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The Dutch Central Sensitization Inventory (CSI): Factor Analysis, Discriminative Power and Test-Retest Reliability

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ABSTRACT

Objectives: A standardized assessment of central sensitization can be performed with the Central Sensitization Inventory (CSI), an English questionnaire consisting of 25 items relating to current health symptoms. The aim of this study was to translate the CSI into Dutch, to perform a factor analysis to reveal the underlying structure, examine its discriminative power, and test-retest reliability.

Methods: The CSI was first translated into Dutch. A factor analysis was conducted on CSI data of a large group of chronic pain patients (n=368). The ability to discriminate between chronic pain patients (n=188) and healthy controls (n=49) and the test-retest reliability was determined on chronic pain patients (n=36) and healthy controls (n=45) with a time interval of 3 weeks.

Results: The exploratory factor analysis resulted in a 4-factor model based on 20 items, representing the domains 'General disability and physical symptoms' (Cronbach's $\alpha = .80$), 'Higher central sensitivity' (Cronbach's $\alpha = .78$), 'Urological and dermatological symptoms' (Cronbach's $\alpha = .60$), and 'Emotional distress' (Cronbach's $\alpha = .80$). Furthermore, a parsimonious 2nd order factor model was found, where the factor 'General central sensitization' was underlying the four first order factors. Chronic pain patients scored significantly worse on all four factors. The test-retest reliability was excellent values in both chronic pain patients (ICC = .88) and healthy controls (ICC = .91).

Discussion: The original CSI was translated into Dutch and did not reveal any problems during data acquisition. The domains represented by the 4 factors may be useful in setting up specific patient profiles and treatment targets. To conclude, the Dutch CSI revealed 4 distinguishable domains, showed good internal consistency for the total score and 3 out of 4 domains, good discriminative power, and excellent test-retest reliability.

Keywords: Central Sensitization Inventory (CSI), Central Sensitization, Chronic Pain, Factor Analysis, Reliability

INTRODUCTION

Central sensitization (CS) is a neurophysiological state resulting in hyperexcitability in the central nervous system. According to Woolf [1], CS is “operationally defined as an amplification of neural signaling within the central nervous system that elicits pain hypersensitivity”. In clinical practice, CS manifests as pain hypersensitivity, particularly dynamic tactile allodynia, secondary punctate or pressure hyperalgesia, longer aftersensations, and enhanced temporal summation [2]. CS seems to be (part of) the explanation for pain in several clinically well-known diagnoses like fibromyalgia, chronic low back pain, osteoarthritis, temporomandibular disorders, chronic whiplash, and chronic patellar tendinopathy [1, 3-7]. Besides pain, more clinical features of CS, including fatigue, concentration difficulties, sleep disturbances, and non-refreshing sleep have been described in CS-related syndromes [8, 9].

Confirmation of the CS diagnosis, necessary to steer treatment, demands for standardized measuring in clinical practice. Physical assessment of CS is often conducted by Quantitative Sensory Testing [10]. A disadvantage is however the high cost of the corresponding system and therefore the reduced applicability in clinical practice. Furthermore, a gold standard in diagnosing is lacking. On the other hand, a more indirect measure to assess the signs and symptoms of CS has been presented recently by Mayer et al. [11]. They developed the Central Sensitization Inventory (CSI) to measure the overlapping symptom dimensions present in CS. It has been designed to identify the symptoms of CS and to alert healthcare professionals about the presenting symptoms apart from pain, which is often the patient's primary complaint. Following the publication of the CSI, Neblett et al. [12] presented CSI norm scores in a heterogeneous group of patients with pain syndromes, including fibromyalgia, chronic fatigue syndrome, and irritable bowel syndrome.

