Clinical Pain Research

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Dimensionality, reliability, and validity of the Finnish version of the pain catastrophizing scale in chronic low back pain

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Abstract

Objectives – The 13-item pain catastrophizing scale (PCS) is the most commonly used measure of pain catastrophizing. A validated Finnish version of the PCS has previously been unavailable. The objectives were to translate the original English version of the PCS into Finnish (PCS-FI), then to evaluate (i) structural validity of the PCS-FI with a confirmatory factor analysis (CFA), (ii) internal reliability with Cronbach's alpha, Omega, and Omega hierarchical, (iii) convergent validity with measures of well-being, quality of life, sleep quality, symptoms of central sensitization, and anxiety, and (iv) known-groups validity between participants with chronic low back pain (CLBP) and pain-free controls.

Methods – The translation process was performed with established guidelines. The PCS-FI was psychometrically validated using 92 participants with CLBP and 53 pain-free controls.

Results – Structural validity with CFA supported a bifactor solution. However, low reliability was found for the three specific factors (ω_h ranging from 0.14 to 0.18) compared to the general factor (ω_h = 0.88) suggesting that only the total score should be used. Convergent validity analysis showed satisfactory correlations and medium effect sizes with the other patient-reported outcome measures. Participants with CLBP had significantly higher total PCS-FI scores than pain-free controls.

Conclusions – The PCS-FI appears to be a valid and reliable instrument for assessing pain-related catastrophizing in Finnish-speaking populations. Ethical approval for this study was obtained from the Research Ethics Committee of the Northern Savo Hospital District, identification number 2131/2022, on the 31st of January 2022.

Keywords: pain catastrophizing scale, chronic low back pain, validation, reliability, cross-cultural adaptation, Finnish

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1 Introduction

Chronic low back pain (CLBP) is the most prevalent musculoskeletal pain syndrome globally [1,2]. Effective management of CLBP has proved to be challenging [2,3]. One of the most measured and studied contributing factors for CLBP is pain catastrophizing. Though pain catastrophizing has been defined in different ways, most authors agree that

it involves a negative and exaggerated cognitive-affective response to anticipated or actual pain [4,5]. Catastrophizing is considered one of the most important contributing psychological factors to the pain experience, chronicity, and disability [6,7].

Patient-reported outcome measures (PROMs) are standardized and subjective self-administrated questionnaires [8,9]. PROMs are used extensively in clinical practice and research to assess different factors associated with CLBP [10,11]. Reliable and valid cross-cultural translations of PROMs into different languages are pertinent for improving the management of CLBP globally.

The pain catastrophizing scale (PCS) is the most commonly used PROM for assessing pain-related catastrophizing. It includes subscales: rumination, magnifying, and helplessness [12,13]. There are three different validated short forms of the PCS (two 4-item [14,15] and one 6-item [16]), but the original 13-item scale is recommended for clinical use because of lower standard errors of measurement [15] and established responsiveness to pain interventions [17].

The PCS has been translated and cross-culturally validated in more than twenty languages [13]. A recent systematic review of 19 published articles found that most validation studies have been completed with different pain populations, and only a few have included a pain-free control group [13]. The high correlation between higher PCS total scores and higher pain intensity has been the most consistent finding in previous validation studies [18]. Considerable variation in PCS total score means and standard deviations have been found in different populations [19]. The measurement properties of the PCS, including reliability, known-groups validity (e.g., between participants with different pain syndromes and pain-free controls), and convergent validity (e.g., with different well-established PROMs) have generally been acceptable, with little variation [13,19]. The results of previous factor analyses have been much more variable. One-factor, [13,19,20] two-factor [21,22], and three-factor models [12] have been determined in previous studies. Three previous Rasch analyses have supported a one-factor model, without subscales [23–25]. However, the three-factor model is still widely used for scoring the PCS [12].

