which the duration was limited to 200 weeks and less, which covered 70% of the participants. (c) There was a significant pain VAS difference between males and females ($F = 5.3$ and $p = 0.022$ from a one-way ANOVA). (d) There was a significant pain duration difference between participants who lived in urban and in rural areas ($F = 5.1$ and $p < 0.025$ from a one-way ANOVA). (e) There was a significant education degree difference between participants who lived in urban and rural areas ($F = 21.4$ and $p < 0.001$ resulted from a one-way ANOVA). (f) The education degree of participates was significantly inversely correlated with age. The Pearson's correlation coefficient = −0.51 and $p < 0.001$ resulted from a one-way ANOVA.
Note: 12 of the total 200 participants did not provide residence information.

(ANOVA), Figure 2(c)). Additionally, there was a significant difference in pain duration ($F = 5.1$ and $p < 0.025$ obtained from a one-way ANOVA, Figure 2(d)) and in education ($F = 21.4$ and $p < 0.001$, Figure 2(e)) between participants who lived in urban and in rural areas. An inverse relation was seen between education and age (Pearson's $R = -0.51$ and $p < 0.001$, Figure 2 (f)). All other interrelationships between demographic variables and pain-related outcomes were not significant. These results imply a strong educational and residential differences in our patient population, and that majority were of rural residence with elementary education.

Distribution of the SC-PCS scores

The distribution of SC-PCS scores is shown in Table 2. The mean score and S.D. of the total score and three subscales (helplessness, magnification, and rumination) were 26.89 ± 10.63, 11.58 ± 5.90, 5.39 ± 2.87, and 9.92 ± 3.53, respectively. Except for magnification, the Kolmogoro–Smirnov normality test indicated that SC-PCS scores were distributed normally given a predefined threshold of significance ($p < 0.05$), which satisfies the assumption for linear regression models to be implemented.

Internal consistency, reproducibility, and concurrent validity

Cronbach's alpha results showed good internal consistency with 0.87, 0.85, 0.62, and 0.65 for the total score and the three subscales, helplessness, magnification, and rumination, respectively.

For reproducibility validity, ICC, mean difference (MD) between test and retest scores, and standard error of measurement (standard deviation of test score × sqrt(1−correlation between test and retest scores)) were calculated for the total score, three subscales, and each item independently. All ICCs, with the exception of items of 3, 4, and 12, were greater than 0.90 with MD being close to 0 and small SEM, indicating excellent reproducibility and temporal consistency (Table 3).

Pain catastrophizing is associated with pain disability, anxiety, depression, and pain intensity, and similar studies have shown moderate or weak correlations between their version of PCS and pain-related outcomes.[5,15,20]

Table 2. Score mean and standard deviation and normality test results.

		PCS subscale		
Measure	PCS total score	Helplessness	Magnification	Rumination
Mean (SD)	26.89(10.63)	11.58(5.90)	5.39(2.87)	9.92(3.53)
Skewness	−0.05	−0.11	0.12	−0.34
K-S Normality Test (p value)	0.26	0.08	0.03*	0.18

K-S: Kolmogorov–Smirnov; PCS: Pain Catastrophizing Scale.
*$p < 0.05$.

Table 3. Measurements of reproducibility validity.

	ICC (95% CI)	MD	SEM
PCS total score	0.97 (0.92–0.99)	−0.24	0.20
Helplessness	0.95 (0.89–0.98)	0.03	0.24
Magnification	0.95 (0.88–0.98)	−0.40	0.26
Rumination	0.98 (0.95–0.99)	0.16	0.16
Item 1	0.97 (0.92–0.98)	0.05	0.21
Item 2	0.96 (0.92–0.98)	−0.08	0.21
Item 3	0.73 (0.48–0.87)	0.02	0.57
Item 4	0.83 (0.65–0.92)	0.08	0.46
Item 5	0.92 (0.82–0.92)	−0.12	0.30
Item 6	0.94 (0.88–0.98)	−0.04	0.26
Item 7	0.91 (0.81–0.96)	−0.24	0.33
Item 8	0.98 (0.95–0.99)	0.04	0.17
Item 9	0.99 (0.97–0.99)	0.04	0.14
Item 10	0.95 (0.90–0.98)	0.04	0.24
Item 11	0.93 (0.85–0.97)	0.04	0.29
Item 12	0.71 (0.44–0.86)	0.12	0.60
Item 13	0.92 (0.83–0.96)	−0.12	0.31

PCS: Pain Catastrophizing Scale; ICC: Intra-class correlation coefficient; MD: mean difference between test and retest scores; SEM: standard error of measurement (standard deviation of test score × sqrt(1−correlation between test and retest scores)).