The development of the CSI has clearly added substantially to the assessment of CS in clinical practice. The initial validation studies supporting the clinimetric properties of the CSI to measure CS [11-13] underscore this notion. Still, more work is required, especially for allowing clinicians in countries where English is not the native language to use the CSI. Also, the items of the CSI were developed by a multidisciplinary team, including physicians (psychiatrists and orthopedic surgeons), rehabilitation specialists, physical therapists, clinical psychologists, health psychologists, and psychophysiological specialists, working with chronic pain patients. They formulated items related to somatic and emotional indices of sixteen central sensitization and central sensitivity syndromes [11], in which no further exploration or qualitative analysis was conducted. A reliability study was only performed in healthy, non-painful participants (students), including 2 time-points with approximately 5 days in between [11]. A factor analysis was conducted in a group of participants from the general population, a group of patients with chronic pain and a group of patients with chronic disabling occupational musculoskeletal disorders [11]. The reliability study showed high inter-item correlations, but the variability of the items was rather low considering that only healthy individuals participated in that study (8 items scored below 1, all items scored below 2) [11]. The results can therefore not be extrapolated to pain patients. Furthermore, the factor analysis was conducted without chronic pain- or central sensitivity syndrome patients [11]. The factor analysis resulted in a 4-factor solution and 3 items did not load sufficiently high on any factor and were therefore not included in the factor solution (item 1; unrefreshed in morning, item 5; diarrhea/constipation and item 14; skin problems). However, a 25-item-CSI was maintained in other studies [12, 13].

Believing in the goals and purpose of the CSI, we think that the development and current description of the CSI needs a replication study for clinical use in patients with chronic pain. By performing a factor analysis, the different domains within the CSI can be

identified. This will enable future studies to set up specific 'patient profiles' based on these domains. Furthermore, clinicians may be able to provide more specific treatments when patient groups can be distinguished through the CSI. To fulfill this need and to allow the use of the CSI in countries where the population has Dutch as the native language, a Dutch translation of the CSI part A and B was developed. Only CSI part A was subject of further analyses. The following research questions were formulated: 1) what is the optimal factor solution of the Dutch CSI; 2) what is the discriminative power, and; 3) what is the test-retest reliability in a chronic pain and healthy control population?

METHODS

Dutch translation of the CSI

The CSI was first translated into Dutch (*Supplemental document, Supplemental Digital Content 1, <http://links.lww.com/CJP/A319>*). Two native Dutch speaking authors from Belgium (FD en MM) and one native Dutch speaking author from The Netherlands (PvW) individually translated the original CSI into Dutch. All three translators were blinded of each other's translation. Afterwards, a consensus meeting was organized in which the differences were discussed. When all authors approved the final version of the translation, the Dutch version of the CSI was deemed to be appropriate. A final pre-testing did not reveal any difficulties in the use of the Dutch CSI by patients with chronic pain having Dutch as their native language.

Participants

Patients with several chronic pain disorders were included. They were only included if they suffered from chronic musculoskeletal pain for at least 3 months. Exclusion criteria were primary nociceptive or neuropathic pain. Diagnosing was done by a physician or physiotherapist in the following settings: (1) a primary care trans-disciplinary pain

management center in the Netherlands; (2) a primary care physiotherapy center in The Netherlands; (3) a multidisciplinary pain center from a university hospital center in Belgium; and (4) a primary care physiotherapy center in Belgium. A subset of the chronic pain population, together with a sample of healthy controls, was asked to fill out the CSI twice, with a time interval of three weeks. The patients for the test-retest analysis did not receive treatment or any intervention in the meantime. The healthy controls were recruited from the general population and were included when they reported no pain, were not diagnosed with any central sensitivity syndrome or chronic pain and no long-term pain complaints during the past 5 years. Informed consent was obtained from all the participating chronic pain and healthy subjects. The study was conducted according to the regulations of the medical ethical committee of the Ghent University.

Statistical analyses

Factor analysis

When validating a new questionnaire or translated version of an existing questionnaire, it is advised to first start a data reduction procedure by means of an exploratory factor analysis (EFA), which will look for latent constructs that underlie a scale. This should be followed by a confirmatory factor analysis (CFA), which is more hypothesis driven and uses hypotheses based on theory or on results from previous empirical research; in the present case it used the results of the EFA. A CFA is generally used to assess the construct validity and is by no means a method for data reduction. The procedures that we followed are in line with the recommendations by Floyd and Widaman [14].

First, the total sample was randomly split in two groups [14] by random assigning numbers between 0 and 1 to each case using SPSS software and assigning cases with numbers between 0-.50 to group 1 and .50-1 to group 2. To inspect if both groups differ on gender,

age, and total score in the CSI we used a χ^2 -test for the former and independent sample t-tests for the latter two possibly confounding variables.

