

# Development and Validation of Short Forms of the Pain Catastrophizing Scale (F-PCS-5) and Tampa Scale for Kinesiophobia (F-TSK-6) in Musculoskeletal Chronic Pain Patients

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**Purpose:** Chronic pain is a complex phenomenon. Understanding its multiple dimensions requires the use of a combination of several patient-reported outcome measures (PROMs). However, completing multiple PROMs is time-consuming and can be a burden for patients. The objective of our study was to simultaneously reduce the French versions of the Pain Catastrophizing Scale (PCS) and Tampa Scale for Kinesiophobia (TSK) questionnaires to enable their use in an ambulatory and clinical settings.

**Patients and Methods:** We conducted a clinical study between May 2014 and August 2020 in our rehabilitation center. 1428 chronic musculoskeletal pain patients (CMSP) were included. The originality of our approach is that the reduction method included qualitative as well as quantitative analyses. The study was divided into two parts: 1) reduction of the questionnaires (n=1363) based on internal consistency (item-to-total correlation), principal component analysis (item loadings), Rasch analysis (infit/outfit), floor and ceiling effect (quantitative analyses) and expert judgment of items (qualitative analysis), and 2) validation of the reduced questionnaires (n=65), including test-retest reliability (intraclass correlation coefficient [ICC]), homogeneity (Cronbach  $\alpha$ ), criterion validity (Pearson correlation [r] with the long-version score), determination of the pathological cutoff and Minimal Clinically Important Difference (MCID). The two full-length questionnaires include 30 items in total.

**Results:** The reduction resulted in a 5-item PCS (score 0–20) and 6-item TSK (score 0–24). Psychometric properties of the reduced questionnaires were all acceptable as compared with other version ( $\alpha=0.89$  and  $0.71$ ,  $ICC=0.75$  and  $0.60$ ,  $r=0.86$  and  $0.70$ ,  $MCID=2$  and  $2$  for PCS and TSK, respectively) while keeping the structure and coherence of the long versions.

**Conclusion:** The two reduced versions of the PCS and TSK can be used in CMSP patient. As their administration only requires a few minutes, they can be implemented in outpatient consultation as well as in clinical settings.

**Keywords:** chronic musculoskeletal pain, CMSP, patient-reported outcomes measures, PROMs, Pain Catastrophizing Scale, PCS, Tampa Scale for Kinesiophobia, TSK

## Introduction

Chronic pain is a worldwide problem and the source of huge medical and social costs. Prevalence of chronic pain ranges from 11% to 40% in the world's population.<sup>1</sup> In Switzerland, musculoskeletal diseases and injuries are the second leading cause of health costs: 8.7 billion Swiss francs per year (9.5 billion USD).<sup>2,3</sup> Chronic musculoskeletal pain (CMSP) is also a multifactorial phenomenon defined by a complex interaction between biological, psychological and social factors<sup>4</sup> that can lead to a physical deconditioning.<sup>5</sup> Based on this observation, the fear-avoidance model (FAM)<sup>6-10</sup> describes how people with musculoskeletal pain develop a chronic pain through thoughts that increase pain and cause disuse and

disability. Psychological processes such as fear of movement and pain catastrophizing seem to be key factors in the development of chronic pain.<sup>9</sup> Indeed, high level of catastrophizing and kinesiophobia are associated with high level of self-reported and performance-based disability<sup>11–13</sup> as well as perceived pain intensity.<sup>14–17</sup> These factors are implicated in the chronicization of the pain. Thus, their detection is necessary for both research and clinical purposes to assist in clinical-decision making in order to optimize introduction of targeted therapeutic programs based on cognitive behavioral therapies.<sup>18,19</sup> Moreover, measured from the onset of the chronic pain, it may be useful in identifying patients who are at risk of poor outcomes.

The Pain Catastrophizing Scale (PCS),<sup>20</sup> and Tampa Scale for Kinesiophobia (TSK)<sup>21</sup> are patient-reported outcomes measures (PROMs) frequently used for patients with chronic pain. These questionnaires evaluate catastrophizing thinking, and pain-related behaviors.

Completing multiple PROMs with a large number of items results in patients' unwillingness because it takes too much time. Moreover, they also are costly and burdensome for clinicians (completion time, scoring, interpretation, management of missing data, data retention), so using them is almost impossible in the context of an outpatient medical consultation. The solution to a complex dilemma is rarely simplification,<sup>22</sup> but reducing the size of several PROMs has been proposed by different teams<sup>23–28</sup> as a workable solution. Provided that the psychometric qualities of the short version of the PROMs remain comparable, this is an elegant approach that deserves to be extended.

The aim of this study was to reduce the PCS and TSK questionnaires with an approach that includes qualitative and quantitative analyses and to validate their psychometric properties in a population of patients with CMSP. The two PROMs already have several reduced versions. However, they were all developed from purely quantitative analyses. Our method, as recommended by Stanton et al,<sup>29</sup> is a combination approach including professional judgment of the relevance of items.

