Original Article

The reliability and validity of The Turkish version of Multidimensional Fatigue Inventory-20 for the evaluation of different dimensions of fatigue in patients with fibromyalgia

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ABSTRACT

Objectives: In this study, we aimed to evaluate the validity and reliability of the Multidimensional Fatigue Inventory-20 (MFI-20) for Turkish patients with fibromyalgia (FM).

Patients and methods: Between February 2011 and September 2011, a total of 120 female patients (mean age 45±9.1 years; range, 20 to 60 years) admitted to our outpatient clinic with extensive pain and fatigue and diagnosed with FM according to 1990 and 2010 American College of Rheumatology criteria were included in this study. The MFI-20 was translated according to forward-backward translation procedure. For the test-retest reliability, the patients re-filled out the scale 48 hours after the first application. Structural validity was evaluated with confirmatory factor analysis (CFA). Reliability was assessed by internal consistency with Cronbach alpha and test-retest reliability was assessed by intra-class correlation coefficient (ICC). For convergent validity, Spearman rho correlation coefficient was used for relevance analysis with the Fatigue Impact Scale (FIS), visual analog scale (VAS)-pain, VAS-fatigue, and Short Form-36 (SF-36) questionnaires.

Results: The total Cronbach alpha coefficient was found to be 0.92 (range, 0.78 to 0.93). The CFA showed good structural validity and revealed five dimensions. The ICC coefficient was found to be 0.934. All correlation coefficients between the MFI and FIS were calculated as above 0.80, indicating a strong relationship.

Conclusion: The results of this study show that the Turkish version of the MFI-20 has a high internal consistency and reasonable construct validity. It is a valid and reliable measurement of the assessment of fatigue in patients with FM multidimensionality.

Keywords: Fibromyalgia, multidimensional fatigue inventory, reliability, validity.

Fibromyalgia (FM) syndrome is typically seen in young or middle-aged females with persistent common pain, fatigue, disrupted unrefreshing sleep, and cognitive difficulties, often accompanied by multiple other unexplained symptoms, anxiety and/or depression, and functional impairment of daily living activities.[1] Besides pain, fatigue appears to be a major limitation for patients with FM. It has been shown to be associated with decreased working capacity, limited physical performance,[2] pain intensity and the symptoms of depression.[3] It has been also suggested that fatigue in FM should be evaluated in all clinical and in daily clinical practice.[4-6]

There are many factors which influence fatigue such as physiological, psychological, social, and personal factors. Therefore, the assessment of its subjective and multidimensional nature is complicated.[7-9] The traditional way of evaluation of fatigue is to use one-dimensional visual analog scale (VAS). However, as clinicians gain more insight

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into the subject, they realize that fatigue is related to several aspects of life. Hence, valid and feasible fatigue instruments which adequately measure fatigue are needed in the healthcare setting.

Smets et al.[8] developed the Multidimensional Fatigue Inventory-20 (MFI-20) that consists of five independent subscales of fatigue including general fatigue, physical fatigue, mental fatigue, reduced motivation, and reduced activity. The MFI has been used in several descriptive and experimental studies of many different diseases, including FM.[10-14]

In the literature, there are few multidimensional fatigue assessment tools available in Turkish. In the present study, we aimed to evaluate the validity and reliability of the MFI-20 in the Turkish patients with FM.

PATIENTS AND METHODS

Between February 2011 and September 2011, a total of 120 female patients (mean age 45±9.1 years; range, 20 to 60 years) admitted to our outpatient clinic with extensive bodily pain and fatigue and diagnosed with FM according to 1990 and 2010 American College of Rheumatology criteria were included in this study. Patients with anemia (hemoglobin <10 g/dL), cardiopulmonary, infectious or hematological diseases, and neurological conditions, any deformities affecting lower limbs, and those who were previously diagnosed with major depression, any anxiety disorders, who scored above 17 using Beck Depression Scale or who were under treatment for any psychiatric disorders were excluded from this study. None of the participants were on medical treatment for FM at the time of the study. The patients were not allowed to consume any drugs, except paracetamol (maximum dose of 1000 mg/day) for pain during the study. A written informed consent was obtained from each patient. The study protocol was approved by the Şişli Hamidiye Etfal Training and Research Hospital Ethics Committee (Date: 27/03/2012, No: 21). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Study protocol