The study objectives were to translate and cross-culturally adapt the original English version of the PCS into Finnish (PCS-FI) and then to determine: (i) the structural validity with a CFA, (ii) internal reliability with Cronbach's alpha, Omega, and Omega hierarchical, (iii) convergent validity with other PROMs of well-being in pain, health-related quality of life, sleep quality, symptoms of central sensitization, and generalized anxiety, and (iv) known-groups validity between participants with CLBP and pain-free controls.

2 Methods

Ethical approval for this study was obtained from the Research Ethics Committee of the Northern Savo Hospital District, identification number 2131/2022, on the 31st of January 2022. This study was conducted according to the Helsinki Declaration.

This validation study adhered to the Consensus-based Standards for the selection of health Measurement Instruments (COSMIN) checklist for the methodological quality of studies on measurement instruments, except for test–retest reliability and sensitivity to change, which were not assessed [26].

2.1 Participants

Adults with self-reported CLBP were recruited from various Finnish musculoskeletal pain and spine-related organizations, and chronic pain support groups, as well as through direct outreach by the authors and healthcare colleagues who promoted the study across websites and social media platforms. The study's advertisements included comprehensive details about the study's nature, the criteria for inclusion and exclusion, data collection methods, and instructions for completing the study PROMs. CLBP was defined as "low back pain persisting for more than three months and occurring at least three days per week" [27]. Pain-free control participants were recruited by the authors and healthcare colleagues through social media. The control participants were defined as "healthy participants who did not report any persistent pain problems within the last month or pain at the moment of completing the questionnaires." All participants were eligible for the study if they met the following inclusion and exclusion criteria.

The inclusion criteria are as follows:

a. Males and females aged 18–68 years.
b. Patients with low back pain lasting more than 3 days per week during the last 3 months (group 1: participants with CLBP) and healthy participants who did not report any persistent pain problems within the last month nor pain at the moment of answering the questionnaire (group 2: pain-free control group).
c. Proficient in written and spoken Finnish language.
d. Provided written informed consent (group 1 only).
e. Completed pain history and PROMs.

The exclusion criteria are as follows:

1. History of any type of cancer.
2. Previous diagnoses of neurological diseases affecting the central nervous system (e.g., MS, dementia).

3. Previous diagnosis of fibromyalgia or rheumatic diseases (e.g., ankylosing spondylitis or rheumatoid arthritis).
4. Spinal surgery in the last 12 months.
5. Pregnancy at the time of the data collection.

2.2 Translation and cross-cultural adaptation

The 13-item PCS uses a 5-point Likert scale, including "Not at all" = 0, "To a slight degree" = 1, "To a moderate degree" = 2, "To a great degree" = 3, and "All the time" = 4. The overall scale score is calculated by summing the responses to each item, resulting in a range from 0 (indicating the absence of catastrophic thoughts) to 52 (representing maximum catastrophic thoughts). A total score of ≥30 is a recommended cut-off, representing a clinically relevant level of catastrophizing [12].

The Professional Society for Health Economics and Outcomes Research (ISPOR) task force recommendations for translation and cultural adaptation [28] were adhered to in the translation phase. First, the original English version of PCS [12] was obtained from the developer, Professor Michael Sullivan, who granted permission for the translation. Second, the PCS was translated by two independent professional translators into Finnish. Third, the translations were reconciled and a consensus provisional version of the PCS-FI was agreed on. No items were found to be problematic due to cultural issues between the original and the provisional translation. Fourth, the provisional version was reviewed and back-translated by two other independent translators unfamiliar with the PCS items. The back-translations were determined to conform closely to the original, prompting no further changes to the PCS-FI. Fifth, the PCS-FI was proofread and typeset to conform to the original English format. Sixth, cognitive debriefing was performed on the PCS-FI by asking eight patients with chronic pain conditions and five healthy pain-free volunteers to complete the translated version. In a non-structured interview by author TL, no problems with comprehension or interpretation of the items were identified, and all participants found the PCS-Fi easy to complete. Finally, the final version of the English back-translation of the PCS-FI was approved by the developer. The PCS-FI is available upon request from Mapi Research Trust (https://eprovide.mapi-trust.org/).