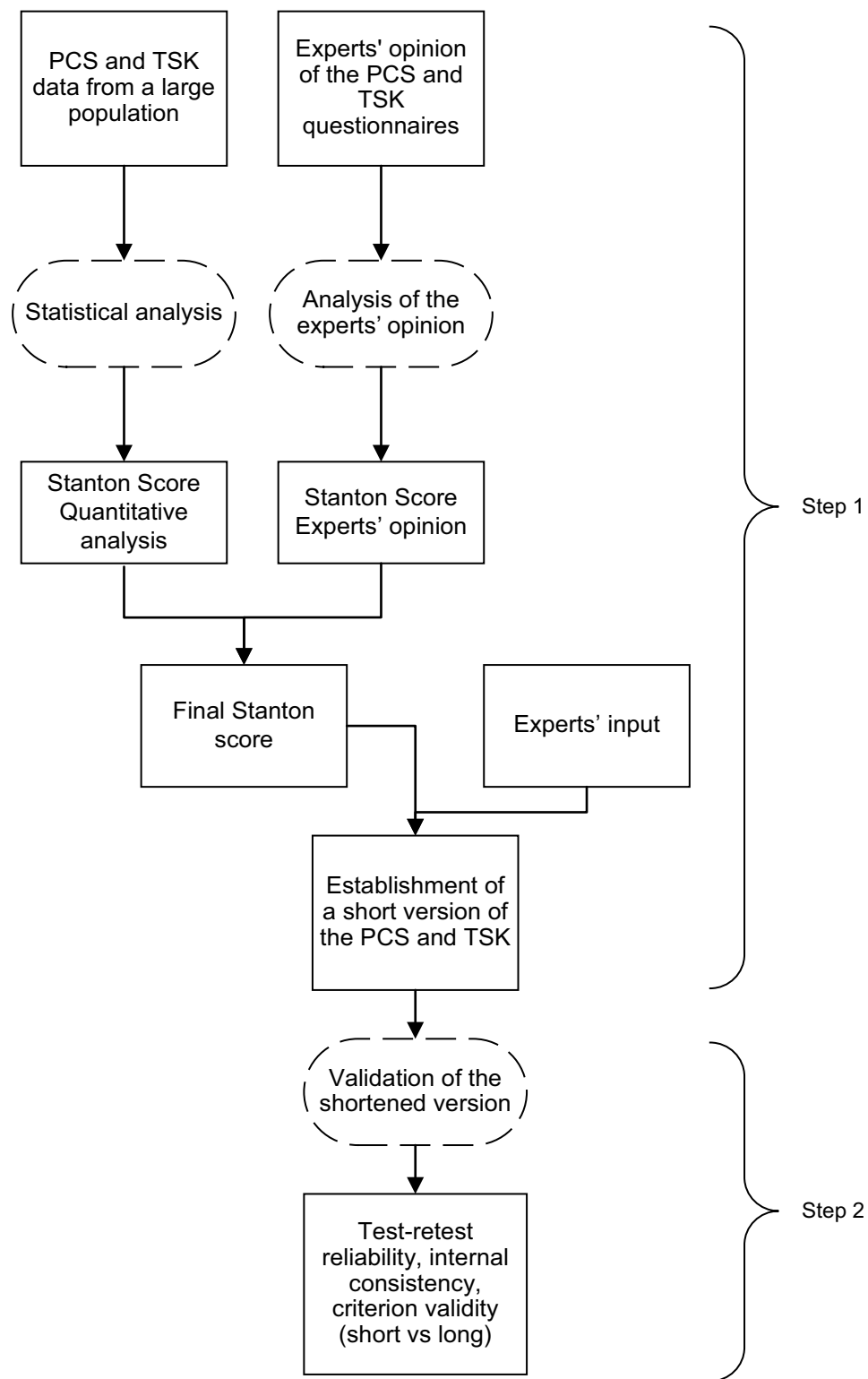
## Materials and Methods

### Study Design, Settings and Participants

The study was divided into two steps: 1) reduction of the questionnaires and 2) validation of the reduced versions. A validated mixed method was used to shorten the questionnaires.<sup>26,29,30</sup> This approach is based on quantitative analysis and expert judgment of items. It allows for selecting items according to their clinical relevance in addition to their psychometric values. Then, we performed a validation step with test–retest reliability and comparison of the long and short versions of the questionnaires (Figure 1). Finally, the pathological threshold and the Minimal Clinical Important Difference (MCID) were determined.

The clinical study took place in a center specialized in vocational rehabilitation after a musculoskeletal injury. Most of hospitalized patients are construction or industry workers with injuries from professional, leisure or traffic trauma. For reducing the questionnaires, all consecutive patients hospitalized in the Musculoskeletal Rehabilitation Department of our rehabilitation center between May 1, 2014 and June 30, 2017 after an orthopedic trauma were considered for inclusion. Inclusion criteria were age 18 to 65 years and CMSP lasting more than 3 months after an orthopedic trauma of the upper/lower limbs or spine. Portuguese, Spanish and Italian patients who did not read French well enough completed the questionnaires in their native language. Exclusion criteria were multiple trauma and neurological deficiencies. For the validation step, patients were recruited from February 1 to August 30, 2020. Patients had to have sufficient ability in French to be able to answer the short version of questionnaires. Terwee et al<sup>31</sup> considered a sample size of 50 patients adequate to assess the reproducibility of a questionnaire. We decided to add 15 more patients to increase the precision of our results.

The study protocol was approved by the local ethics committee, the Commission Cantonale Valaisanne d'Ethique Médicale (CCVEM 034/12) and conducted according to the recommendations of the Declaration of Helsinki. All participants signed an informed consent form before enrolment. The study is reported according to the CONsensus-based Standards for the selection for health status Measurement INstruments (COSMIN) guidelines.<sup>32</sup>



**Figure 1** Study design scheme. Step 1: reduction of the PCS and TSK questionnaires. Step 2: validation of the reduced questionnaires. **Abbreviations:** PCS, Pain Catastrophizing Scale; TSK, Tampa Scale for Kinesiophobia.