Second, the first group was used in an ordinal (Likert scale from 0 to 4) EFA with oblique PROMAX rotation due to the probability of inter-correlated factors. The cut-off value for the factor loading was set at .40 [14]. The PROMAX rotated factor loadings were presented as well as the correlations between the factors. Correlations of .1 were considered small effect sizes, correlations of .3 moderate and correlations of .5 large [15]. Third, the results of the EFA were examined in the second group of patients using an ordinal confirmatory factor analysis (CFA) with polychoric correlations. The goodness-of-fit was evaluated with the following descriptive fit indices: (1) the Satorra-Bentler global goodness of fit, which takes the non-normality into account; (2) the root mean square error of approximation (RMSEA); (3) the comparative fit index (CFI); (4) the normed fit index (NFI); and (5) the non-normed fit index (NNFI).

The Satorra-Bentler χ^2 should yield p-values of $>.05$ indicating a good fit. The RMSEA should yield values $<.06$ indicating a good fit [16] and values $<.08$ are indicative of an acceptable fit [17]. For the CFI, NFI, and NNFI, values $>.95$ indicate a good fit [16].

In addition to examining the multi-factor structure found with the EFA, the possible presence of a single second order factor was examined, representing an underlying general CS factor which could explain the intercorrelations between the first order factors. Testing the possibility of replacing the first order factor model by a more parsimonious second order factor model was performed with a Likelihood Ratio test, which has a χ^2 distribution. All analyses were carried out using LISREL 8.80 [18].

Internal consistency

The Cronbach's alpha coefficients of the factors, the second order general CS factor, and the total score of the CSI were calculated as a measure of internal consistency of each domain. An alpha between .50 and .60 was considered poor, between .60 and .70 was considered acceptable, between .70 and .90 was considered good, and higher than .90, excellent [19, 20].

Comparison of patients with healthy controls

The discriminative power of the CSI was examined by comparing the group of patients used for the CFA with a group of healthy controls on each of the factors with an independent sample t-test when the two groups did not differ in age and gender, or ANCOVA when controlling for age and/or gender is warranted. Significant differences between the patient group and control group on each of the factors was indicative of the discriminative power of the questionnaire.

Reliability analysis

Intraclass correlation coefficients (ICC, model two-way random, type absolute agreement) were calculated for examining the test-retest reliability. A Bland-Altman plot was constructed in which the individual differences were plotted against the individual mean scores. Significance level was set at 5%.

RESULTS

Factor analysis

Four hundred and ten patients with chronic pain were evaluated with the CSI. Of those, 42 were excluded (in 30 patients the CSI had too many missing data and in 12 patients the age and/or gender was not retrievable). As a consequence, 368 patients were enrolled in this study and after the random division of the patients into two groups, group 1 consisted of 180 patients and group 2 consisted of 188 patients. The groups did not differ in gender, age, or total CSI score. (see Table 1.)

<<<<<Table 1. Demographic variables of the study sample. >>>>>

The exploratory factor analysis resulted in a 4-factor model where factor 1 consists of items 2, 6, 8, 9, 17, and 25, and is named 'General disability and physical symptoms'; items 4, 7, 10, 13, 18, 19, and 20 load on factor 2 which was named 'Higher central sensitivity'; factor 3 consists of items 11, 14, and 21, and is named 'Urological and dermatological symptoms'; and factor 4 consists of items 3, 12, 13, 15, 16, and 17, which is named 'Emotional distress'. Items 1, 5, 22, 23, and 24 do not load on any of the factors (i.e. factor loading <.40) and were dropped from the subsequent confirmatory factor analyses (see Table 2).

<<<<<Table 2. Factor loadings(primary loadings in bold) of the Ordinal Exploratory Factor Analysis with PROMAX rotation and the Confirmatory Factor Analysis of the Dutch CSI in chronic pain patients (n=368).>>>>>

The intercorrelations between the factors are presented in Table 3, in which all effect sizes of the correlations were between moderate and large, indicating that oblique PROMAX rotation was justified.

<<<<<Table 3. PROMAX factor correlations of the Dutch CSI in patients with chronic pain (n=180).>>>>>

All the factor loadings in the CFA are larger than .40 and statistically significant (Table 2). The fit indices in Table 4 show that even though the $SB\chi^2$ has a p-value <.05 indicating not a good fit, the RMSEA of .065 and the CFI, NFI, and NNFI are all >.95 indicating a good fit.