2.3 Data collection

Participant data were gathered through a two-stage process. The sample size was determined a priori in accordance with COSMIN checklist recommendations [29]. The data collection was concluded when the sample size comprised an adequate number of participants to effectively measure the study objectives. During the initial stage, data collection from the CLBP group was done in conjunction with a registered clinical study (ClinicalTrials.gov Identifier: NCT05268822) and was conducted between February 16, 2022, and October 20, 2022 [30]. All CLBP subjects provided written informed consent prior to participation.

In the second stage, data collection from the pain-free control group took place from January 14 to April 30, 2023. The University of Eastern Finland Research Ethics Committee, following the Finnish National Board on Research Integrity guidelines, determined that obtaining written informed consent before data collection from pain-free controls was not necessary. The pain-free participants were informed about the study, as was done with the CLBP group, but additional information was provided about why written informed consent was not needed.

All data were collected on the Nordhealth Connect website (https://connect.nordhealth.com/) using electronic versions of the PROM questionnaires. This platform, provided by a Finnish company, Nordhealth, offers a secure electronic system with robust authentication measures for both collecting and storing study questionnaires. In Finland, the use of strong electronic identification allows participants to securely confirm their identity across various electronic services before completing study questionnaires.

Upon logging into the site, participants were instructed to answer a structured series of web-based dichotomous (yes/no) questions regarding their pain history. Additionally, participants were asked to share demographic information, including height in centimeters, weight in kilograms, age in years, and educational attainment (1. Elementary school, 2. High school/vocational school, 3. Lower university degree, 4. Higher university degree). Body mass index (BMI) was calculated using the height and weight data provided. Finally, participants were asked to complete the questionnaires. Inclusion/exclusion from the study was determined from these self-reported data. Because all patients eventually visited the clinic, inclusion/exclusion criteria were verified by a clinician.

2.4 PROMs

The following PROMs were used to evaluate the convergent validity of the PCS. They were selected because they assess well-established and multifactorial pain-related variables.

The Wellness in Pain Questionnaire evaluates participants' multidimensional biopsychosocial well-being experienced in

the past month. The WPQ has 11 items, with a 5-point Likert scale (with "almost always" = 4, "often" = 3, "sometimes" = 2, "rarely" = 1, and "never" = 0. The overall scale score is calculated by summing the responses to each item, resulting in a total score that spans from 0 (reflecting minimal well-being in pain) to 44 (representing maximal well-being in pain). The original Finnish version validation study is currently under review [31].

The EuroQol EQ-5D-5L assesses health-related quality of life across five dimensions – self-care, mobility, usual activities, pain/discomfort, and anxiety/depression – using a Likert scale (ranging from 0 for no problems to 4 for unable/extreme problems) [32]. Additionally, the EQ-5D-5L includes a visual analog scale, where individuals rate their self-perceived health from 0 ("The worst health you can imagine") to 100 ("The best health you can imagine") [32]. To determine an index value, a standard value set specifically for the Finnish population has not been established yet. Consequently, a value set derived from a Danish population was utilized for index value calculations, as recommended by the EuroQol EQ-5D-5L User Guide [33]. Despite this, it is worth noting that EQ-5D-5L remains one of the most frequent PROMs for assessing health-related life quality in CLBP populations [34].

The pain and sleep questionnaire three-item index (PSQ-3) is a concise assessment comprising three questions that explore the direct impact of pain on sleep quality. These questions inquire about the frequency of experiencing trouble falling asleep due to pain, being awakened by pain during the night, and being roused by pain in the morning. Responses are rated on a scale from 0 (indicating pain does not influence sleep) to 30 (representing the maximum effect of pain on sleep) [35]. The PSQ-3 has undergone translation into Finnish and psychometric evaluation has determined acceptable reliability (Cronbach's alpha 0.83) and validity within a Finnish population with CLBP [36].