The criteria of Guillemin et al.[15] were followed for the translation process. The original MFI-20 questionnaire was translated into Turkish by two different bilingual translators whose native language was Turkish. After delivering each version of the forward translations, the two translators reviewed and discussed any inconsistencies in the text. Once they

agreed upon a synthesis of the two versions as part of the back-translation process, the Turkish version was translated into English by two English speaking translators who are fluent in Turkish. One of the forward translators and one of the back translators were aware of the purpose of the translation process and the concepts involved in the questionnaires, while the other translators were blinded to the process.

In the first phase of the pilot testing process, the two translators who were aware of the purpose of the process and the other two research fellows reevaluated the translated Turkish version and the original English version to achieve conceptual equivalence. The non-occurring factors between the translated and back translated scales were resolved by consensus. Afterwards, a pre-final Turkish version of MFI-20 was created.

This pre-final version was tested in a small pilot study group which consisted of 20 patients. The patients were asked to report whether they experienced any difficulties in understanding the statements or answering the questionnaire. Few patients made any comments. Therefore, no major changes were thought to be necessary.

At the first visit, all patients in the study were evaluated for the demographic data and the outcome measures of the study. Data including age, occupation, educational background, concomitant diseases, and ongoing medication were collected. All patients were tested for the outcome measures at the first visit.

For the test-retest reliability assessment, the patients filled out the MFI-20 questionnaire on the first visit. To avoid a significant change in clinical or mental status, patients filled out the form for the second time (second visit) 48 hours later. All of the patients were able to complete the questionnaire by themselves (no intervention needed). The time needed to complete the questionnaire was approximately 10 min for each patient.

Scales

The MFI-20 was developed by a Dutch group in 1995 to assess the concept of fatigue multidimensionality.[8] It was first evaluated in a group of patients with chronic fatigue syndrome, cancer patients receiving radiotherapy, and a healthy control group (e.g., psychology and medical students, army recruits).

The MFI covers domains of general fatigue (e.g., I feel tired), physical fatigue (e.g., I feel only able

to do a little physically), reduced activity (e.g., I feel very active), motivation (e.g., I dread having to do things), and mental fatigue (e.g., my thoughts easily get distracted). The individual filling out the scale is expected to specify the extent to which the statements relates to him/her on a five-point scale, ranging from "Yes, that is true" to "No, that is not true."[8] Every subscale consists of two positive (formulated as: 1= yes 5 = no) and two negative (formulated as: 1= no 5= yes) statements. Subscale items were summed to produce scores for general fatigue, physical fatigue, reduced activity, reduced motivation, and mental fatigue. The scores range from 4 to 20 for each scale, and higher scores represent more severe fatigue.

The authors of the original article recommended that general fatigue score should be used as an indicator of overall fatigue instead of the total score.[8] Cut-off values were undetermined by the original publishers, although some authors reported that the patients with a MFI-total score of >60 could be diagnosed with severe fatigue.[16]

To date, the MFI-20 has been used in large number of studies involving patients with rheumatoid arthritis, FM syndrome, ankylosing spondylitis, primary Sjögren's syndrome, multiple sclerosis, schizophrenia, and systemic lupus erythematosus.[13,14,17] The results of a recently published study have indicated that the specific questions of the questionnaire help patients to differentiate between the different aspects of fatigue, providing professionals valuable information. The relationship between the subscales of MFI-20 and the other health-related aspects suggests that it is possible to identify the different dimensions of fatigue in FM using the MFI.[18]