Comparing the 4-factor model with the 2nd order factor model with the Likelihood Ratio test, ($SB\chi^2$ 2nd order factor model- $SB\chi^2$ 4-factor model) resulted in a χ^2 difference of .68 with 2 degrees of freedom. The corresponding p-value is .71, indicating that the more parsimonious 2nd order factor model, where the factor general CS is underlying the four first order factors, explains the data well.

<<<<<Table 4. Fit indices for the CFA models of the Dutch CSI in patients with chronic pain (n=188).>>>>>

The internal consistency of factors 1, 2 and 4 are good, with Cronbach's alphas of respectively .80, .78, and .80. The Cronbach's alpha for factor 3 is considered poor with a value of .60.

The internal consistency of all 20 items in the CFA was excellent, with a Cronbach's alpha of .90, as well as the internal consistency of all 25 items of the CSI (Cronbach's alpha = .91)

Comparison of patients with healthy controls

The group of patients did not differ significantly on gender compared to the healthy control group ($\chi^2(2) = 3.03, p=.08$), but did differ significantly in age ($t(235)=2.61, p=.01$) with the healthy control group (mean age = 36.98 (14.79) being younger than the patient group (mean age = 42.66 (13.24)). Subsequent comparisons of the patient group and control group on the mean factor scores of the CSI were done with ANCOVAs controlling for age.

The results of the ANCOVAs showed that the patient group scored significantly worse on all four factors (see table 5), indicating a good discriminant power of the domains.

<<<<Table 5. Comparisons of patients (n=188) with healthy controls (n=49) on the four factors, controlling for age.>>>>

Reliability

A subgroup of 58 chronic pain patients were asked to fill out the CSI twice. These subjects were selected as a convenience sample from 2 participating centers. From 22 patients (36.2%) no retest data was available, which resulted in a total sample of 36 patients. From this sample, 32 subjects were female (88.9%). The mean age was 47.0 (± 13.5) years. The CSI mean total scores of the first and second assessment were, respectively, 55.2 (± 13.2) and 53.2 (± 11.2). The healthy control group consisted of 49 subjects, from 4 subjects (8.2%) no retest data was available. In the remaining total sample of 45 subjects, 31 were female

(53.4%) and the mean age was 37.2 ($\pm$ 14.7) years. The CSI mean total scores of the first and second assessment were 21.6 ($\pm$ 10.9) and 22.8 ($\pm$ 11.2) respectively.

The Bland-Altman plot (Figure 1) shows the difference in total scores against the mean total scores for both the chronic pain patients and healthy controls. The mean difference approached zero, indicating that no bias had occurred. In both the chronic pain patients and healthy controls, one outlier was shown outside the 95% CI band.

<<<<<Figure 1. Bland-Altman plot of the average of the first and second CSI total scores, plotted against the difference between the first and second CSI total scores.>>>>>

The ICC in the chronic pain group, based on the total scores of the first and second assessment, was .88 (ICC 2,1; 95% CI = .77 – .93; p < .001). An analysis of individual item scores revealed that 22 out of 25 items showed an ICC > .60 (range .60 – .89). ICC of items 1 (.10), 2 (.59), and 21 (.56) showed values < 0.60.

The total score ICC of the healthy controls was .91 (ICC 2,1; 95% CI = .85 – .95; p < .001). Based on individual items scores, 21 out of 25 items showed an ICC > .60 (range .62 – .95). ICC of items 1 (.49), 6 (.47), 9 (.54), and 19 (.51) showed an ICC < .60.

DISCUSSION

After translation into Dutch, a factor analysis was performed on a large group of chronic pain patients, which resulted in 4 distinguishable domains. Three of these 4 domains showed good internal consistency. The scores of a subset of chronic pain patients were compared with a sample of healthy controls, revealing a good discriminative power. Test-retest reliability was excellent when the CSI was administered twice in a chronic pain and healthy controls sample.

As a first step in analyzing the psychometric validation of the Dutch version of the CSI, the questionnaire was translated from English into Dutch and finalized in a consensus meeting including Dutch-speaking researchers from Belgium and The Netherlands. In our opinion, the translation into Dutch was appropriate, since the data collection did not reveal any confusion or problems mentioned by the participants.