The Central Sensitization Inventory (CSI) is designed to evaluate symptoms and conditions associated with central sensitization [37]. This inventory comprises two sections: Part A consists of 25 questions assessing CS-related symptoms using a Likert scale ranging from 0 (never) to 4 (always), resulting in a total score that ranges from 0 to 100. Part B of the CSI involves "No/Yes" questions and queries about the year of diagnosis concerning prior CS-related disorders. It is important to note that Part B serves solely to gather information and is not scored [38]. The CSI has been translated into Finnish and psychometric evaluation has determined acceptable reliability (Cronbach's alpha 0.88) and validity acceptable within a Finnish population with CLBP [39].

The Generalized Anxiety Disorder Assessment (GAD-7) evaluates symptoms associated with generalized anxiety disorder. Respondents rate the items based on their experiences over the past two weeks, ranging from "not at all" = 0 to "nearly every day" = 3. Consequently, the total score spans from 0 (indicating minimal anxiety) to 21 (indicating severe anxiety) [40]. The GAD-7 has undergone cross-cultural adaptation and acceptable validation in Finnish [41].

2.5 Statistical methods

The COSMIN checklist [26] was used as guidance for the selection of the psychometric analyses detailed below. Statistical analysis was conducted using SPSS version 25 (IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp.) and Mplus version 7.4. For determining statistical significance, a threshold of $p < 0.05$ was set. The data were presented as n (%) for categorical variables or as means with standard deviations (mean ± SD) for continuous variables. The Mann–Whitney U-test was used to assess skewed distributed data. Kurtosis values ranging from −3 to +3 and skewness values from −10 to +10 were considered indicators of univariate normality [42]. Likelihood ratio was used for comparing categorical variables. Cronbach's alpha was calculated to gauge the internal consistency of the data. An alpha value between 0.70 and 0.90 was considered acceptable, and higher than 0.90 was considered excellent [43].

CFA with the variance-corrected weighted least squares estimator was conducted to assess the structural validity of the PCS-FI in the subsample with chronic pain (n = 92). As previously mentioned, the one-factor model and the three-factor model are the most supported factor structures of the PCS [13]. Both were tested in different ways to find out which best fit the Finnish version of the scale: (i) all 13 items forming a single latent factor, (ii) the original three-factor model proposed by Sullivan et al. [12] with a "helplessness" factor (items 1, 2, 3, 4, 5, and 12), a "magnification" factor (items 6, 7, and 13), and a "rumination" factor (items 8, 9, 10, and 11), (iii) the hierarchical factor model with three first-order factors plus one second-order factor model, and (iv) a bifactor structure was fitted to examine whether the PCS-FI dimensionality could be captured using a general factor of pain catastrophizing, as measured by all PCS items, and three specific factors, as measured by aforementioned item subsets. The data fit of the models was assessed by examining the Tucker–Lewis index (TLI; ≥0.95, good; ≥0.90, acceptable), the comparative fit index (CFI; ≥0.95, good; ≥0.90, acceptable), the root-mean-square error of approximation (RMSEA; ≤0.06, good; ≤0.10, acceptable) with a 90% confidence interval, and the weighted root-mean-square residual (WRMR; ≤1.00,

acceptable) [44]. Corrected item-total correlations (r_{tot}) were calculated for the PCS items to examine how each item contributed to the overall scale.

To evaluate the reliability of the PCS bifactor model, McDonald's ω, omega hierarchical (ω_h), coefficient H (≥0.70 for acceptable defined construct), the factor determinacy index (FDI; ≥0.80 for acceptable factor score estimates), the explained common variance (ECV; ≥0.70 for unidimensionality), and the percent of uncontaminated correlations (PUC ≥0.70 for unidimensionality) [45].

Convergent validity between other PROMs was calculated with Pearson's correlation coefficient (r). The strengths of the correlations were interpreted as little or no correlation ($r < 0.25$), fair ($0.25 > r \leq 0.50$), moderate to good ($0.50 > r \leq 0.75$), or good to excellent ($r > 0.75$). Correlation effect sizes were considered small (≥0.1), medium (≥0.2), and relatively large (≥0.3) [46]. To examine known-group validity, an independent-sample t-test was conducted to investigate differences in PCS scores between the CLBP and pain-free control groups.

