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ORIGINAL ARTICLE

Validity and reliability of the Tampa Kinesiophobia-Fatigue Scale in patients with multiple sclerosis

Burak Kese[1] · **Yeliz Salcı**[2] · **Öznur Tunca Yılmaz**[2]

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Abstract

Background Kinesiophobia can be a barrier for physical activity in patients with multiple sclerosis (PwMS) and it can develop as a result of fear and avoidance reactions due to fatigue. However, there is no valid and reliable scale available to assess kinesiophobia due to fatigue in PwMS.

Aims To investigate the test–retest reliability and construct validity of the Tampa Scale of Kinesiophobia-Fatigue (TSK-F) in PwMS.

Methods Eighty-seven PwMS were included in the study. In addition to TSK-F, the following measurements were used for construct validity: Expanded Disability Status Scale (EDSS), Fatigue Severity Scale (FSS), Fatigue Impact Scale (FIS), 6-Minute Walking Test (6MWT), International Physical Activity Questionnaire (IPAQ), Beck Depression Inventory (BDI), Multiple Sclerosis Quality of Life Scale-54 (MSQoL-54). TSK-F was administered twice (3–7 days apart) to measure test–retest reliability.

Results The intraclass correlation coefficient of the TSK-F was 0.867. It had a weak correlation with the IPAQ and EDSS, moderate correlation with the MSQoL-54 and 6MWT, and strong correlation with the BDI, FSS, and FIS (respectively, rho − 0.345, rho 0.365, rho 0.544, rho − 0.449, rho 0.690, rho 0.602, rho 0.650). The scale had good performance to discriminate the disease severity with the area under the curve (AUC) value 0.730.

Conclusions TSK-F has excellent reliability and moderate-to-good validity in evaluating kinesiophobia and the scale may be a useful outcome measurement for assessment of kinesiophobia due to fatigue in PwMS.

Keywords Fatigue · Kinesiophobia · Multiple sclerosis · Tampa Scale of Kinesiophobia-Fatigue

Introduction

Multiple sclerosis (MS) is a central nervous system disease that is characterized by inflammation, demyelination, and axon damage, and presents with various clinical signs and symptoms [1]. Among all symptoms, fatigue is the most common symptom that affects the functional capacity, daily life, mood, and quality of life. Fatigue is described by patients with MS (PwMS) as one of the worst problems [2]. In addition, fatigue also causes economic problems such as unemployment by affecting the work life and professional performance of the patients [3, 4].

Fear of movement, also known as kinesiophobia, can be caused by fatigue as well as pain [5–7]. False assumptions, such that physical activity leads to more pain or fatigue, result in further restriction of physical activity by increasing fear and symptoms [8–10]. Previous studies have shown that PwMS are significantly less physically active after diagnosis than before [11]. Physical activity-induced fatigue reveals fear and avoidance reactions against physical activity in PwMS. As a result of increasing level of fear, patients reduce physical activity levels, and fatigue increases paradoxically and causes a decrease in the quality of life [12]. Although kinesiophobia is an important underlying factor of fatigue that should not to be ignored, few studies have been conducted on this subject [13].

TSK is a scale developed to measure fear of movement in patients with pain. The scale consists of 17 Likert scale

✉ Burak Kese
keseburak@gmail.com

[1] Osmaneli Vocational School, Department of Patient Care at Home, Bilecik Seyh Edebali University, Bilecik, Turkey

[2] Faculty of Physiotherapy and Rehabilitation, Department of Neurologic Physiotherapy and Rehabilitation, Hacettepe University, Ankara, Turkey

items. The normal score range is 17–68. The TSK-F was created by replacing the expression of pain with fatigue by Silver et al. for patients with chronic fatigue syndrome (CFS), and the validity and reliability of this scale were found to be high in patients with CFS [7]. Although there are many scales in the literature that evaluate fatigue, there is no valid and reliable scale evaluating kinesiophobia due to fatigue in PwMS.

We think that valid and reliable measures to evaluate kinesiophobia should be available in order to increase the number of studies on MS. The aim of our study was to investigate the validity and the test–retest reliability of the TSK-F in PwMS.

