



Psychometric properties of the Turkish version of the fear avoidance components scale in patients with chronic pain related to musculoskeletal disorders

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Received: 18 October 2022 / Accepted: 7 May 2023

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Summary

Background The fear avoidance components scale (FACS) evaluates patients' cognitive, emotional and behavioral fear avoidance behavior. The aim of the study was to conduct the cross-cultural adaptation, reliability and validity of the Turkish version of the FACS.

Methods A prospective cross-sectional study was carried out with 208 patients (46.2 ± 11.4 years, 116 women, 92 men) diagnosed with chronic pain related to musculoskeletal disorders. Individuals were assessed with FACS, Tampa scale of kinesiophobia (TSK), Beck depression inventory (BDI), Oswestry disability index (ODI), numerical pain scale (NPS), and pain catastrophizing scale (PCS). A total of 70 patients completed the FACS for the second time 3 days later.

Results Internal consistency of the total score was excellent (Cronbach's alpha: 0.815). There was a strong correlation between FACS and TSK and PCS (r_1 0.555,

r_2 0.678, $p < 0.001$). In addition, the relationship between FACS and BDI and NPS was moderate in terms of construct validity (r_1 0.357, r_2 0.391, $p < 0.001$). FACS had a two-factor structure, as expected. The test-retest reliability of the FACS was acceptable to excellent (ICC = 0.526–0.971).

Conclusion The Turkish version of FACS is a valid and reliable questionnaire for patients with chronic pain related to musculoskeletal disorders. The FACS provides a further advantage over identical questionnaires by evaluating cognitive, behavioral and emotional fear avoidance components.

Keywords Factor analysis · Fear of pain · Reliability · Internal consistency · Validity

Introduction

In the recent past, pain was addressed and evaluated independently of nonphysical conditions, including past sensory experience, sensory dimension, genetic difference, and anxiety. Over time, there have been many developments in resolving pain mechanisms [1, 2]. The fear-avoidance model is one of the most influential models describing the psychological factors of pain, as defined in 1983 [3, 4]. Vlaeyen et al. developed an updated fear-avoidance model, including cognitive behavioral components, in 1995 [5]. The central concept of fear-avoidance behavior is to avoid the action due to the fear of pain. There are two different responses to the fear of pain: confrontation and avoidance. While a decrease in fear is observed over time with confrontation, avoidance behavior creates a phobic situation and causes the fear to be maintained and intensified [6].

Pain-related fear-avoidance is a common problem that affects many patients with painful medical conditions. As a result of fear and avoidance behaviors,

Availability of data and material All data generated or analyzed during this study are included in this published article.

Supplementary Information The online version of this article (<https://doi.org/10.1007/s00508-023-02224-1>) contains supplementary material, which is available to authorized users.

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fear-related situations such as hypersensitivity, disability and lack of physical activity might appear [6, 7]. Increasing pain or the fear of reappearance of pain causes a limitation of physical activity. As a result, it causes more disability, creating a vicious circle and prolonging the treatment process. Evaluating a pain-related disability requires an assessment of fear-avoidance behavior in terms of pain [4, 6, 8]. As the clinical significance of the relationship between fear-avoidance and disability has attracted significant attention, many questionnaires have been developed to measure this psychosomatic parameter [9]. Neblett et al. developed the fear avoidance components scale (FACS). This patient-reported tool addresses critical issues not previously considered in questionnaires related to fear avoidance. The FACS evaluates the components of fear-avoidance behavior, including cognitive, emotional and behavioral aspects, from different perspectives on a single scale and eliminates the deficiencies encountered in other fear-avoidance scales [10, 11].

The FACS includes the most recent components of the fear-avoidance model, which were not considered in previously developed questionnaires. It aims to comprehensively evaluate cognitive, behavioral and emotional components of the fear-avoidance model in patients with chronic pain [11]. The FACS has 20 items on a 6-point Likert scale ranging from 0 “strongly disagree” to 5 “strongly agree”. The total score of the FACS ranges from 0 to 100. One of the other unique features of the FACS is five cut-off points, which provide more comprehensive clinical implications for clinicians. These norm values are classified as subclinical (0–20), mild (21–40), medium (41–60), severe (61–80), and highly severe (81–100) [10].