3 Results

A total of 168 individuals met the inclusion criteria and agreed to participate in the study. Twelve participants from the CLBP group and eleven from the pain-free control group did not complete all the study questionnaires, leading to their exclusion from the analyses. Consequently, 145 participants were included in the final analyses, as illustrated in Figure 1. According to the COSMIN checklist [29], our dataset, including its subgroups, comprised an adequate sample size of participants to effectively measure the study objectives encompassing (I) factor analysis with CFA, (II) reliability measures, (III) convergent validity, and (IV) known-groups validity.

There were no missing data, as the electronic questionnaires automatically reminded the respondents if any items were missing. There were no scores of "zero" (the minimum possible score) or "52" (the maximum possible score) in the PCS-FI, resulting in no ceiling or floor effects.

Table 1 displays the PROM scores and the demographic details of the participants. Notably, two statistically significant differences emerged in the demographics between the two subject groups. Participants with CLBP were roughly 7 years older on average, and the pain-free control group exhibited a higher level of education, with more individuals holding higher university degrees. The pain-free control group demonstrated significantly lower scores on pain-related questionnaires, including the PCS-FI, and higher scores on well-being and quality of life compared to the CLBP group.

3.1 Structural validity

Table 2 shows the descriptive statistics of the PCS-FI items. The skewness and kurtosis levels showed that the item

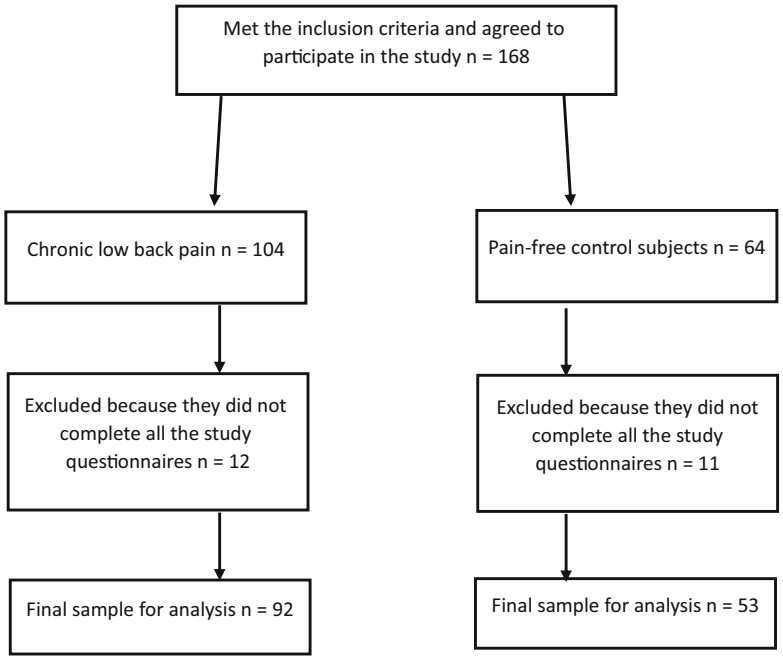

Figure 1: Flow chart of the study subjects.

Table 1: Demographics and patient-reported outcome measure scores

	Participants with CLBP (n = 92) mean (SD or %)	Pain-free controls (n = 53) mean (SD or %)	p-value
Age (years)	49.3 ± 12.2	42.1 ± 8.8	<0.01*
Female, N (%)	69 (75%)	40 (75%)	0.95
Height (cm)	169.7 ± 8.5	170.1 ± 8.7	0.71
Weight (kg)	77.0 ± 14.4	73.9 ± 8.7	0.35
BMI	26.7 ± 5.2	25.3 ± 4.8	0.42
Educational level	3.0 ± 0.9	3.4 ± 0.7	0.02*
PCS	15.3 ± 8.8	7.1 ± 4.9	<0.01*
Well-being in pain questionnaire	34.0 ± 7.7	40.4.0 ± 3.5	<0.01*
EuroQol 5-level EQ-5D version	0.71 ± 0.11	0.94 ± 0.09	<0.01*
EQ-5D-5L visual analog scale	65.5 ± 19.7	89.4 ± 8.4	<0.01*
Pain and sleep questionnaire three-item index	10.4 ± 8.8	0.8 ± 1.5	<0.01*
Central sensitization inventory	39.9 ± 13.5	24.6 ± 9.2	<0.01*
Generalized anxiety disorder – 7	4.1 ± 4.0	2.5 ± 2.8	0.01*