Table 4. Correlation coefficients (R) with other related measures.

		PCS subscale		
Other Measures	PCS total score	Helplessness	Magnification	Rumination
Pain VAS	0.19**	0.21**	0.01	0.20**
BDI	0.32**	0.24**	0.34**	0.25*
PASS	0.49***	0.28**	0.52***	0.49***
PANAS_N	0.26*	0.18	0.36***	0.13

Pain VAS: Pain Visual Analog Scale; BDI: Beck Depression Index; PASS: Pain Anxiety Symptoms Scales; PANAS_N: Negative part of Positive and Negative Affect Schedule; PAS: Pain Catastrophizing Scale; PCS: Pain Catastrophizing Scale; PCS: Pain Catastrophizing Scale.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

Table 5. Exploratory factor analysis of the SC-PCS.

Item No.	Factor I loading	Factor II loading	Communality
Item 1	0.62	0.25	0.44
Item 2	0.83	0.15	0.71
Item 3	0.80	0.06	0.64
Item 4	0.85	0.08	0.73
Item 5	0.85	0.14	0.74
Item 6	0.50	0.52	0.53
Item 7	0.29	0.34	0.20
Item 8	−0.09	0.77	0.60
Item 9	0.79	0.23	0.68
Item 10	0.81	0.22	0.71
Item 11	0.02	0.79	0.62
Item 12	0.24	0.44	0.25
Item 13	0.28	0.55	0.38
Eigenvalue	4.92	2.32	
Variance (%)	37.83	17.84	

PCS: Pain Catastrophizing Scale.

For concurrent validity, as shown in Table 4, the PCS total and the three subscales were weakly or moderately, but significantly, correlated with the other questionnaires (pain VAS, BDI, PASS, and PANAS_N). Therefore, we expect a moderate or weak correlation between PCS and relevant parameters. We observed a correlation range from 0.19 to 0.52, providing evidence of the concurrent validity of the SC-PCS.

Factor structure analysis

Exploratory factor analysis was done using PCA, which suggested a two-factor structure in the SC-PCS with an eigenvalue threshold greater than one. As shown in Table 5, factor I consisted of items of 1, 2, 3, 4, 5, 9, and 10 most related to the subclass of helplessness and factor II consisted of items of 6, 7, 8, 11, 12, and 13 most related to magnification. The two factors accounted for 37.83% and 17.84% of the variance, respectively.

Confirmatory factor analysis was done using AMOS software, which tested five models that provided the best

Table 6. Goodness-of-fit values for different models.

Model Type	Chi-square	df	Chi-square/df	NFI	CFI	RMSEA
Null	1276.86	78	16.37	–	–	0.28
One-factor	261.36	66	3.96	0.80	0.84	0.12
Two-factor (Osman)	259.20	64	4.05	0.80	0.84	0.12
Two-factor (Current)	192.64	64	3.01	0.85	0.89	0.10
Three-factor	182.28	62	2.94	0.86	0.90	0.10

Null: 13 uncorrelated items; One-factor: 13 items are indicated by one latent factor; Two-factor: suggested by Osman et al.,[49] Two-factor (Currently): suggested by current study; Three-factor: suggested by Sullivan et al[1]; NFI: normalized fit index; CFI: comparative fit index; RMSEA: root-mean square error of approximation.