The fatigue impact scale (FIS) is a multidimensional fatigue scale which evaluates the impact of fatigue on cognitive, physical, and psychosocial domains of daily life. It was first developed in 1994 by a Canadian group.[19] The FIS examines the patients' perceptions of the functional limitations that fatigue has caused over the past month.[19] It consists of 40 items, each of which is scored 0 (no problem) to 4 (extreme problem), providing a continuous scale of 0 to 160. It is composed of three subscales that describe how fatigue impacts upon cognitive (10 items), physical (10 items), and psychosocial functioning (20 items). The scale was used in many different group of patients in many languages[20] and has shown to be valid in the Turkish population.[21]

The VAS is a typically a 100-mm line with the end points anchored by two statements, representing extreme ends of a single condition's continuum. For fatigue, it is mostly labelled as from "no fatigue" to "total exhaustion". The individual marks the line at the appropriate point that best reflects the status of fatigue. The distance from the left-hand anchor to the respondent's mark on the VAS is measured by a ruler and recorded in millimeters. The VAS scales have their theoretical foundations in psychological theories of response to sensory stimuli and have a long history in psychometric research to measure subjective states.

The VAS is also valid and reliable measure of chronic pain intensity.[22] For pain, it is mostly labelled as from "no pain" to "the worst possible pain".

The short form-36 (SF-36) is a multidimensional, patient-reported outcome measure containing subscales for eight domains to assess general health status. The original SF-36 was constructed by the RAND Corp. in 1992 as a part of the Medical Outcome Study. [23] It consists of eight scaled scores, which are the weighted sums of the questions in their section. Each scale is directly transformed into a 0-100 scale on the assumption that each question carries equal weight and the lower the score is, the more the disability is. The eight domains are vitality (energy), physical functioning, bodily pain, general health perceptions, and physical role functioning, emotional role functioning, social role functioning, and mental health. It is the most commonly used generic scale in evaluating the quality of life all over the world. The SF-36 questionnaire is a valid and reliable Turkish version.[24]

Reliability

The reliability of the MFI was assessed by internal consistency with Cronbach alpha (α) and test-retest reliability by intra-class correlation coefficient (ICC). The internal consistency of the MFI, which measures the degree to which items that make up the total score are all measuring the same underlying attribute, was assessed using Cronbach α value. A value of ≥0.7 is acceptable.[25] In practice, values ≥0.50 may be taken into consideration.[26] Test-retest reliability of the MFI was evaluated using the ICC. Values of ≥0.7 are considered good.[27]

Structural validity

The structural validity of the Turkish version of the MFI-20 was evaluated by confirmatory factor analysis (CFA). The fitness of model with the data was evaluated by computing the absolute and comparative fit indices (CFI) and a value greater than 0.9 for CFI was considered as the good fit.[28] Absolute fit indices

TABLE 1		
Demographic and clinical characteristics of patients (n=120)		
	n	%
None	16	12.9
Elementary	71	59.3
High school	22	19.4
University	11	9.4
Single	11	8.6
Married	104	87.4
Widow	5	4.0
Housewife	87	73.1
Teacher	6	4.1
Nurse	9	7.1
Public services	8	7.0
Cleaning-lady	6	4.2
Cook	2	2.1
Student	1	1.3
Architect	1	1.2

TABLE 2	
The reliability analysis of Turkish MFI-20	
Subscales of MFI-20	Cronbach's alpha values
General fatigue	0.83
Physical fatigue	0.93
Mental fatigue	0.87
Reduced activity	0.93
Reduced motivation	0.94
Total	0.92

MFI-20: Multidimensional fatigue inventory-20.

include chi-square goodness-of-fit, root mean squared residual (RMR) (values less than 0.05), and root mean square error of approximation (RMSEA) (values less than 0.08).[28] A good model fit was ascertained with a lower chi-square value at a *p* value of >0.05.