Results are presented as mean ± SD or n (%). Educational level categories: 1. Elementary school; 2. High school/vocational school; 3. Lower university degree; 4. Higher university degree.
*Statistical significance $p < 0.05$.

scores were normally distributed. The corrected item-total correlation coefficients for the overall scale were all greater than 0.30, thus suggesting good scale homogeneity.

The fit indices for the factor models of the PCS-FI are shown in Table 3. CFA showed that the best-fitting model was the bifactor model, with three uncorrelated factors and a single general factor (CFI = 0.99; TLI = 0.99; WRMR = 0.53; RMSEA = 0.06; 90% confidence interval [0.00, 0.10]). Some items such as 1 and 12 (Factor I – helplessness), items 6, 7, and 13 (Factor II – magnification), and item 10 (Factor III – rumination) obtained non-significant factor loadings with their respective specific factors ($p < 0.05$; factor loadings <0.30), whereas all items significantly loaded on the general factor (see Figure 2 for more details).

3.2 Reliability

The reliability indices of the PCS-FI are shown in Table 4. Overall, Cronbach's alpha and McDonald's ω values

Table 2: Descriptive statistics of the Finnish PCS (n = 92)

Items	M (SD)	S	K	r_{tot}
Factor I. Helplessness				
1. I worry all the time about whether the pain will end	1.41 (0.25)	0.71	0.14	0.64
2. I feel I can't go on	1.20 (1.04)	0.49	−0.65	0.71
3. It's terrible and I think it's never going to get any better	1.09 (1.03)	0.49	−0.96	0.75
4. It's awful and I feel that it overwhelms me	0.85 (0.96)	1	0.99	0.85
5. I feel I can't stand it anymore	0.91 (0.97)	0.99	0.45	0.75
12. There is nothing I can do to reduce the intensity of the pain	0.83 (0.92)	1.05	0.75	0.33
Factor II. Magnification				
6. I become afraid that the pain may get worse	1.36 (0.98)	0.80	0.35	0.66
7. I think of other painful experiences	0.34 (0.56)	1.83	4.5	0.39
13. I wonder whether something serious may happen	0.92 (0.96)	1.06	0.66	0.59
Factor III. Rumination				
8. I anxiously want the pain to go away	1.95 (1.04)	0.11	−0.67	0.62
9. I can't seem to keep it out of my mind	1.61 (1.01)	0.53	−0.23	0.69
10. I keep thinking about how much it hurts	1.22 (0.99)	0.93	0.65	0.82
11. I keep thinking about how badly I want the pain to stop	1.64 (1.10)	0.40	−0.80	0.65

M = mean; SD = standard deviation; S = Skewness; K = Kurtosis; r_{tot} = corrected item-total correlation.

Table 3: CFA goodness-of-fit indices of potential models for the Finnish PCS (n = 92)

Examining factor structure	Model χ^2			CFI	TLI	WRMR	RMSEA [90% CI]
	Est.	Df	*P*				
All 13 items forming one single latent factor	129.14	65	<0.001	0.976	0.971	0.851	0.104 [0.077, 0.130]
Three correlated factors	90.41	62	<0.001	0.989	0.987	0.658	0.071 [0.035, 0.101]
Three correlated factors forming one higher-order latent factor	90.41	62	<0.001	0.989	0.987	0.658	0.071 [0.035, 0.101]
Three uncorrelated factors and one single general factor (bifactor model)	69.93	52	<0.001	0.993	0.990	0.526	0.061 [0.004, 0.096]

n = 92. TLI = Tucker–Lewis Index; CFI = comparative fit index; RMSEA = root mean square error approximation; 90% CI = 90% confidence interval of the RMSEA; WRMR = weighted root mean square residual. The chosen estimator was weighted least square mean and variance adjusted (WLSMV).

suggested adequate reliability of the PCS-FI factors, ranging both from 0.64 to 0.95. However, the ω_h values indicated that the reliability of the specific factors was low (ranging from 0.14 to 0.18) when controlling for the variance of the general factor. The *H*, FDI, ECV, and PUC values suggested that the PCS-FI is primarily unidimensional.