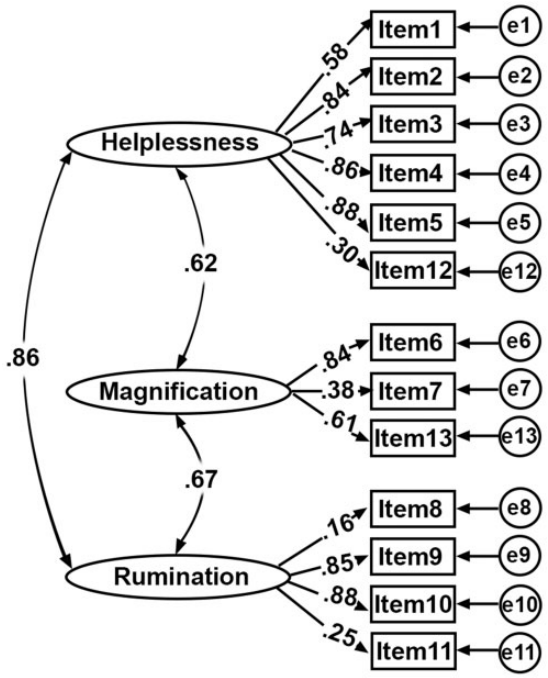

Figure 3. Three-factor model with standardized parameter estimates. The observed 13 items were determined by three latent factors (Helplessness, Magnification, and Rumination) and their measurement error. The Pearson's correlation coefficients between three factors were 0.62, 0.67, and 0.86, respectively. The factor loadings from each factor to 13 items are shown in the middle of the figure, the range of which was between 0.25 and 0.88.

fit to the data. The four criterions (chi-square/df, NFI, CFI, and RMSEA) were computed and shown in Table 6, which suggested the original three-factor model explained the most variance and its model structure with standardized parameter estimates are illustrated in Figure 3.

Correlations with demographic variables of SC-PCS

As shown in Table 7, the total score and two of its three subscales (helplessness and rumination) were significantly correlated with age and education level.

Table 7. Correlation coefficients (R) with demographic variables.

	PCS total score	PCS subscale		
		Helplessness	Magnification	Rumination
Age	0.23***	0.26***	0.02	0.23***
Gender	0.08	0.06	0.13	0.03
Pain Duration	−0.07	−0.03	−0.14	−0.06
Residence	−0.03	0.01	−0.07	−0.04
Education	−0.20**	−0.22**	−0.04	−0.20**

PCS: Pain Catastrophizing Scale.
**$p < 0.01$; ***$p < 0.001$.

Table 8. Estimated coefficients of pain VAS prediction model.

	Unstandardized coefficients/ Standard error	t Value	Significance
Constant	3.17/0.39	8.07	0.000
Total of PCS	0.36/0.01	2.89	0.004
Gender	0.67/0.26	2.56	0.011

PCS: Pain Catastrophizing Scale; VAS: Visual Analog Scale. Dependent variable: Pain VAS; independent variable: total of PCS and gender (Male = 1 and Female = 0).

Prediction of pain VAS

As shown in Tables 8 and 9, only two independent variables, total of PCS and gender, statistically significantly predicted pain VAS, $F(2, 197) = 6.94$, $p < 0.001$, $R^2 = 0.07$.

Discussion

Pain research continues its rapid development in China and the need to generate validated and generalizable self-reported measure is of great importance. The aim of the current study was to cross-culturally adapt and validate the PCS into an SC version and to examine its psychometric properties in a chronic pain population. The final

Table 9. Summary of pain VAS prediction model.

R	R^2	F value	Significance
0.26	0.07	6.94	0.000

VAS: Visual Analog Scale.

version of SC-PCS is available for public use and can be found in online Appendix.

Participants and translation

The translation and implementation of the PCS began in a Chinese population that varied in terms of education and residence compared to Western countries. The original PCS was generated in an urban and college-educated population. Therefore, we considered education level during the creation and validation process. Socioeconomic status of chronic pain patients in China is disproportionately economically and socially disadvantaged. We explored how educational background may negatively impact comprehension and mitigate usage of complicated language in the SC-PCS. For instance, item 1 "I worry all the time about whether the pain will end", the first version (v1) translated into:: "我一直对疼痛是否会结束而忧心忡忡". The v1 translation used a common Chinese idiom (忧心忡忡), which may not be fully understood by patients who have only completed elementary education. The second version (v2): "我一直担心疼痛是否会结束" replaced the idiom with a more common word (担心), but the logic sounded slightly complicated. In the final version (v3), incorporated a direct word-to-word translation that was more straightforward: "我一直担心疼痛不会结束". During the validation, we observed an extremely low miss rate, and 95% of participants did not report any misunderstandings. In addition, with the assistance of a research coordinator, the remaining 5% finished the questionnaire without any comprehension issues. Generally, this cross-cultural adaptation, translation, and validation of PCS were determined a success.