Convergent validity

The MFI-20 is a self-assessment questionnaire which intends to assess fatigue severity multidimensionality. In other words, it estimates the impact of fatigue in different aspects of patients' lives. Thus, it is expected that the questionnaire and its subgroups would be significantly associated with fatigue severity as assessed by the FIS, and all of its subgroups such as pain and fatigue severity according to the VAS (0-100 cm). Since the MFI is designed to point out the effect of

TABLE 3				
The factorial validity of Turkish MFI-20				
	Standardized estimate values	Measurement error variances	Relationship between the factors	
GF-item-1	0.79	0.60	GF→ RA	-0.33
GF-item-5	0.71	0.58	GF→ PF	0.27
GF-item-12	0.80	0.59	GF→ MF	0.31
GF-item-16	0.71	0.47	GF→ RM	-0.32
RA-item-3	0.71	0.45	RA→ PF	-0.28
RA-item-6	0.76	0.52	RA→ MF	0.37
RA-item-10	0.70	0.41	RA→ RM	0.46
RA-item-17	0.70	0.42	PF→ MF	0.28
PF-item-2	0.84	0.61	PF→ RM	-0.27
PF-item-8	0.90	0.63	MF→ RM	0.37
PF-item-14	0.76	0.59		
PF-item-20	0.72	0.43		
MF-item-7	0.70	0.38		
MF-item-11	0.70	0.40		
MF-item-13	0.80	0.60		
MF-item-19	0.84	0.63		
RM-item-4	0.71	0.57		
RM-item-9	0.72	0.59		
RM-item-15	0.70	0.56		
RM-item-18	0.84	0.61		

MFI-20: Multidimensional fatigue inventory-20; GF: General fatigue; RA: Reduced activity; PF: Physical fatigue; MF: Mental fatigue; RM: Reduced motivation.

fatigue in a person's life in many aspects, it would be related to SF-36 (particularly the vitality subscale), which evaluates different aspects of the quality of life. The Spearman rank correlation coefficient was used to assess construct validity. The relationships were interpreted as being moderately correlated, when r was >0.60 and slightly correlated when r was 0.30-0.60.[29]

Statistical analysis

Statistical analysis was performed using the PASW version 17.0 software (SPSS Inc., Chicago, IL, USA). Descriptive data were expressed in mean ± standard deviation (SD), median (min-max), or number and frequency. A *p* value of <0.05 was considered statistically significant.

RESULTS

Of all patients included in the study, 73.1% were housewives and 87.4% were married. The patients were usually able to fill out the questionnaires without any help. Demographic characteristics of the patients are shown in Table 1.

There were no statistically significant differences between the two completions of the questionnaires. The test-retest reliability of the questionnaire was high (r=0.934). Internal consistency of the factors (overall Cronbach α coefficient: 0.92) were higher than 0.70. The Cronbach α coefficients of each of five subscales of the MFI-20 ranged from 0.78 to 0.93. Accordingly,

no item in the MFI-20 was excluded from the scale (Table 2).

To assess the structural validity of the Turkish MFI, CFA was performed. The results of CFA indicated that there was a significant standardized estimate of all the items on their respective factors (>0.70). These standardized estimates ranged from 0.71 to 0.81 for general fatigue; 0.70 to 0.76 for physical fatigue; 0.72 to 0.84 for mental fatigue; 0.70 to 0.84 for reduced activity; and 0.70 to 0.84 for reduced motivation. Additionally, this model showed a good fitting to the data. The relationship among the subscales were non-significant, indicating that all the five factors were different from each other. The values of minimum value of the discrepancy divided by its degree of freedom (CMIN/DF) were below 3 (2.118), comparative fit index was over 0.9 (0.91), and RMSEA was below 0.08 (0.061). This model supported five-factor model of the Turkish version of MFI-20 (Table 3).

The correlation coefficients between the Turkish MFI-20 (overall and subscales) and VAS-fatigue, FIS, SF-36 subdimensions were significant (p<0.001) (Table 4).