The FACS have been validated for the Spanish, Serbian and Gujarati (Indian) versions [12–14]. The standardized questionnaires should be cross-culturally adapted for the native tongue of the patients by considering the principles of international guidelines [15, 16]. In addition, the psychometric properties of a scale should be evaluated in the relevant case groups [17]. Adaptation and analysis of FACS according to the parameters of the consensus-based standards for the selection of health measurement instruments (COSMIN) guidelines would provide the validity and reliability of the scale [18]. To our knowledge, FACS has not been translated into Turkish, and its psychometric properties have not been analyzed so far. The aim of the study was to conduct the cross-cultural adaptation, reliability and validity of the Turkish version of the FACS.

Methods

Translation and adaptation process

Permission was received from the original proprietor, Randy Neblett, before translating and adapting the questionnaire. After obtaining permission, the cross-sectional study was carried out in two stages. First of all, English-Turkish translation and cross-cultural adaptation were carried out according to the recommendations in the World Health Organization (WHO) and International Test Commission (ITC) guidelines in order to ensure the conceptual equivalence of all test items and, at the same time preserve their cultural linguistic qualities appropriate to Turkish [15, 16]. Two different translators accomplished two independent English-Turkish translations, and two Turkish versions of FACS were formed. One of the translators was informed about the scope of the scale. As the international translation guidelines specifically state that “familiarity with the concepts and terms of health and disability should be essential in translations”, we aimed for one translator to address the translation within the scope of health terminology and not only focus on grammar. After the discussion between the two translators, a single version of FACS was obtained. In the next stage, FACS was evaluated by four physiotherapists to provide expert opinion in terms of content intelligibility, content equivalence, content relevance and representation. After the expert opinion, two blind and independent Turkish translators who did not know the original document completed a backward Turkish-English translation, and a compromise was reached. Back translation and the original version of the questionnaire were compared with the original version and approved by the native English-speaking questionnaire owner, Randy Neblett. The final version of the scale was evaluated with a pilot application in 20 subjects. After passing all the described stages, the final version of the scale was created (Appendix 1).

Sample size estimation

Simple random sampling was preferred as the case selection method. Based on the sample size method of 10 times the number of items recommended by Terwee et al. for questionnaire-based psychometric studies, the minimum required case was determined as 200 [17]. For test-retest reliability, at least 69 cases were required based on the following parameters: minimum acceptable reliability 0.60 (H_0), expected reliability 0.80 (H_1), significance level 0.05, power 90% and 5% drop-out rate [19, 20].

Study design

A cross-sectional and prospective study was performed at Bursa City Hospital. Marmara University

Faculty of Medicine Clinical Research Ethics Committee approved the study (No: 09.2020.823). Verbal and written information was given to individuals who met the study criteria before the evaluations, and their consent was obtained by signing an informed consent form.

Participants

The inclusion criteria were: (1) having chronic pain related to the musculoskeletal system for at least

3 months, (2) individuals between the ages of 18–70 years old, (3) being able to communicate in Turkish and (4) volunteering to participate in the research. The exclusion criteria were: (1) having undergone a surgical operation in the last 6 months, (2) individuals with pain after fracture, (3) patients with severe neurological and psychiatric diseases, (4) having a malignant condition, (5) having an acute infection.

A total of 208 patients (46.2 ± 11.4 years, 116 women, 92 men) diagnosed with chronic pain related to musculoskeletal disorders were enrolled in the study. Besides, 70 people were included in the test-retest assessment. The demographic and physical characteristics of the patients are presented in Table 1. The clinical characteristics are given in Table 2.