## Data Collected

For each patient, we collected sociodemographic variables: age, sex, education level ( $\leq$  or  $>9$  years), employment contract at the time of the accident (yes/no), profession (skilled or unskilled worker/employee, business executive, other), spoken language, pain duration, and pain localization (upper limb, lower limb or back/neck).

## PROMs

The PCS and TSK are validated PROMs with good psychometric properties.<sup>20,21,33,34</sup>

**PCS:** The PCS was developed by Sullivan et al<sup>20</sup> to measure catastrophic thinking in relation to pain experience. It contains 13 items, each scored from 0 (“not at all”) to 4 (“always”), with a maximum total score of 52. A total PCS score  $> 30$  suggests a clinically relevant level of catastrophizing. The PCS has good internal consistency (Cronbach  $\alpha = 0.87$ ) and good reliability (intraclass correlation coefficient [ICC]=0.75).<sup>20</sup> The French version of the PCS has good psychometric properties, with Cronbach  $\alpha = 0.87$  and reliability = 0.85.<sup>35</sup> To our knowledge, there is no official MCID for this questionnaire. The PCS takes about 5 min to complete.<sup>36</sup>

**TSK:** The TSK was proposed by Miller et al<sup>37</sup> to measure fear of movement and (re)-injury. It contains 17 items, each scored on a 4-point Likert type scale: 4 items are inversely scored to detect poor responders. The total TSK score ranges from 17 to 68. We chose a cutoff according to sex as proposed by Roelofs et al:<sup>38</sup> scores  $> 36$  for women and 38 for men are associated with high fear of pain. There are many versions of the TSK,<sup>39</sup> the Cronbach  $\alpha$  ranging from 0.70 to 0.92 and test–retest reliability generally  $> 0.80$ . The Cronbach  $\alpha$  is 0.71 for the French version.<sup>40</sup> To our knowledge, no study has reported the test–retest reliability of the French version. There is no consensus regarding the MCID for TSK.

## Step I: Reduction of the Questionnaires

We followed the procedure described by Stanton et al.<sup>29</sup> The method consists of scoring items on several characteristics to help a panel of experts make the best possible selection of a group of items. For each questionnaire, the items were scored by using five methods (four quantitative analyses + one expert judgment) (Table 1). At the end of each method, each item was scored from 0 to 2. Therefore, each item received a maximum of 10 points at the end of the procedure. Then, a group of experts made the final selection considering these results and other criteria such as their own clinical experience or the need to ensure the coherence of the

**Table 1** Preselection of Items of the Two Questionnaires and Scoring According to the Stanton Criteria

Category	Cut-Off	Scores
Item-to-total correlation	0.6–0.9	2
	0.4–0.59	1
	$<0.4$ or $>0.9$	0
Principal component analysis	Loading $>0.5$ on one factor	2
	Loading $>0.5$ on no or $>1$ factor	0
Rasch analysis: infit and outfit	0.5–1.5	2
	$>1.5$ to 2	1
	$> 2$ or $< 0.5$	0
Floor/ceiling effect: proportion of answers with the lowest or the highest score	$< 85\%$	2
	$> 85\%$	0
Expert interviews (n = 7)	Item selected by 7/7 experts	2
	6 of 7	1.7
	5 of 7	1.4
	4 of 7	1.1
	3 of 7	0.9
	2 of 7	0.6
	1 of 7	0.3
None	0	

reduced questionnaire (including keeping the most relevant items while avoiding redundancies). It was important to have input from a large panel of professionals who work routinely with patients, covering every different dimension of rehabilitation (medical and paramedical care, physiotherapy, occupational therapy, psychotherapy, socio-professional worker).

### Quantitative Analysis

Different multiple-factor models were proposed for the TSK. The two-factor model comprising items linked to somatic focus (TSK-SF) and activity avoidance (TSK-AA) are the most extensively used. Some discrepancies exist in terms of which items are included in these two factors.<sup>41</sup> In our clinic, we use only the total score of the TSK questionnaire to discriminate patients with high and low kinesiophobia. Thus, the reduced version of the TSK was based on one dimension. Therefore, we conducted two sets of analyses (PCS, TSK).

### Internal Consistency

Internal consistency was evaluated with the item-to-total correlation. The Pearson correlation coefficient was calculated between each item and the total score.<sup>42</sup> According to the Stanton criteria,<sup>29</sup> a score of 2/2 is given for a correlation between 0.6 and 0.9, 0/2 for a correlation  $< 0.4$  or  $> 0.9$ , and 1/2 otherwise (Table 1).

### Principal Component Analysis (PCA)

The PCA involves building a new set of uncorrelated variables (factors) that are linear combinations of the original intercorrelated variables (items). Factors represent the uncorrelated underlying clinical dimensions assessed by the questionnaire. The coefficients of these linear combinations (factor loadings) may be interpreted as correlation coefficients between the items and the factors. PCA was performed with Varimax rotation to force the loadings to be either large or small for easier interpretation.<sup>43</sup> We used the Kaiser's criterion to determine the number of factors to retain in the analysis:<sup>44</sup> eigenvalues (proportion of the explained variance)  $> 1$ . An item loading  $> 0.5$  on one factor is interpreted as a good and specific representation of one clinical dimension of the questionnaire, so the item receives a Stanton score of 2/2. Loadings  $> 0.5$  on no factor (the item poorly assesses the dimensions) or on more than one factor (the item assesses more than one dimension) receives a Stanton score of 0/2 (Table 1).