3.3 Convergent validity

As shown in Table 5, correlations between the PCS-FI and PROMs assessing well-being in pain, health-related quality of life, sleep quality, central sensitization, and generalized anxiety were statistically significant, demonstrating fair to moderate convergent validity. Relatively large effect sizes were found for well-being, central sensitization, and anxiety.

3.4 Known-group validity

The independent-sample t-test analysis determined statistically significant differences in PCS scores (t (143) = −6.07; p < 0.001) between the CLBP (n = 92; M = 15.32, SD = 9.06) and pain-free control (n = 53; M = 7.09, SD = 5.10) groups, showing the CLBP group higher scores in the PCS-FI.

4 Discussion

The original English version of the PCS was translated into Finnish (PCS-FI) using standard guidelines [28]. In an initial debriefing with a group of CLBP subjects, the translated

Table 4: Reliability indices of the confirmatory measurement model for the Finnish PCS (n = 92)

Scale	α	ω	ω_h	*H*	FDI	ECV
General factor	0.92	0.95	0.88	0.95	0.95	0.79
Factor I. Helplessness	0.88	0.92	0.18	0.56	0.85	0.22
Factor II. Magnification	0.64	0.77	0.14	0.25	0.61	0.19
Factor III. Rumination	0.86	0.90	0.15	0.42	0.74	0.20

N = 92; α = Cronbach's alpha; ω = omega composite reliability; ω_h = omega hierarchical; *H* = construct replicability; ECV = explained common variance; FDI = factor determinacy index. The percent of uncontaminated correlations (PUC) was 0.69.

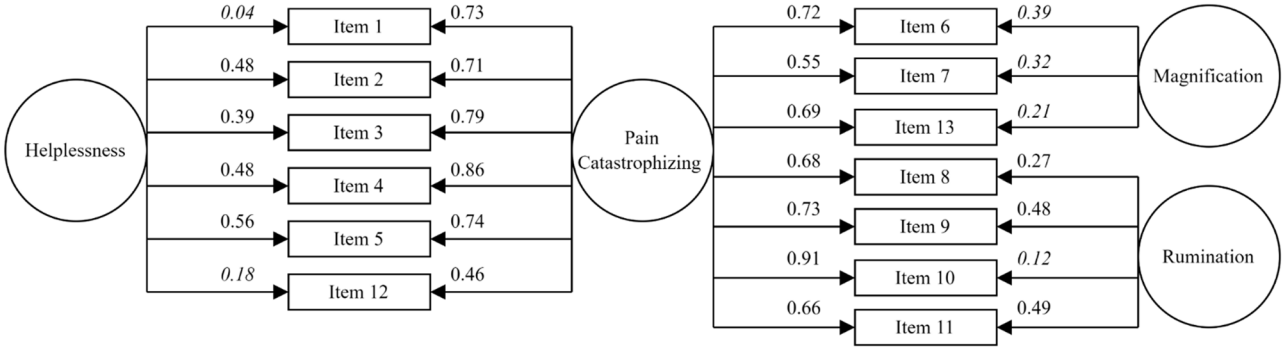

Figure 2: Bifactor model of the PCS-FI obtained in the CFA (n = 92). Note: Standardized factor loadings on the general and specific factors are shown. Nonsignificant parameters ($p \geq 0.05$) are italicized.