Table 1 The demographic characteristics of the patients

<i>n</i> :208	Total
Age (years, mean \pm SD)	46.2 \pm 11.4
Body mass index (kg/m ²)	28.9 \pm 10.0
Gender (n, %)	
Women	116 (55.8)
Men	92 (44.2)
Education (n, %)	
Primary school	74 (35.6)
Middle school	31 (14.9)
High school	56 (26.9)
University or higher degree	47 (22.6)
Marital status (n, %)	
Married	171 (82.2)
Single	33 (17.8)
Employment status (n, %)	
Active working	105 (50.5)
Unemployed	23 (11.1)
Retired	35 (16.8)
Housewife	45 (21.6)
SD standard deviation, <i>n</i> number of patients	

Table 2 The clinical characteristics of the patients

<i>n</i> :208	Total
Pain duration (months, mean \pm SD)	12.0 \pm 15.5
Diagnosis (n, %)	
Lumbar disc herniation	76 (36.5)
Cervical disc herniation	33 (15.9)
Osteoarthritis	20 (9.6)
Rotator cuff disease	41 (19.7)
Impingement syndrome	16 (7.7)
Adhesive capsulitis	14 (6.7)
Meniscal injury	6 (2.9)
Anterior cruciate ligament injury	2 (1.0)
Pain location (n, %)	
Low back	76 (36.5)
Neck	33 (15.9)
Knee	28 (13.9)
Shoulder	71 (34.1)
Have you received physical therapy? (n, %)	
Yes	67 (32.2)
No	141 (67.8)
SD standard deviation, <i>n</i> number of patients	

Data collection

Conditions such as region of pain, diagnosis, and duration were recorded. Individuals were assessed face to face by a single physiotherapist. Patients were assessed with FACS, Tampa scale of kinesiophobia (TSK), Beck depression inventory (BDI), Oswestry disability index (ODI), numerical pain scale (NPS), and pain catastrophizing scale (PCS). FACS was re-applied to 70 individuals to analyze test-retest reliability.

Fear avoidance components scale (FACS): The FACS aims to comprehensively assess the cognitive, behavioral and emotional components of fear avoidance in patients with painful medical conditions. FACS includes 20 separate items scored between 0 (“strongly disagree”) and 5 (“strongly agree”) with a total possible score of 100. The FACS consists of two sections: “general fear avoidance” (items 1–14, Sect. 1) and “types of activities that are avoided” (items of 15–20, Sect. 2). Five cut-off levels have been established to help the clinical interpretation of fear-avoidance behavior in FACS. Ease of interpretation is provided by targeting equal score intervals between each cut-off severity level [10].

Tampa scale for kinesiophobia (TSK): The TSK consists of 17 questions, including work-related activities, injury/re-injury, and fear-avoidance parameters. This scale aims to measure the fear of injury with movement. The Turkish version of the questionnaire was validated by Tunca-Yilmaz et al. in 2011 [5, 21].

Beck depression inventory (BDI): The BDI consists of 21 items in total. Each item is scored in the range of 0–3 points to measure the intensity of depressive symptoms [22]. Hisli conducted a Turkish validity and reliability study of BDI in 1988 [23].

Oswestry disability index (ODI): The ODI is used to evaluate disability in patients with low back pain. Yakut et al. conducted a reliability and validity study of the ODI. It consists of 10 items measuring the

severity of pain, personal care, lifting, walking, sitting, standing, social life, sleep, sexual activity, travel and pain level. Each item is scored between 0–5 points. As the total score increases, the level of disability also increases. The highest score that can be obtained as a result of the evaluation is 50 points. The total score of the ODI is interpreted as “strong disability” between 31–50 points, “moderate disability” between 11–30 points, and “mild disability” between 1–10 points [24].

Numerical pain scale (NPS): The NPS is a scale for assessing the severity of pain. Patients are asked to evaluate their pain by scoring 0–10 points (0: I have no pain, 10: the most severe pain). It has been demonstrated that the scale is valid and reliable for measuring pain intensity in patients with chronic pain [25].

Pain catastrophizing scale (PCS): The PCS aims to measure how people catastrophize their exaggerated and negative mental responses to the painful experience they have or anticipate. The PCS consists of 13 items, and each item scores the pain catastrophizing as none=0, mild=1, moderate=2, major=3 and always=4. A high total score indicates a high level of catastrophizing the pain [26]. The validity and reliability study of the Turkish version of the scale was conducted by Uğurlu et al. [27].

Statistical analysis

Data analysis

SPSS for Windows v25.0 (SPSS Inc, Chicago, IL, USA) was operated for statistical analysis. Data were presented as mean and standard deviation (SD) and number, percent (*n*, %). Kolmogorov-Smirnov or Shapiro Wilk test were calculated check the normality of the data. The significance level was accepted as 0.05.