Method

This study included 87 MS patients who were followed at Istanbul University Faculty of Çapa Medicine. The study protocol was approved by the clinical research ethics committee of Üsküdar University, Istanbul (61,351,342-/2019–08). The study conformed to the principles of the Declaration of Helsinki. The volunteering patients participated in the study after signing a written informed consent form.

Participants

The sample size was determined to be 85, at least 5 times the number of items in the scale [14]. Adults who were diagnosed with MS by a neurologist, had an EDSS score ≤ 4, did not have an exacerbation and changed medication within the last three months, could walk without support, and had a mini mental test score of ≥ 24 were included in the study. The exclusion criteria were having any orthopedic, systemic, or additional neurological problems that would prevent physical activity, and an additional disease that caused pain or fatigue. A total of 105 patients were included in the initial evaluation and 87 patients met the inclusion criteria.

Measures

Procedure

Data on demographic information (age, gender, and body mass index) and clinical course of the disease (time of the last exacerbation, duration of disease, comorbid diseases, and treatments) were recorded. In the first evaluation of the patients, the TSK-F, EDSS, FSS, FIS, IPAQ, BDI, 6MWT, and MSQoL-54 scales were used. Patients were asked to fill out the TSK-F scale again 3–7 days later for test–retest reliability. This time interval was chosen to minimize the questionnaire recall and to reduce the likelihood of any significant changes in the disease course of the subjects from the first measurement to the next. All the scales were completed in face-to-face interviews at the Istanbul University Faculty of Çapa Medicine.

TSK-F The TSK, developed but not published by Miller, Kori, and Todd in 1991, was published by Vlaeyen et al. in 1995 [5]. The TSK, whose Turkish validity and reliability studies were made by Yılmaz et al. in 2011, is a 17-item scale developed to measure fear of motion/re-injury [15]. Silver et al. modified the TSK by changing the word "pain" with the word "fatigue" to be used in patients with chronic fatigue syndrome. In our study, the word "pain" in the Turkish version of the TSK was replaced with the word "fatigue" with permission from Kori Shashidhar, one of the authors who developed the original version of the scale. The normal score range is between 17 and 68.

EDSS EDSS is one of the most widely used scales to assess the disability status in PwMS [16]. The scale consists of twenty digits and has a score range from 0 to 10. Higher scores indicate more severe disability.

FSS Turkish validity and reliability study of the FSS was conducted by Armutlu et al. It has been used in many studies to evaluate fatigue in PwMS [17]. The scale consists of 9 items in total, and each item is scored between 1 and 7 (from strongly disagree to totally agree). Higher scores indicate an increase in the level of fatigue.

FIS FIS, whose validity and reliability were established by Armutlu et al., is a scale consisting of 40 four-point Likert scale items. It has been reported that the FIS is one of the most common and ideal scales for evaluating fatigue in PwMS [18–20]. Higher scores indicate an increase in the level of fatigue.

IPAQ IPAQ was used for determining physical activity level of the patients. It has been validated in the general population and PwMS. Turkish validity and reliability of this questionnaire were established by Saglam et al. [21]. The total physical activity level is determined in this scale by questioning the duration and number of days of severe, moderate, and low-intensity activities, and the time spent by walking and sitting during the previous 7 days.

6MWT The 6-Minute Walk Test is one of the practical and widely used field tests used to determine the functional capacity of the individual, for which the necessary materials can be found easily. The test was made according to the guidelines published by the American Thoracic Society (ATS) [22]. Heart rate and oxygen saturation measurements were made with a pulse oximeter. Fatigue levels of the subjects were determined with the Modified Borg Scale.

Walking distance was recorded. The test was terminated in cases of dyspnea, leg cramps, staggering, excessive sweating, and fatigue.

MSQoL-54 MSQoL-54 is a quality of life scale specific to MS. The questionnaire includes physical health, general health, mental health, health-related concern, cognitive function, sex life, etc. It consists of 12 sections and contains 54 Likert-type items in total [23, 24]. The MSQoL-54 was completed by the patients. It was accepted that patients had a better quality of life as they approached to the score of 100.