### Rasch Analysis

According to the Rasch model,<sup>43</sup> each questionnaire respondent can be mathematically located on a single axis (latent trait) that is supposed to measure the clinical dimension assessed by the questionnaire (eg, the intensity for kinesiophobia for TSK). The adequacy of a questionnaire to the Rasch model implies several hypotheses, and Stanton et al<sup>29</sup> propose to use the unidimensionality indices "infit" and "outfit" to check the adequacy of the data to the Rasch model and to select the items to keep or not in a reduced version of a questionnaire.<sup>44</sup> The Stanton score for each item was attributed as follows: both infit and outfit from 0.5 to 1.5 indicate good fit and score 2/2; both values  $< 0.5$  or  $> 2$  indicate insufficient fit and score 0/2; and other cases score 1/2 (Table 1).

### Floor and Ceiling Effect

A ceiling effect occurs when more than 15% of participant scores are near the upper limit of the measure. The opposite is the floor effect.<sup>45</sup> If an item receives the lowest or the highest score for more than 15% of the patients, it receives a score of 0/2 according to the Stanton criteria. For the other items, a score of 2/2 was attributed (Table 1).

IBM SPSS Statistics 27 and Winsteps 3.8 were used for statistical analyses.

### Expert Opinions

Seven experts (1 rheumatologist, 1 physiatrist, 2 psychologists, 1 occupational therapist, 1 physiotherapist and 1 socio-professional worker) participated in the focus group. Experts had more than 5 years' experience in the rehabilitation of patients with CMSP. Experts were asked to independently rate the three questionnaires and to select the most clinically relevant items related to CMSP patients. At this stage, experts were not provided with a recommendation on the number of items to be removed in order to avoid influencing their choice. The responses were "Yes/No". The Stanton score for an item was the percentage of answers "Yes" multiplied by 2 to obtain a score from 0/2 to 2/2 (Table 1).

## Final Item Selection

The same group of experts plus a moderator (physiatrist) who presented the quantitative results met to make the final selection. Discussions were held for each questionnaire to decide which items fit the best with routine clinical practice. Experts had to consider the overall Stanton score as well as the detailed results for each of the methods used. At first, they should not only judge each item individually but also evaluate items as a whole, keeping in mind that the different clinical aspects measured by a questionnaire should also be measured in its short version and that redundancies between items evaluating very similar clinical dimensions should be discarded. Of course, they had to favor the items with the highest Stanton scores. Finally, the moderator asked experts to keep about 1/3 of the items in each questionnaire as was the case for the QuickDASH.<sup>23</sup>

## Step 2: Validation of the Reduced Questionnaires

Patients completed the short versions of the questionnaires on day 1 (test day) and day 4/5 (retest day) and the long versions on day 2 (Figure 2). The “test” questionnaires (day 1) were given to patients together with other questionnaires systematically completed on admission in our clinic, whereas the “retest” questionnaire (day 4/5) was given alone. We considered that a “fatigue” or “lassitude” effect was more likely to be observed in the answers to the “test” rather than the “retest” questionnaire and therefore that the answers to the latter were likely to be more reliable. For this reason, we decided to use the responses to the second short questionnaires for validity and for estimating the threshold and the MCID (calculation of the standard deviation, which is part of the standard error of measurement [SEM] formula, see below).

## Participants

Between February 1 and August 30, 2020, all consecutive eligible French-speaking patients were selected to participate in the validation step.

## Psychometric Analysis

### Internal Consistency

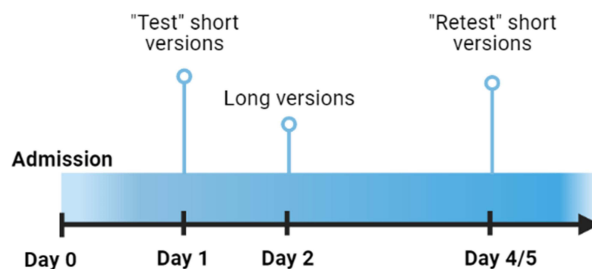
Internal consistency refers to the homogeneity of the questionnaire (ie, checking to what extent the questionnaire’s items measure the same concept). It was estimated with the Cronbach  $\alpha$ . Acceptable values range from 0.70 to 0.95, depending on the report.<sup>46</sup>

### Reliability

Test–retest reliability measures the reliability of the questionnaire over time. It was assessed with the ICC(2,1), two-way random, single measure, absolute agreement.<sup>47</sup> An ICC > 0.80 was considered “excellent”, 0.71 to 0.80 “good”, 0.51 to 0.70 “moderate”, 0.31 to 0.50 “poor” and < 0.30 no correlation.<sup>48</sup> The Bland-Altman plot was used to visually check for reliability ([Supplementary Data 1](#)).

### Criterion Validity

Criterion validity estimates how well one measure is correlated with a “gold standard”. The long-version scores of the questionnaires were considered the “gold standard” and correlations with the short-version scores were calculated.<sup>48</sup> Pearson correlation coefficients > 0.7 were expected.<sup>42</sup>



**Figure 2** Timeline Of Questionnaire Administration.

## MCID and SEM

The MCID indicates the minimal change in score that the questionnaire should measure to represent a real change considered clinically relevant by patients and physicians. In the absence of an anchor, MCIDs were estimated with one of the most widely used distribution-based methods with the following formula:<sup>49,50</sup>  $MCID = 1 \times SEM = SD\sqrt{1 - ICC}$ , where SD = standard deviation of the change. Because the responses to the questionnaires are integers, the MCID was defined as the smallest integer greater than the SEM. For example, for a SEM = 0.7, the MCID is 1.