Analysis plan

Internal consistency and test-retest reliability were analyzed to determine reliability. Cronbach's alpha (α) value was calculated for internal consistency analysis. Alpha values between 0.70 and 0.95 indicate an acceptable internal consistency [17]. Test-retest results were calculated by Pearson correlation analysis to determine the changeover status of the data obtained from the scale against time. The test-retest results of the items were evaluated using the intraclass correlation coefficient (ICC). An $ICC \geq 0.8$ demonstrates excellent reproducibility [28].

The construct validity of FACS was analyzed using the Pearson correlation coefficient (*r*). The total score of FACS was compared with TSK, BDS, ODI, NPS, and PCS. The correlation between the questionnaire scores was considered strong if the coefficient was higher than 0.50, moderate if the value was be-

tween 0.50 and 0.35, and weak if the value was less than 0.35 [29].

Exploratory factor analysis (principal component analysis with varimax rotation) was calculated to explore the factor structure of the FACS by identifying the scale's factor structure. Kaiser-Meyer-Olkin (KMO) test was performed to investigate the power of the partial correlation. Bartlett's test of sphericity (BTS) was used to compare the correlation matrix to the identity matrix [30].

Results

Reliability

Cronbach's alpha coefficient values of FACS (Sect. 1), FACS (Sect. 2), and FACS (total score) were found to be 0.828, 0.649 and 0.815, respectively. The Cronbach's alpha of the FACS (total score and Sect. 1) and item-scale correlations were within the acceptable ranges ($0.70 > \alpha > 0.95$).

The test-retest reliability of the FACS (Sect. 1), FACS (Sect. 2), and FACS (total score) were 0.854, 0.849 and 0.809, respectively. The test-retest reliability of the FACS (total score, Sects. 1 and 2) was excellent ($ICC > 0.80$). Test-retest reliability of the FACS items were ranged between 0.526 and 0.971 (Table 3).

Table 3 The internal consistency and the test-retest reliability of the FACS

	Item-scale correlations ^a	Intraclass correlation coefficient ^b
FACS-1	0.818	0.953
FACS-2	0.803	0.960
FACS-3	0.800	0.939
FACS-4	0.800	0.963
FACS-5	0.806	0.807
FACS-6	0.813	0.679
FACS-7	0.806	0.971
FACS-8	0.792	0.724
FACS-9	0.800	0.942
FACS-10	0.803	0.914
FACS-11	0.803	0.917
FACS-12	0.816	0.526
FACS-13	0.802	0.810
FACS-14	0.806	0.818
FACS-15	0.815	0.910
FACS-16	0.810	0.918
FACS-17	0.816	0.923
FACS-18	0.809	0.848
FACS-19	0.818	0.949
FACS-20	0.810	0.758

FACS fear avoidance components scale
^a internal consistency
^b test-retest reliability

Table 4 Correlation between TSK, PCS, BDI, NPS and ODI with FACS

n:208	TSK	PCS	BDI	NPS	ODI
FACS	0.555**	0.678**	0.357**	0.391**	0.475**
FACS (Sect. 1)	0.572**	0.700**	0.368**	0.396**	0.450**
FACS (Sect. 2)	0.201**	0.278**	0.180**	0.184**	0.276*

FACS fear avoidance components scale, TSK Tampa scale of kinesiphobia, BDI Beck depression inventory, ODI Oswestry disability index, NPS numerical pain scale, PCS pain catastrophizing scale
*: $p < 0.05$, **: $p < 0.001$

Validity

FACS (total score and Sect. 1) was strongly correlated with TSK and PCS ($r > 0.50$, $p < 0.001$) and moderately related with BDI, NPS and ODI ($0.35 < r < 0.50$, $p < 0.001$). There was a weak correlation between FACS (Sect. 2) with PCS, NPS, BDI, and ODI was 0.278, 0.180, 0.276, and 0.276, respectively (Table 4).