DISCUSSION

Fatigue seems to be one of the most disabling symptoms for patients with FM; therefore, a clinical evaluation of a FM patient should certainly involve a detailed fatigue evaluation tool. The results of the

TABLE 4
Correlation coefficients between MFI, VAS, FIS, and SF-36 subscales

	General fatigue		Physical fatigue		Mental fatigue		Reduced activity		Reduced motivation	
	p	rho	*p*	rho	*p*	rho	*p*	rho	*p*	rho
VAS-pain	0.008	0.313	NS	NS	NS	NS	NS	NS	NS	NS
VAS-fatigue	0.000	0.548	0.005	0.333	0.000	0.581	0.004	0.300	NS	NS
FIS-cognitive	0.001	0.391	0.001	0.389	0.000	0.590	0.001	0.370	0.000	0.580
FIS-physical	0.000	0.529	0.000	0.607	0.000	0.433	0.000	0.501	0.004	0.344
FIS-social	0.000	0.706	0.002	0.428	0.025	0.267	0.002	0.310	0.025	0.267
SF-36 PF	0.000	0.507	0.000	-0.490	NS	NS	0.000	0.480	NS	NS
SF-36 RP	0.000	0.458	0.000	-0.543	0.003	-0.348	0.001	0.542	0.003	0.348
SF-36 BP	0.000	0.427	0.042	-0.244	NS	NS	0.002	0.321	NS	NS
SF-36 GH	0.000	0.620	0.002	-0.356	NS	NS	0.003	0.356	NS	NS
SF-36 VT	0.000	0.635	0.000	-0.460	NS	NS	0.000	0.470	0.000	0.279
SF-36 SF	0.000	0.594	0.000	-0.504	NS	NS	0.000	0.603	NS	NS
SF-36 RE	0.000	0.433	0.000	-0.490	NS	NS	0.000	0.390	NS	NS
SF-36 MH	0.000	0.520	0.000	-0.582	0.003	-0.247	0.000	0.578	NS	NS

MFI: Multidimensional fatigue inventory; VAS: Visual analog scale; FIS: Fatigue impact scale; SF-36: Short Form-36; p<0.05 indicates statistical significance; rho: Spearman correlation coefficients; NS: Non-significant; PF: Physical function; RP: Limitation in physical role; BP: Body pain; GH: General health; VT: Vitality; SF: Social function; RE: Limitation in emotional role; MH: Mental health.

Outcome Measures in Rheumatology Clinical Trials (OMERACT 7) conference indicated fatigue as an entity that should be evaluated both in clinical studies and daily practice in FM patients.[5]

Since the term fatigue refers to a complex multidimensional concept that includes physical, social, motivational and psychological aspects, clinicians need to evaluate patients with multidimensional fatigue evaluation tools. The MFI is a widely used and easy-to-administer questionnaire to estimate the effect of fatigue in different aspects of a patient's life. It is a brief measure of fatigue that captures relevant dimensions of fatigue severity. It has been successfully used in FM and appears to be a good marker of illness across a broad range of medical conditions.[8] While not as brief as a single-item VAS (as is commonly used), the MFI correlates well with these measures, but offers greater clarification of the type of fatigue being experienced and offers better assessment precision than single-item measures. Considering all these arguments, we attempted to develop a validated Turkish version of the MFI in the present study. Psychometric evaluations of the MFI-20 for Swedish, Brazilian, French, Canadian, Chinese, German, Spanish, and Polish populations are available in the literature.[30-38] In the original article, the authors recommended that English version should be used in cultural adaptation studies.[8]

While developing a valid Turkish version of MFI, we used a forward-backward translation method and instead of literal translation, we aimed to retain the original meanings of the statements. The Turkish version of the MFI was found to be an easy-to-understand tool by the Turkish patients and there was no need to make considerable changes in any of the items during this process. We found that the Turkish MFI has high test-retest reliability with an ICC coefficient of 0.934. Our results are consistent with the results of the French, Canadian, and Dutch studies reporting ICC coefficients as 0.83, 0.69, and 0.80, respectively.[32,33,36] The Cronbach α values of our five-factored model also indicated that our version had a good internal consistency (range, 0.83 to 0.94). Previous studies investigating the psychometric properties of MFI-20 also reported that they had a good internal consistency.[31-39]