## Determination of the Thresholds

The scores of the short versions were compared with the pathological thresholds for the long versions (PCS: 30/52; TSK: 38/68 for men and 36/68 for women) with receiver operating characteristic curves. For each short version, the optimal cutoff was defined as the one that gave the highest Youden index (sensitivity + specificity – 1).<sup>51</sup>

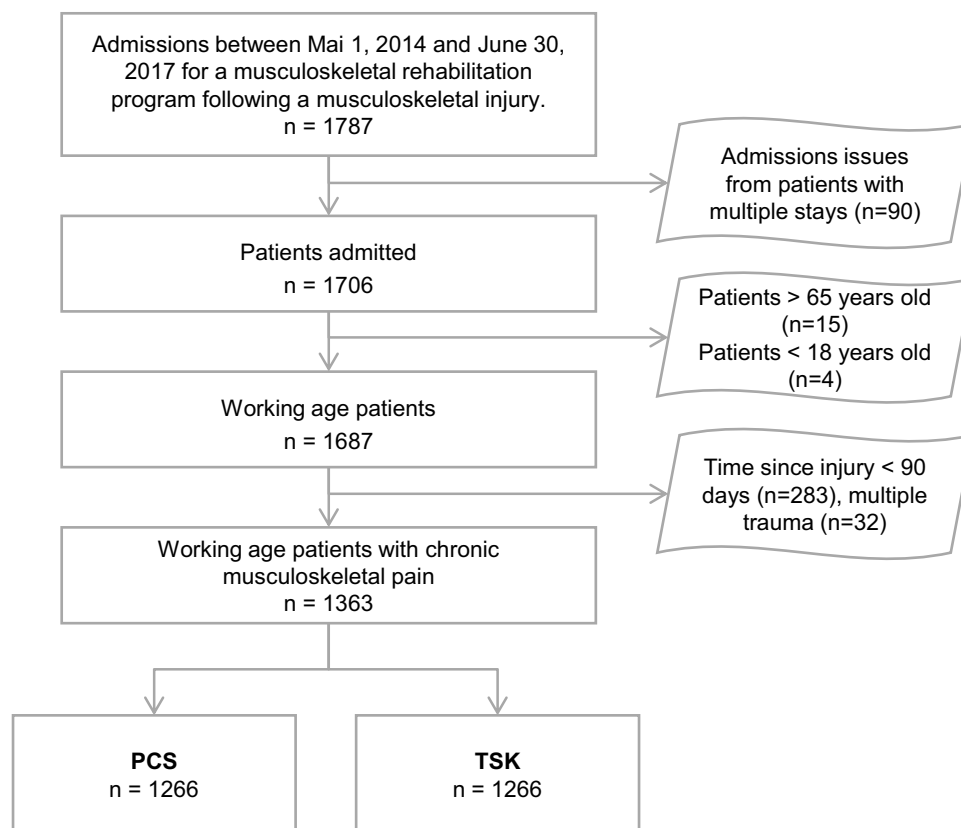
## Results

### Step I: Reduction of the Questionnaires

#### Participants

Between May 1, 2014 and June 30, 2017, 1796 patients were admitted for a musculoskeletal rehabilitation program for chronic pain following a musculoskeletal injury. For the quantitative analysis, 1363 patients were eligible for inclusion. A total of 1266 questionnaires for the PCS and TSK were available for analysis (Figure 3).

The main characteristics of patients are in Table 2. Patients included were mainly middle-aged (median 45 years [interquartile range (IQR) 35–53] and men (88%) with chronic pain due to a musculoskeletal injury that occurred at a median of 12 months [IQR 8.3–20.7] previous. Pain localization was equally distributed between upper and lower limbs, and 15% of the patients had neck/back pain. In all, 57% of patients had ≤ 9 years of school education, 84% were



**Figure 3** Flow Diagram Of Patient Inclusion And Number Of Completed PCS And TSK Questionnaires In The First Step Of The Study.

**Abbreviations:** PCS, Pain Catastrophizing Scale; TSK, Tampa Scale for Kinesiophobia.

**Table 2** Socio-Demographic Characteristics of Patients

Variables	Quantitative Analysis n=1363	Validation Step n=65
Age, years, median [IQR]	45 [35–53]	43 [35–54]
Sex, men (%)	1195 (88%)	49 (75%)
Education	n=1360	
≤ 9 years	772 (57%)	23 (35%)
> 9 years	588 (43%)	42 (65%)
Employment contract	n = 1360	
Yes	774 (57%)	30 (46%)
No	586 (43%)	35 (54%)
Profession		
Skilled or unskilled worker	1150 (84%)	48 (74%)
Employee, business executive, other	213 (16%)	17 (26%)
Spoken language		
French	1187 (87%)	65 (100%)
Other	176 (13%)	0
Pain duration, months, median [IQR] (range)	12.2 [8.3–20.7] (3.0–493.7)	n=62 12.9 [9.1–20.9] (2.9–392.7)
Pain localization		
Upper limb	559 (41%)	30 (46%)
Lower limb	602 (44%)	23 (35%)
Neck/back	202 (15%)	12 (19%)

**Abbreviation:** IQR, Interquartile Range.

workers and 57% were in an employment contract at time of rehabilitation. Most (85%) patients were fluent French speakers.