There was a strong correlation ($r = 0.924$, $p < 0.001$) between the total score of the FACS and FACS (first section). Besides, there was a high correlation ($r = 0.620$, $p < 0.001$) between the FACS total score and FACS (second section). The correlation value between the subsections of the questionnaire was weak ($r = 0.289$, $p < 0.05$).

As the FACS has two sections (“general fear avoidance: items 1–14” and “types of activities avoided:

Table 5 Factor loadings of the FACS

n:208	Factor 1 (general fear avoidance)	Factor 2 (types of activities avoided)	A priori hypothesis
FACS-8	0.783	–	General fear avoidance
FACS-3	0.728	–	General fear avoidance
FACS-10	0.718	–	General fear avoidance
FACS-9	0.656	–	General fear avoidance
FACS-7	0.652	–	General fear avoidance
FACS-4	0.642	–	General fear avoidance
FACS-11	0.629	–	General fear avoidance
FACS-14	0.561	–	General fear avoidance
FACS-2	0.489	0.223	General fear avoidance
FACS-13	0.455	0.255	General fear avoidance
FACS-6	0.397	–	General fear avoidance
FACS-5	0.371	0.256	General fear avoidance
FACS-18	–	0.683	Types of activities avoided
FACS-16	–	0.658	Types of activities avoided
FACS-17	–	0.612	Types of activities avoided
FACS-19	–	0.596	Types of activities avoided
FACS-20	–	0.596	Types of activities avoided
FACS-15	–	0.456	Types of activities avoided
FACS-12 ^a	–	0.291	General fear avoidance
FACS-1 ^a	–	0.182	General fear avoidance

n number of patients, FACS fear avoidance components scale
^a items not conforming to the a priori hypothesis, Note: factors loading less than 0.15 were excluded from the table

items 15–20”), the results of the factor analysis were expected to have two factors. According to our hypothesis, items 1–14 of the Turkish version of the FACS were expected to load on factor 1 (general fear avoidance) and items 15–20 on factor 2 (types of activities avoided). The KMO was found to be 0.785, demonstrating an adequate power of the partial correlation. The BTS result was statistically significant ($p < 0.001$) and suitable for factor analysis.

The factor loadings ranged between 0.18 and 0.78, with 2 factors a priori. All items loaded to the relevant factor, except items 1 and 12. Four factors with eigenvalues above one were found, although as two factors were below the 10% variance value [31], it was decided that the scale consisted of 2 factors. The 2 scale factors illustrate 40.74% of the total variance. The first factor defines 28.13% of the total variance; the second factor depicts 12.60% of the total variance. Factor 1 explains 28.139% of the total variance; on the other hand, factor 2 explains 12.609% of the total variance. In the cumulative total, it was determined that both factors explained 40.749% of the total variance (Table 5).

Discussion

The present study aimed to psychometrically evaluate the validity and reliability of FACS in patients with chronic pain due to musculoskeletal system problems. The Turkish version of FACS was found to be a valid and reliable questionnaire for patients with chronic pain. The FACS provides a further advantage over identical questionnaires by evaluating cognitive, behavioral and emotional fear-avoidance components.

Internal consistency

The Spanish version showed a high internal consistency for FACS (Sect. 1) (Cronbach's alpha = 0.902) and for FACS (Sect. 2) (Cronbach's alpha = 0.808) [31]. In the Serbian version, internal consistency was found high for FACS (Sect. 1) (Cronbach's alpha = 0.904) and FACS (Sect. 2) (Cronbach's alpha = 0.880) [13]. In the Gujarati version, internal consistency of FACS (Sect. 1) (Cronbach's alpha = 0.800), FACS (Sect. 2) (Cronbach's alpha = 0.670), and total FACS (Cronbach's alpha = 0.835) [14]. The original English version of the FACS also showed a high internal consistency (Cronbach's alpha = 0.92); however, the two factors were not evaluated separately [10]. In our study, FACS (Sect. 1) (Cronbach's alpha = 0.829) was found to be highly reliable, FACS (Sect. 2) (Cronbach's alpha = 0.647) was found to be moderately reliable, and the reliability coefficient of the total scale (Cronbach's alpha = 0.815), was found to be highly reliable. Section 1 has higher reliability because it has more items than Sect. 2. In addition, factor 1 contains more general items on fear avoidance, while factor 2 contains more activity-based specific items.