The EFA yielded a 4-factor model. When comparing the categorization of items with the original analysis of Mayer et al. [11], the factors ‘General disability and physical symptoms’, ‘Urological and dermatological symptoms’, and ‘Emotional distress’ are similar factors identified in both datasets, although the item distribution over the factors differed. ‘General disability and physical symptoms’ shared 4 items (items 2, 6, 8, 9) with ‘Physical symptoms’ from the original article, whereas item 25 was added in the current analysis. This factor encompassed some questionable items in the original analysis (item 12, ‘Do not sleep well’; item 22; ‘Restless legs’), whereas in the current analysis all items seemed to involve general disability and physical symptoms. The second factor, from which 5 items (items 4, 7, 10, 19, 20) in the original study loaded on ‘Headache/jaw symptoms’, was named ‘Higher central sensitivity’ in the present study. Furthermore, items 13 (‘Difficulty concentrating’) and 18 (‘Tension neck and shoulder’) loaded sufficiently high on this factor in the current study. Notwithstanding the partial agreement between the item-inclusion of this factor in both studies, it better reflects higher CS in the current sample instead of only headache/jaw symptoms. ‘Urological and dermatological symptoms’ shared 2 items (items 11 and 21) with the factor ‘Urological symptoms’ from the original article. Item 25 (‘Pelvic pain’) loaded on this factor in the original article, which seems adequate, but did not load on this factor in the current analysis, where item 14 (‘Skin problems’) loaded on this factor. As item 14 is the only item referring to dermatological symptoms, it was decided to name this factor ‘Urological and dermatological symptoms’. The factor ‘emotional distress’ shared 5 items

(items 3, 13, 15, 16, 17) with the same factor from the original article. Item 12 ('Do not sleep well') loaded on this factor in the current analysis, as opposed to the original article, however including this item as an emotional symptom seems adequate.

Subsequently, a second-order factor analysis was performed with 20 items (items 1, 5, 22, 23, and 24 did not load sufficiently on any factor in the EFA). This resulted in a more parsimonious second-order factor model, where a second-order factor, referred to as "General Central Sensitization", is underlying the 4 first-order factors.

A total of 5 items (items 1, 5, 22, 23, 24) did not load sufficiently on any factor in the current factor analysis, whereas the same was demonstrated in the original article for items 1 and 5. A possible explanation for item 1 ('Unrefreshed in morning') may be the broad interpretation of this item. It is furthermore not a symptom that can be attributed specifically to CS alone. For item 5 ('Diarrhea/constipation') possibly the same explanation can be given, however, constipation, can be a side-effect of opioid-use rather than a direct effect of CS [21]. Since not every chronic pain patient uses the same medication or no medication at all, results on this item may be inconclusive.

This implies that a 20-item CSI remains and 5 items are not valuable to each of the domains. Even though in the original article [11] items 1, 5, and 14 did not load sufficiently on any factor in the factor analysis, these items remained in that study and subsequent studies [12, 13]. When working with the total score of the CSI, however, it is not a problem to implement these 5 items. For practical implications, we therefore think that it is desirable to continue the use of the 25-items CSI. Moreover, the demonstrated underlying factor structure, based on chronic pain patients in the current study, may be useful for clinicians and researchers when a more specific assessment of CS problems is preferred than just the CSI total score.

The comparability analyses per factor demonstrated that “General disability and physical symptoms” is the most characteristic factor for chronic pain patients. Patients’ scores differed most on this factor compared to healthy controls, whereas patients showed higher scores on the other 3 factors as well.

The internal consistency of factors 1, 2 and 4 was good, indicating that the three domains represented by these factors may be useful in setting up specific patient profiles for different CS populations. Following these profiles, clinicians may also be able to set up specific treatment targets. The internal consistency of factor 3 (Urological and dermatological symptoms) was poor. This factor also differentiated least between patients and healthy controls. With an excellent internal consistency of 20 items ($ICC = .90$), the total score of the CSI might also be useful in treating patients with CS. In an earlier study, a clinically relevant cutoff score was calculated at 40 [12], which might be a useful threshold in evaluating CS patients for the responsiveness of a treatment.