### Quantitative Analysis (Table 3)

The median global Stanton score for the 30 items was 8.2/10 (IQR 7.1–9.1). For the item-to-total correlation analysis, 15 items scored < 2. For the PCA, 6 items scored 0/0; all others scored 2/2. Most of the items with a score < 2 belonged to the TSK questionnaire, with 15 items scoring < 2 in the item-to-total analysis (88% of all items) and 5 items scoring < 2

**Table 3** Statistical Performance of the Two Questionnaires According to the Stanton Criteria. Items Selected by Experts are Highlighted in Grey

Domain	Items	Item-to-Total-Correlation	PCA	Rasch	Floor/Ceiling	Experts	Total
PCS	01	2	2	2	2	1.7	9.7
	02	2	2	2	2	0.9	8.9
	03	2	2	2	2	1.1	9.1
	04	2	2	2	2	0.6	8.6
	05	2	2	2	2	1.7	9.7
	06	2	2	2	2	1.7	9.7

(Continued)

Table 3 (Continued).

Domain	Items	Item-to-Total-Correlation	PCA	Rasch	Floor/Ceiling	Experts	Total
	07	2	2	2	2	0.3	8.3
	08	2	2	2	2	0.6	8.6
	09	2	2	2	2	2.0	10.0
	10	2	2	2	2	0.9	8.9
	11	2	2	2	2	1.1	9.1
	12	2	0	2	2	2.0	8.0
	13	2	2	2	2	1.1	9.1
TSK	01	1	2	2	2	1.7	8.7
	02	1	2	2	2	1.1	8.1
	03	2	2	2	2	2.0	10.0
	04	0	2	2	2	1.1	7.1
	05	1	2	2	2	1.1	8.1
	06	1	0	2	2	0.6	5.6
	07	1	0	2	2	2.0	7.0
	08	0	2	2	2	1.1	7.1
	09	1	0	2	2	0.9	5.9
	10	0	0	2	2	1.7	5.7
	11	1	2	2	2	0.3	7.3
	12	0	2	2	2	0.9	6.9
	13	1	0	2	2	1.4	6.4
	14	1	2	2	2	0.9	7.9
	15	2	2	2	2	1.1	9.1
	16	0	2	2	2	1.1	7.1
	17	1	2	2	2	1.1	8.1

**Abbreviations:** PCS, Pain Catastrophizing Scale; TSK, Tampa Scale for Kinesiophobia; PCA, Principal Component Analysis.

in the PCA analysis (29% of all items). All items scored 2/2 in the floor/ceiling and Rasch analyses. For the experts, values ranged from 0.3 to 2.

### Synthesis and Final Decision

The experts were instructed to keep about 1/3 of the items, favoring the highest Stanton scores and maintaining the structure of the questionnaire. The items were chosen collectively, with each expert giving an opinion according to their specialization. The experts kept as a priority the items with a good Stanton score but sometimes had to choose between items with the same Stanton scores. This situation occurred with items 1, 5 and 6 of the PCS: items 1 and 6 had the same profile (quantitative analyses) and were redundant. Thus, from their experience, experts chose to keep item 6. In other situations, they had to choose between 2 items with a different Stanton score and still chose the one with the lowest score

in order to respect the structure of the questionnaire or because this item seemed more clinically relevant. This was the case for item 3 of the PCS (Stanton score 5.1), which was preferred over item 5 (Stanton score 5.7) because experts considered it less specific to catastrophism than the others. In other cases, the items did not participate in any of the dimensions but were nevertheless retained by the experts because they considered them indispensable. This was the case for items 7 and 10 of the TSK or item 12 of the PCS. We asked the experts to retain 1 or 2 inversely scored items of the TSK to preserve the construction of the questionnaire.

The scores for the PROMs were calculated in the same way as for the long versions (ie, by adding up the scores for each item). The sum gives a range of 0–20 for the 5-item PCS and 0–24 for the 6-item TSK.

## Step 2: Validation of the Reduced Questionnaires

### Participants

In total, 65 additional patients with chronic pain due to a musculoskeletal injury that had occurred about 13 months previous were recruited between February 1 and August 30, 2020 for the validation step. Five patients did not respond to the retest. If patients did not respond to  $\geq 1$  item in any of the three PROMs, the questionnaire was not used for further analysis. Patient characteristics are in Table 2. The median age was 43 (IQR 35–54) and 75% of patients were men. In all, 46% of patients had upper-limb pain, 35% lower-limb pain and 19% neck/back pain. A total of 35% of patients had  $\leq 9$  years of school education, 74% were workers and 46% had an employment contract at the time of rehabilitation. All were fluent French speakers.

### Psychometric Properties

#### Internal Consistency

Cronbach  $\alpha$  values were 0.89 and 0.71 for PCS and TSK, respectively (Table 4).

#### Reliability

The PCS shows a “good” ICC and the TSK a “moderate” ICC (Table 4).

#### Criterion Validity

The correlation coefficients were  $\geq 0.70$  for both PROMs (Table 4).

**Table 4** Reliability and Criterion Validity of the Two Reduced Questionnaires

	Homogeneity		Reliability			Criterion Validity			
	N	Cronbach $\alpha$	Mean Score Day 1	Mean Score Day 4/5	ICC [95% CI]	N	Mean Score Short/Range	Mean Score Long/Range	Correlation Coefficient [95% CI]
PCS	60	0.89	11.2 (5.7)	9.6 (5.3)	0.75 [0.57–0.85]	60	9.6/20	25.1/52	0.86 [0.78–0.92]
TSK	60	0.71	17.5 (3.7)	16.9 (4.1)	0.60 [0.42–0.74]	60	16.9/24	45.3/68	0.70 [0.54–0.81]

**Abbreviations:** PCS, Pain Catastrophizing Scale; TSK, Tampa Scale for Kinesiophobia; ICC, Intraclass Correlation Coefficient; CI, Confidence Interval.