The results of CFA as structural validity assessment support five-factor model. As a result of this analysis, factor loadings of all items were found to be over 0.7; therefore, there was no need to exclude any items from the scale. In addition, values of CFI supported

a good model fit to the data. The results of the factor analysis confirmed the multidimensionality of the MFI-20 inventory in the Turkish population. General fatigue, physical fatigue, mental fatigue, reduced activity, and reduced motivation subscales could be distinguished in the Turkish version. There are many studies available in the literature about the cross-cultural adaptation of MFI-20.[30-41] Our results were similar to the Hindi version of MFI-20.[41] They also found five-factor model as a result of CFA in the Indian cancer population.[41] However, this was not the case for Polish, French, Chinese, and Brazilian versions where physical and general aspects of fatigue were unable to be separated. The Chinese version has also reported a three-factored solution, named as spiritual fatigue, mental fatigue, and physical fatigue.[31] The Polish version of MFI-20 demonstrated a good structure validity and revealed three dimensions including physical fatigue, mental fatigue, and reduced motivation.[42] The authors reported that their patients tended to aggregate the physical fatigue, general fatigue, and reduced activity dimensions under one subscale. The French study, held in a population of cancer patients, indicated that there were four dimensions in the French MFI including general fatigue (a composition of general and physical fatigue), mental fatigue, reduced activity, and reduced motivation.[33] An additional assessment held by Smets et al.[43] showed that a four-factored model was equally acceptable as the five-factored original model and these two subscales (general and physical fatigue) might be combined in a revised version of the questionnaire. The results of American and Brazilian studies are also in line with these arguments.[37,38] Supportingly, Hagelin et al.[35] claimed that it was difficult to distinguish between the general and physical fatigue subscales (particularly for patients); that is why, they might be combined.

As in other chronic diseases, FM is at the forefront of mental fatigue, as well as physical fatigue. As a result, patients feel reduced activity and reduced motivation in daily work. By means of good structural validity of the MFI-20 Turkish version, fatigue in FM has been supported to be multidimensional.

In the present study, there were strong correlations between the Turkish MFI-20 and FIS, pain and fatigue severity as assessed by VAS and SF-36 questionnaires. The correlation analyses revealed significant correlations between general fatigue subscale of MFI-20 and social function subscale of FIS (p<0.01), mental fatigue subscale of MFI-20 and cognitive function subscale (p<0.01) and physical fatigue subscale of

MFI-20 and physical function subscale of FIS, as expected (p<0.01). General fatigue subscale was also found to be significantly correlated with the general health and social function subscales of SF-36, and VAS pain (p<0.01). Mental fatigue subscale of MFI-20 was correlated with the mental health subscale of SF-36 (p<0.01). These results indicate that the Turkish MFI is a valid questionnaire to assess severity of fatigue multidimensionality (measured by FIS-a multidimensional valid fatigue assessment scale) and its effects on the quality of life (measured by SF-36 questionnaire under eight dimensions).

Similar to our results, an American study reported that physical fatigue subscale was significantly correlated with the SF-36 physical function and physical role functioning subscales.[37] Mental fatigue subscale was also correlated with the mental health and vitality subscales and reduced motivation. Reduced activity subscales were correlated with social functioning and vitality subscales. In another study, Gentile et al.[33] and Smets et al.[43] assessed the correlation between VAS and MFI-20 general fatigue subscale and reported a strong correlation between them. The latter authors also showed a strong correlation between all subscales of MFI and the Rotterdam Symptom Scale which questions one's functioning in daily activities.[43] The Chinese study also revealed that spiritual fatigue and mental fatigue subscales of their version was significantly correlated with the emotional function and cognitive function subscales of the European Organisation for the Research and Treatment of Cancer-Quality of Life questionnaires.[31] The results of these qualified studies in the literature indicate that MFI is a well-known and valid questionnaire for the evaluation of fatigue in various dimensions.

Although this study contributes significantly to the literature for the Turkish version of MFI-20, there is only one limitation. Further studies are needed to evaluate responsiveness.

In conclusion, our study results show that the five-factored model of the Turkish version of MFI-20 has an adequate internal consistency and construct validity with a high test-retest reliability. Therefore, the Turkish version of the MFI-20 is a reliable and valid instrument which can be used in the multidimensional assessment of fatigue in Turkish FM patients.

Declaration of conflicting interests
The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

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