Both chronic pain patients and healthy controls filled out the CSI twice, with an interval of three weeks. The test-retest reliability showed excellent ICC values for both chronic pain patients ($ICC = .88$) and healthy controls ($ICC = .91$), which confirms that the Dutch CSI is a psychometrically sound questionnaire. This is in accordance with the findings of Mayer et al. [11], in which Pearson’s correlation ($r = .82$) was used. Pearson’s correlation is a common used measure in test-retest reliability assessment, however, it is more correct to use the ICC due to its sensitivity to any bias between or among measurement times [22]. Another difference with Mayer et al. [11] is the population and time interval for test-retest analyses. Their population consisted of only healthy controls in which the consistency of filling out the CSI twice, might be higher compared to chronic pain patients. Secondly, in the

current study a longer time interval (i.e. three weeks) was chosen, thereby reducing the likelihood of remembering the responses given during the first assessment.

Study limitations & strengths

The present work has both strengths and limitations. The multicenter nature, the large study sample and the use of appropriate statistical analyses are an important study strength. Also the present work builds on the pioneering work from Mayer and Neblett et al. [11-13] and examined several crucial aspects of validity in one study sample. Hence, the present study substantially extends the external validity of previous findings regarding the clinimetric properties of the CSI. The findings should, however, be interpreted in light of the study limitations, like the lack of back-translation of the Dutch CSI. Contrary, an important side-effect of a procedure that includes back-translation, is that the translation into the target language may be influenced by the fact that there will be a back-translation. This may result in rather artificial language and conflicts with the requirements of a sound translation, including change, adaptation and compromise [23]. A translation procedure without back-translation was therefore chosen. Moreover, the translation process included a consensus meeting with three Dutch-speaking authors from both Belgium and The Netherlands. This was important to control for the most typical national discrepancies between Belgium and The Netherlands.'

A second limitation is the limited number of patients participating in the second assessment in the test-retest reliability analysis with a dropout of 36.2%. This is higher than the common accepted 20% loss to follow-up [24] and therefore a possible validity threat. A possible explanation for this high rate is that this assessment was acquired via digital communication and that patients might be more likely to respond to a face-to-face assessment with a therapist/researcher.

Recommendations for further research

The population used for the current study is characterized as a common chronic pain group. Future studies with the Dutch CSI should include subpopulations of chronic pain patients (e.g. fibromyalgia or chronic low back pain) to investigate the discriminative ability of the Dutch CSI within different dominant pain pathologies. For instance, it seems warranted to examine the discriminative ability of the CSI between patients with dominant CS pain, nociceptive and neuropathic pain. Nijs et al. [25] already proposed a classification algorithm for the assessment of CS pain and to differentiate between neuropathic and nociceptive pain. The CSI was incorporated in this algorithm, which may be a useful tool for clinicians, especially due to the absence of a gold standard in assessing CS. Furthermore, Mayer et al. [11] already found that the CSI scores of patients with fibromyalgia were statistically distinguishable from patients with chronic widespread pain, chronic low back pain, and a healthy controls group. In light of these studies and the recently demonstrated cut-off score of 40 between patients with a central sensitivity syndrome and healthy subjects, it would be relevant for future studies to assess a clinical significant cut-off score between e.g. dominant CS pain, nociceptive and neuropathic pain. A receiver operating characteristic (ROC) analysis was therefore not included in the present study. The concurrent validity of the CSI with other questionnaires or assessments, including Quantitative Sensory testing and functional MRI [26], used with chronic pain patients to quantify the underlying mechanisms of CS, may furthermore be examined.

The originally described Part B of the CSI, not part of the current study, identifies other (previously) diagnosed disorders that are to a greater or lesser extent explained by CS. This part was not included in the analyses of the current study. In clinical practice however, this part may indicate an additional sign of CS when patients checked one or more boxes in part B, especially in combination with a high score on part A. The co-occurrence of

frequently unexplained chronic syndromes has been shown previously [27]. Also, the number of these disorders was positively correlated with the total score of the CSI part A [12]. It may be interesting for future studies with the Dutch CSI to investigate possible patterns within subpopulations of chronic pain patients and their associated disorders in part B.

Conclusion

In light of the study limitations, the results of the current study indicate that the Dutch version of the CSI is equivalent to the original version. Four distinguishable factors were identified, representing four domains of symptoms linked to CS. The domain 'General disability and physical symptoms' was most characteristic for the chronic pain patients. Furthermore, good discriminative power between chronic pain patients and healthy controls and excellent test-retest reliability in both groups was demonstrated.