### Cutoffs

On the basis of 60 patients, results suggested the following optimal pathological cutoffs: 9/20 for the PCS and 16/24 for the TSK. For the latter, we also calculated the threshold according to sex as suggested for the long version. The cutoff was 14 for women and 16 for men. However, because of few women in our analysis ( $n=16$ ), the cutoff needs to be confirmed with a larger population (Table 5, Figure 4).

### MCID

The MCIDs estimated were: 2 for PCS (0–20) and 2 TSK (0–24) (Table 5).

**Table 5** Cutoff Values and SEM/MCID for the Two Reduced Questionnaires

	Cutoff	Youden Index	Sensitivity	Specificity	AUC [95% CI]	SEM/MCID
PCS, /20	9	0.61	0.95	0.66	0.89 [0.78–0.95]	1.79/2
TSK, /24	16	0.62	0.82	0.80	0.79 [0.51–0.92]	1.81/2

**Abbreviations:** PCS, Pain Catastrophizing Scale; TSK, Tampa Scale for Kinesiophobia; AUC, Area Under the receiver operating characteristic Curve; SEM, Standard Error of Measurement; MCID, Minimal Clinically Important Difference.

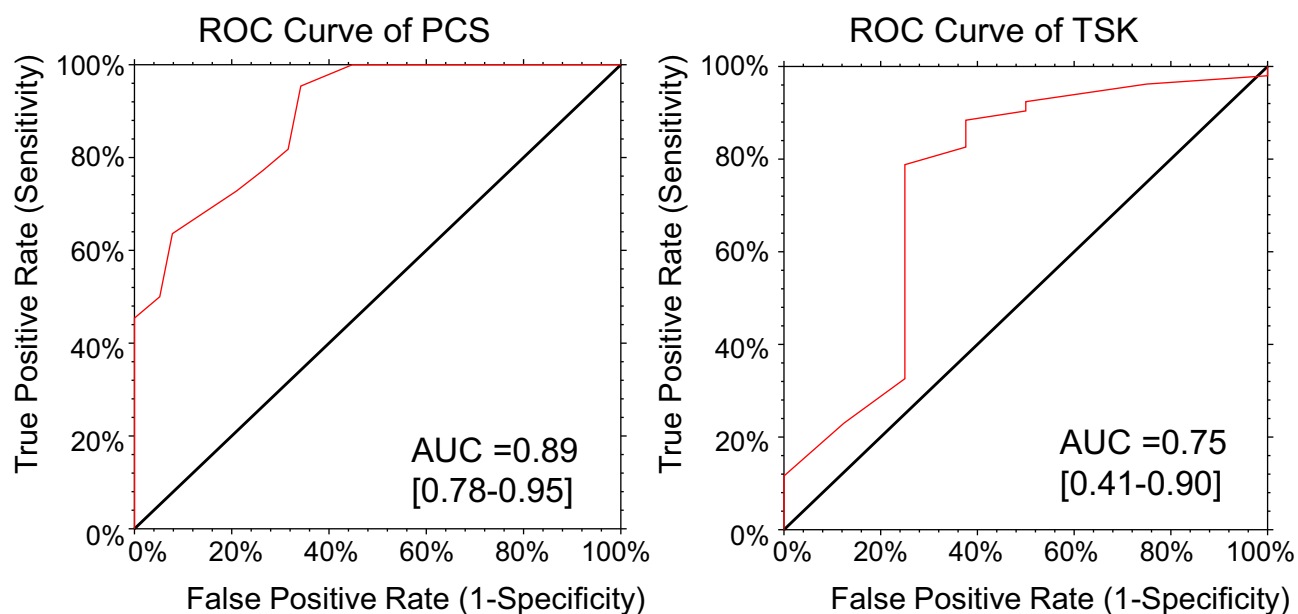
## Discussion

We developed short forms of the French-language PCS and TSK questionnaires that contain 5 and 6 items ([Supplementary Data 2](#)). We selected items from well-designed full-length questionnaires while keeping their structure and coherence. The Stanton et al method is complex but complete and has been extensively used by several authors.<sup>24,26</sup> Although other approaches heavily prioritize statistical methods, this approach gives greater importance to experts' opinions. The final choice of items was decided during a collegial debate during which experts had to consider results of the quantitative analyses and maintain the structure and coherence of the questionnaires. Because the experts were solicited individually and then during a collective debate, their final choice was not necessarily the same as their first choice.

The psychometric properties of the two short versions of the PROMs were satisfactory and MCIDs could be estimated. We hypothesized that the criterion validity would be slightly less good with the “test” than the “retest” short forms, which was confirmed by additional calculations (data not shown).

## PCS

Five of the original 13 items were selected. Internal consistency and reliability were comparable to those for the French long PCS version ( $\alpha = 0.87$  and  $ICC = 0.85$ , respectively)<sup>35</sup> and the English original version ( $\alpha = 0.87$  and  $ICC = 0.75$ , respectively). Criterion validity was excellent. We recommend setting the cutoff at 9/20 and the MCID = 2. There is no “official” score indicating a significant change in the questionnaire. An MCID of 6.71 was proposed by Suzuki et al<sup>52</sup> for patients with low back pain. This MCID represents about 12% of the total score, which is close to our MCID (about 10%). Several short versions of the PCS have been proposed.<sup>53–57</sup> Most gave priority to quantitative analysis.<sup>53,55,57</sup>

**Figure 4** Receiver Operating Characteristic (ROC) Curves For The Two Reduced Questionnaires.

**Abbreviations:** PCS, Pain Catastrophizing Scale; TSK, Tampa Scale for Kinesiophobia.

Darnall proposed a 3-item version but did not analyze the correlation with the original version. Walton et al<sup>56</sup> (4-item PCS) added a qualitative analysis to reduce the questionnaire as we did. However, it was a conceptual analysis to detect possible mismatch between conceptual theory and wording. Our qualitative approach was more patient-centered because the experts had to evaluate the items according to their clinical practice with CMSP patients. For this reason, we needed input from a large panel of specialists who work routinely with patients.