BDI BDI created by Beck et al. is a 21-item scale measuring vegetative, emotional, cognitive, and motivational signs and symptoms that occur during depression. The lowest score in the scale is zero, and the highest is 63. The Turkish reliability and validity of the scale were established by Hisli in 1989 [25, 26].

Statistical analysis

In the data analysis of the study, the Statistical Package for Social Sciences (SPSS) version 21.0 (SPSS Inc. Chicago, IL, USA) statistical program was used. Descriptive statistics (number-percentage, mean, standard deviation, minimum–maximum values) were used for demographic and clinical data. Reliability and validity analyses were performed according to the Cosmin checklist [27].

Test–retest reliability

The reliability of the TSK-F scale was analyzed with the test–retest method at a 95% confidence based on single measure, absolute agreement, 2-way mixed-effects model. The intraclass correlation coefficient (ICC) value was used for reliability analyses. The Cronbach α coefficient was used for the internal consistency analysis of the scale.

In addition, the Standard Error of Measurement (SEM) and the minimum detectable change (MDC) were computed. SD is the pooled standard deviation. As a result of the statistical analysis, MDC (95% level of confidence) of the scale was calculated using the following formulas:

$$SEM = SD\sqrt{1 - ICC}$$

$$MDC = SEM \times 1.96 \times \sqrt{2}$$

Construct validity

Construct validity was investigated by analyzing the relationship between disease-related scales and TSK-F. It was made by using the non-parametric Spearman's correlation coefficient since the TSK-F is a Likert-type scale [28]. IPAQ, EDSS, MSQOL-54, BDI, FSS, and FIS were selected as related scales. Correlation coefficients of 0–0.20 were interpreted as insignificant, 0.21–0.40 weak, 0.41–0.60 moderate, 0.61–0.80 strong, and 0.81–1.0 very strong [29].

Sensitivity and specificity

The discriminatory power (sensitivity and specificity) of the TSK-F scale was obtained by the receiver operator characteristics curve (ROC) analysis. As a result of the statistical analysis, the cutoff value of the scale was calculated. In all analyses, the significance level was determined as 0.05, and it was stated that there was a statistically significant difference when $p < 0.05$, and there was no significant difference when $p > 0.05$.

Results

Sociodemographic and clinical features

The mean age of the patients was 36.52 ± 10.93 years. The demographic and clinical characteristics of the patients are shown in Table 1. According to the 6MWT, which was performed to determine the functional capacities of the patients, mean distance was 460.18 ± 100.23 m. The pre- and post-test difference in heart rate, fatigue level, and oxygen saturation was, respectively, 26.14 ± 16.11 beats/min; 1.85 ± 0.88; and $0.24\% \pm 1.53\%$.

Reliability of the TSK-F

The mean initial test score of the TSK-F was 41.48 ± 6.27, and the retest mean score was 41.19 ± 6.77. The ICC was 0.867 based on the test–retest reliability analysis. It was determined that there was a statistically significant, high level correlation between the two test scores ($p < 0.05$).

Internal consistency of the TSK-F

While the lower and upper scores that can be obtained in the TSK-F, which consists of 17 items, were 17 and 68, the lower and upper scores in our study were 23 and 62. The mean value of the TSK-F was 41.50 ± 6.26. Total internal consistency coefficient of the scale (Cronbach α) was 0.708. The ICC values are shown in Table 2.

In the study, it was found that, if any of the items of the TSK-F scale is deleted, there was no significant change in Cronbach alpha.

In our study, the standard error measurement (SEM) and the minimum detectable change (MDC) value were

Table 1 Demographic and clinical characteristics of patients

Sociodemographic characteristics	Number (*N*)	Percent (%)
Gender	87	100
Female	71	81.6
Male	16	18.4
Distribution of patients according to EDSS scores	87	100
1	21	24.1
1.5	15	17.2
2	18	20.7
2.5	8	9.2
3	15	17.2
3.5	7	8
4	3	3.4
Distribution of patients by age group	87	100
18–29 (years)	29	33.1
30–44 (years)	38	43.3
45–64 (years)	20	23.6
Clinical features (*N* = 87)	**Mean ± SD**	
Age (years)	36.52 ± 10.93	
BMI (kg\m^2)	25.51 ± 4.72	
MS duration (years)	7.60 ± 5.38	

SD standard deviation

calculated at a 95% confidence interval [14]. As a result of the statistical analysis, the MDC value of TSK-F was determined as 6.34.