Table 5: Correlations between total PCS scores and other patient-reported outcome measures (n = 92)

Patient-reported measures	Correlation with the PCS	Effect sizes between correlations
Well-being in pain questionnaire	−0.45*	0.20
EuroQol 5-level EQ-5D version	−0.41*	0.17
EQ-5D-5L visual analog scale	−0.39*	0.15
The pain and sleep questionnaire three-item index	0.35*	0.12
Central sensitization inventory	0.50*	0.25
Generalized anxiety disorder assessment	0.49*	0.24

Pearson's correlation coefficient.
*Correlation two-tailed-statistical significance $p < 0.01$.

items were found to be easy to comprehend and complete, providing evidence of face validity.

Regarding its factor structure, the CFA supported a bifactor model, including previously established PCS subscales (helplessness, rumination, and magnification) and one general factor. However, despite the multidimensionality of the items, the three subscales showed poor reliability compared to the general factor, suggesting that only PCS-FI total scores should be used and reported instead of computing separate subscale scores. We recognize that a three-factor model is still widely used for scoring the PCS [13]. However, three previous Rasch analyses have supported a one-factor model, without subscales, which corresponds with our findings [23–25].

The convergent validity with Pearson's correlation coefficient showed satisfactory results between the PCS-FI and PROMS of well-being in pain, health-related quality of life, sleep quality, symptoms of central sensitization symptoms, and anxiety. Again, the results were very similar compared to previous validations [13]. It is noted that there have been no previously published correlations between the PCS and the well-being in pain questionnaire and the PSQ-3.

Significant differences in total scores between individuals with CLBP and healthy pain-free controls provided evidence supporting the known-groups validity of the PCS-FI. This supports the strong evidence base from previously published studies, that pain-related catastrophizing is closely associated with one's pain experience and chronicity [4,6,47].

5 Limitations

The generalization of the study findings to heterogenous CLBP and other pain populations should be made with caution because conclusions were drawn using data from one fairly small cohort of subjects with CLBP and pain-free controls. It was difficult for us to recruit pain-free control subjects. As a result, this group was smaller than the CLBP group, which could have affected the comparison between them. However, it should be noted that most previous PCS validations have included no control group. Though the two subject groups were unequal, the addition of a control group in the present study can be seen as a strength. Furthermore, test–retest reliability and sensitivity to change were not tested. Finally, we did not collect additional pain-related data (such as other comorbid pain conditions, single vs multisite pain distribution, and pain severity ratings), which may have affected the results.

6 Conclusion

A Finnish version of the PCS was successfully translated and validated. Its psychometric properties were all found to be within acceptable levels and comparable to previous validations. However, unlike some previous validations, we determined high reliability for one general factor of pain catastrophizing and low reliability for subscales. Therefore, we recommend that only total scores on the PCS-FI be reported. In conclusion, the PCS-FI appears to be a valid and reliable instrument for assessing pain-related catastrophizing in Finnish-speaking populations. Future studies should assess the Finnish version of the PCS with other pain-related disorders and evaluate test-retest reliability and sensitivity to change.

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Author contributions: The authors have accepted responsibility for the entire content of this manuscript and approved its submission. JM: conceptualization; data curation; formal analysis; investigation; methodology; project administration; resources; software; validation; visualization; roles/writing – original draft; and writing – review and editing. VL: conceptualization; data curation; formal analysis; investigation; methodology; supervision; validation; roles/writing – original draft; and writing – review and editing. TL: conceptualization; investigation; methodology; resources; validation; roles/writing – original draft; and writing – review and editing. RH: conceptualization; formal analysis; methodology; resources; validation; roles/writing – original draft; and writing – review and editing. KE: conceptualization; formal analysis; methodology; roles/writing – original draft; and writing – review and editing. PK: conceptualization; formal analysis; methodology; roles/writing – original draft; and writing – review and editing. OA: conceptualization; formal analysis; methodology; roles/writing – original draft; and writing – review and editing. JL: conceptualization; data curation; formal analysis; methodology; resources; software; roles/writing – original draft; and writing – review and editing. JN: conceptualization; data curation; formal analysis; methodology; resources; software; roles/writing – original draft; and writing – review and editing. RN: conceptualization; investigation; methodology; validation; roles/writing – original draft; and writing – review and editing.

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