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Table 1. Demographic variables of the study sample.

	Chronic pain patients n=368	Healthy controls n=49	EFA n=180	CFA n=188	Test statistic	p-value
Gender (% women)	72.0%	57.1%	73.89%	70.21%	$\chi^2(1)=.62$	.43
Age (SD)	42.67 (13.24)	36.98 (14.79)	42.68 (13.27)	42.66 (13.24)	t(366)=.01	.99
CSI total score (SD)	43.88 (17.67)	21.55 (10.92)	43.31 (18.14)	44.41 (17.24)	t(366)=.60	.55

Table 2. Factor loadings (primary loadings in bold) of the Ordinal Exploratory Factor

Analysis with PROMAX rotation and the Confirmatory Factor Analysis of the Dutch CSI in chronic pain patients (n=368).

Item no.		EFA n=180				Items not loading on factors	CFA* n=188			
		F1	F2	F3	F4		F1	F2	F3	F4
1	Unrefreshed in morning	.27	.21	-.23	.32	X				
2	Muscles stiff/achy	.64	.22	-.01	.04		.72			
3	Anxiety attacks	-.05	.18	.32	.52					.76
4	Grind/clench teeth	-.17	.41	.20	.02			.60		
5	Diarrhea/constipation	.23	.29	.34	-.02	X				
6	Need help with daily activity	.67	-.07	.13	.09		.64			
7	Sensitive to bright lights	.13	.54	.15	.01			.69		
8	Easily tired with physical activity	.71	-.15	.13	.38		.78			
9	Pain all over body	.66	.29	.06	-.01		.79			
10	Headaches	.04	.77	-.12	-.09			.64		
11	Bladder/urination pain	.07	-.02	.72	.03				.78	
12	Do not sleep well	.17	.20	-.22	.57					.53
13	Difficulty concentrating	.13	.46	-.12	.45					.69
14	Skin problems	-.03	.22	.44	.11				.59	
15	Stress makes symptoms	-.05	.28	.21	.50					.73

	worse									
16	Sad or depressed	-.03	-.15	.27	.83					.71
17	Low energy	.41	-.11	.19	.56					.68
18	Tension neck and shoulder	.14	.59	.01	.08			.68		
19	Pain in jaw	.25	.46	.28	-.09			.67		
20	Certain smells make dizzy	-.15	.41	.39	.04			.74		
21	Urinate frequently	.23	-.15	.64	-.06				.60	
22	Restless legs	.38	.30	.02	.06	X				
23	Poor memory	.17	.34	.08	.32	X				
24	Trauma as a child	-.03	.12	.37	.23	X				
25	Pelvic pain	.43	.14	.17	-.12			.54		

EFA = Exploratory Factor Analysis, CFA = Confirmatory Factor Analysis, F1 = General disability and physical symptoms, F2= Higher central sensitivity, F3 = Urological and dermatological symptoms, F4 = Emotional distress (anxiety and depression) * = the factor loadings of the four factor solution and the second order factor analysis are the same and only presented once in this table

Table 3. PROMAX factor correlations of the Dutch CSI in patients with chronic pain (n=180).

	Factor 1	Factor 2	Factor 3	Factor 4
Factor 1	-			
Factor 2	.53	-		
Factor 3	.39	.48	-	
Factor 4	.46	.55	.35	-

Table 4. Fit indices for the CFA models of the Dutch CSI in patients with chronic pain (n=188).

	4-factor model	2nd order factor model	
SB χ^2	(164)=294.07; P<.001	(166)=294.75; P<.001	
RMSEA	.065	.064	
CFI	.97	.98	
NFI	.95	.95	
NNFI	.97	.97	

Table 5. Comparisons of patients (n=188) with healthy controls (n=49) on the four factors, controlling for age.

	Patients Mean (SD)	Healthy controls Mean (SD)	F value	df	p-value
General disability and physical symptoms	2.26 (.84)	.69(.47)	147.68	234	<.001
Higher central sensitivity	1.56 (.84)	.80 (.51)	37.47	234	<.001
Urological and dermatological symptoms	1.31 (.91)	.86 (.62)	9.76	234	.002
Emotional distress	1.89 (.80)	1.11 (.61)	42.58	234	<.001

Figure 1