Test-retest reliability

The test-retest reliability of the FACS was excellent in our study (r and $ICC > 0.80$). In the original English version, unlike our study, test-retest was performed both in the non-patient sample and in patients with chronic pain with musculoskeletal problems. In comparison, test-retest reliability was calculated in a sample of 87 healthy patients ($r = 0.94$, $p < 0.01$), and it was analyzed in a sample of 131 patients with chronic pain ($r = 0.90$, $p < 0.01$) [10]. The FACS-Serbian total score-based ICC value was 0.928. In addition, the ICC value of Sects. 1 and 2 was 0.922 and 0.847, respectively [13]. In the Gujarati (Indian) version, 150 patients-based test-retest reliability value of the scale was found as 0.923 [14]. In the Spanish version, the test-retest reliability analysis results were not included [31]. Although these results are similar to our results, higher results were found in other studies. These results are thought to originate from cultural structure, education level, patient population, sample size, and translation procedures.

Construct validity

The Turkish FACS showed a satisfactory construct validity. In the Spanish version, the construct validity of the central sensitization inventory was analyzed with FACS. A moderate correlation value was found between FACS and the central sensitization inventory. The reason for the lack of a high correlation coefficient value between FACS and the central sensitization inventory has been shown to be that the central sensitization inventory does not directly measure fear avoidance [31]. A high level of positive correlation was found between FACS and all parameters, including PCS, ODI, and BDI, in the Serbian version of FACS [13]. The Gujarati version found a high correlation with the fear avoidance beliefs scale [14]. These results show parallelism with our study.

Factor analysis

The developers of the scale, Neblett et al. revealed that FACS has a 2-factor structure [10]. In our study, the factor analysis results supported the development study. In the original English version, the first factor loading explained as 39.7%, the second factor 11.6%, and the total variance 51.54%. The distribution of the factor loads of the items provided the factor load of the 1st item was not high, as in our study. Therefore, we think that item 1 could be excluded [11]. The 2-factor structure (48.75% of the total variance) appeared from the factor analysis of the Spanish version of the FACS, which is in line with our results. In addition, the factor load of the 12th item was found to be as low as 0.195. As a result of the analysis performed in our study, similarly, the factor load of the 12th item was found to be low. We think that item 12 could also be

removed [12, 31]. In the validity analysis of the Serbian version of the FACS, confirmatory factor analysis was performed, unlike in other studies, and the fit indices showed an acceptable fit: $\chi^2 = 592.91$, $p < 0.001$, Root Mean Square Error of Approximation (RMSEA) = 0.088, and Comparative Fit Index (CFI) = 0.96 [13]. Construct validity was not evaluated by factor analysis in the study conducted in Gujarati [14].

Some limitations of the study should be mentioned. First, in order to reveal the results of the exploratory factor analysis (two-factor structure) of FACS more clearly, the result of confirmatory factor analysis would be more effective. Secondly, it may be valuable to carry out further psychometric work on the COSMIN tool's core parameters, such as responsiveness and measurement error [18, 32]. Finally, the validity of the severity cut-off levels of FACS can be evaluated in future studies.

Conclusion

The Turkish version of FACS is a valid and reliable questionnaire for patients with chronic pain related to musculoskeletal disorders. The FACS provides a further advantage over identical questionnaires by evaluating cognitive, behavioral and emotional fear-avoidance components. In addition, the presence of five severity cut-off levels defined for clinical interpretation in FACS distinguishes it from other pain-related fear-avoidance measurement tools in the literature as a useful and essential measurement tool to predict post-treatment study results.

Funding The authors certify that no funding has been received for this study and/or preparation of this manuscript.

Declarations

Conflict of interest K. Turan, Z. Sarı and F. Özden declare that they have no competing interests.

Ethical standards The permission for the translation for the Turkish version of the fear avoidance components scale (FACS) was acquired from the developers of the original questionnaire. The study was carried out in accordance with the ethical principles and the Helsinki Declaration. Informed consent of the patients were obtained. The study protocol was approved by the ethics committee of Marmara University (no: 09.2020.823).

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