Internal consistency and reproducibility of the SC-PCS

The internal consistency of the SC-PCS was evaluated using Cronbach's alpha, which was also reported in the original study validating PCS.[1] However, our study had a lower alpha coefficient compared to other reports.[20,21] The lower alpha coefficient of magnification could be explained by the small number of items and its minimum item redundancy. Consistent low alpha coefficients of magnification in other studies may challenge the reliability of the magnification subscale as an independent subscale, and warrants investigation of a two-factor alternative.[5]

The reproducibility of the SC-PCS was assessed using ICCs, indicating excellent reproducibility. These results were stronger than other studies replicating PCS validation,[1,5,20,21] which represents an improved temporal consistency. However, the value of ICC is a function of the interval between test and retest, longer interval periods inherently increase the variability and in turn decrease ICC. For our study, the interval was 10 days, shorter than 21 days as shown in Meyer et al.,[5] and longer than 7 days as shown in Yap et al.[20] It is safe to assume that the agreement of scores between test and retest is reliable.

Factor structure analysis of SC-PCS

Other investigators have raised concerns regarding the stability of a three-factor PCS.[49] Numerous studies have demonstrated a similar decomposition of the PCS into a two-factorial model.[2,8,22] Furthermore, in the child version for PCS adaptation, only one factor was found in a German version,[23] but in an English version,[3] the typical three factors were revealed. Undoubtedly, the agreed number of PCS subcomponents is debatable. In our dataset, we observed a similar instability of the three-factor model. Additionally, educational differences may bias the dimensionality analysis, and we divided the 200 completed participants into two groups (participants with only middle-school education or less vs. who those with high-school education or more). However, the effects were marginal, implying that education is not related to the PCS structure.

Although PCA suggested two factors in the SC-PCS, a confirmatory factor analysis indicated a three-factor model had the best fit compared with a null, one-factor, and two-factor models (current and Osman's study). Regarding goodness-of-fit values of model fitting values (Table 5), the three-factor structure was the only one with an acceptable CFI (0.90). Similarly, the Spanish,[18] German,[5] Catalan,[7] French,[17] Norwegian,[51] Brazilian Portuguese,[13] Sinhala,[14] and Hindi[45] PCS versions had approximately the same comparative fit indices using a three-factor model. Overall, this convergence implies that the original three-factor model has the best goodness-of-fit values when testing in model fitting.

Education interaction with SC-PCS

Although the majority of our patients were from a lower socioeconomic background, the strong inverse correlation between education and SC-PCS is a novel finding. To our knowledge, this is the first such evidence. This observation may help explain the failure of assessment of the reliability and validity of the Chinese version of Beck Depression Inventory (SC-BDI),[27] although the authors attributed the failure of application of the SC-BDI to

China's cultural sensitivity and cultural bias. This confound may occur in other cross-culturally translated questionnaires, which needs to be addressed in future studies.

Pain intensity prediction

PCS is linked to pain perception and its contribution to predicting pain intensity can be explored through linear regression analysis, as indicated by normality test. A multiple regression analysis with SC-PCS scores and demographic variables significantly modeled pain intensity. However, the small coefficient determination ($R^2 = 0.07$) of the pain intensity model indicates a poor level of prediction, suggesting PCS may be more related to affective dimensions of pain rather than the intensity.

Study limitations

Certain limitations may have affected the study, such as a lack of formal cognitive debriefing training during testing the pre-final version. Another limitation was the number of patients for test-retest analysis (N = 24), below the minimum requirement of 30. Therefore, the chance of the size effect on the test-retest reliability cannot be ruled out although the ICC results are still in the right range. In addition, some indices of the best-fit model (three-factor model) are short of reaching to the lower zone, which needs to be explored in future studies.

Conclusions

In this study, the original English version of the PCS was semantically translated into an SC version and tested its reliability and validity in a representative patient population. We observed socioeconomic status confounds and addressed educational background of the patient population during the creation of the SC-PCS. We explored the SC-PCS structure through PCA and demonstrated an instability in the three-factor model. We improved on previous attempts of translating the PCS and statistically validated the SC-PCS in patients suffering from chronic pain.

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Supplemental Material

Supplementary material is available for this article.

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