## TSK

Six of the 17 items were selected. The Cronbach  $\alpha$  was the same as for the French long TSK version ( $\alpha = 0.71$ )<sup>40</sup> and close to that for the English version of Vlaeyens et al ( $\alpha = 0.77$ ).<sup>8</sup> The reliability of the 6 items was moderate. We suggest a cutoff of 16/24 for men and 14/24 for women and to consider an MCID of 2 (6–24). There is no consensus regarding the MCID for TSK, but Monticone et al<sup>58</sup> proposed a value of 5.5 that corresponds to about 7% of the total score, which is close to our 8%. Several short versions exist<sup>59–67</sup> (TSK-13, TSK-12, TSK-11, TSK-7, TSK-6, TSK-5, TSK-4). All were developed using quantitative analyses. To our knowledge, our study is the first to consider the opinions of clinicians in reducing the questionnaire. The TSK-13, –12 and –11 were too long for our purpose. The TSK-6 is limited to patients with knee and hip osteoarthritis. The TSK-5 was developed from the TSK-11. The authors of the TSK-4 suggested that it more likely represents catastrophic thinking than fear of movement. Moreover, a further analysis of the TSK-4 with a spinal surgery population revealed insufficient internal consistency.<sup>68</sup>

The strength of our study was the high number of datasets used for the quantitative analysis as well as the approach used to reduce the questionnaires, based on both quantitative and qualitative approaches. Finally, because the criterion validity was satisfactory, we can compare short-form scores to the long-form scores.

The ability to assess a patient's perspective on his or her health is critical for clinical decision making, outcomes measurement and evaluation of rehabilitation program performance and quality.<sup>69</sup> In the case of a systematic and routine collection of PROMs in healthcare settings, short PROMs spare time, reduce patient and clinician burden, and thus enhance patient engagement, leading to more effective screening and evaluation of health services.<sup>70</sup> In the case of chronic pain, short forms of the PCS and TSK questionnaires can be used as repeated measures in longitudinal research to assess the effectiveness of psychological and pain management.

The reduced version of the two questionnaires allows more patients to benefit from this screening because they can be completed in less time. We tested the application of these shortened PROMs in clinical practice. The two short versions were distributed to 20 patients during a physiatrist consultation. For several patients, symptoms for kinesiophobia could not have been detected without these questionnaires, and a discussion about the results with the patient was possible. In clinical care, use of shortened versions of questionnaires can reduce the burden of patients as well as the administrative burden. Over time, the shortened version may be more appealing to use than the long version.

The two reduced PROMs can be used together or independently, depending on the clinical scenario. If used with an additional measure of pain severity/interference and depression/anxiety, they could assess the fear-avoidance model thoroughly.<sup>8,71</sup> They are complementary to the use of very short questionnaires such as the STarT Back<sup>72</sup> or the Örebro.<sup>73</sup> Indeed, they can be early screening tools for use in primary care settings by the general practitioner to detect patients with musculoskeletal pain at high risk of becoming chronic. The reduced versions of the PCS and TSK are rather intended for the physiatrist or the rheumatologist to assess in a second step the chronic pain of patients with CMSP. Finally, therapists who need further exploration of catastrophizing and fear of movement could use the long versions.

According to Putman et al, the translation of a short version arising from an already validated long version does not affect the psychometric properties.<sup>74</sup> A shortened version could be adapted in another language if the long version has already been validated in this language and the items are conserved. This method was used for the QuickDASH, all cross-cultural adaptations of the latter being derived from the English version.<sup>23,75</sup> The [Supplementary Data 3](#) includes the English, Spanish, Italian and Portuguese versions of the two reduced PROMs that could be used in future validation studies.

## Limitations

A weakness of the study was that all experts came from the same rehabilitation center, which could imply biased representativeness of the jury, especially because our procedure was preferentially based on the opinion of experts.

Moreover, the short questionnaires were developed with CMSP patient, mostly men, so we cannot assert that this selection of items would have been the same among another group of patients. Another limitation is that cutoffs were determined on the basis of 60 patients only and should be confirmed with a larger population. Finally, the MCIDs were determined with a distribution-based method and must be confirmed with an anchor-based method.

## Conclusions

The present study suggests that the F-PCS-5 and F-TSK-6 questionnaires are reliable and valid PROMs, suitable for assessing catastrophizing thinking and fear of movement of patient with chronic musculoskeletal pain. Their simplicity and quickness of use allows their implementation in outpatient consultation as well as in clinical settings. However, when the highest level of measurement precision is required, the long versions should still be used.

## Abbreviations

CMSP, Chronic Musculoskeletal Pain; PROMs, Patient-Reported Outcome Measures; PCS, Pain Catastrophizing Scale; TSK, Tampa Scale for Kinesiophobia; MCID, Minimal Clinically Important Difference; ICC, Intraclass Correlation Coefficient; SEM, Standard Error of Measurement; IQR, Interquartile Range; PCA, Principal Component Analysis.

## Data Sharing Statement

The datasets used during the current study are available from the corresponding author on reasonable request.

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## Disclosure

The authors report no conflicts of interest related to this work.

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