Construct validity of TSK-F

The correlation of the TSK-F with the IPAQ and EDSS was weak, with the MSQOL-54 and 6MWT was moderate, and with the BDI, FSS, and FIS was strong (respectively, rho −0.345, rho 0.365, rho 0.544, rho −0.449, rho 0.690, rho 0.602, rho 0.650) ($p < 0.05$).

Predictive validity of the TSK-F

Whether the TSK-F is sensitive in determining the severity of the disease according to the EDSS scale was investigated by the ROC analysis. Individuals were divided into 2 groups according to the EDSS scale as mild (1–2.5) and moderate (3–4) based on the severity of the disease. The analysis was made according to these groups. The AUC value of the TSK-F was 0.730. The predictive validity of TSK-F in determining the severity of the disease is shown in Fig. 1.

Table 2 TSK-F scale total internal consistency

Number of items	17
Lower and upper scores	17–68
Lower and upper scores obtained in this study	23–62
Mean ± SD	41.50 ± 6.26
Cronbach alpha (α) coefficient value	0.708
Intraclass correlation coefficient	0.867

SD standard deviation

Sensitivity and specificity of TSK-F

The sensitivity and specificity of the TSK-F in the differentiation of the severity of the disease were performed by the ROC analysis. The cutoff value in the differentiation of the severity of the disease was determined as 42.5 with 60% sensitivity and 62.5% specificity [30].

Discussion

In this study, we aimed to investigate the reliability and validity of the TSK-F scale, which evaluates kinesiophobia due to fatigue in PwMS; it was found that TSK-F has excellent reliability and moderate-to-good validity.

Erim evaluating pain-induced kinesiophobia in PwMS found that the mean value of the TSK was lower than that of the present study [31]. This result may be due to more

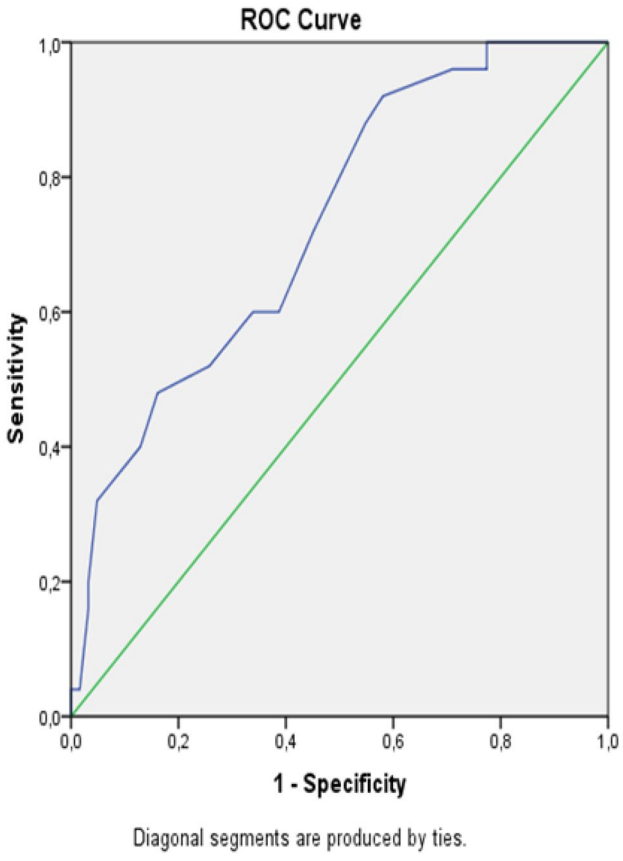

Fig. 1 The predictive validity of the TSK-F in determining the severity of the disease

dominant effect of fatigue than pain on kinesiophobia in PwMS.

Vlaeyen et al. reported that TSK scores ≤ 37 indicate low kinesiophobia and > 37 indicate high kinesiophobia [5]. In our study, the mean values of the test and retest of the TSK-F scale were found higher than these values. As a result of our study, it was found that primary fatigue symptoms and high level kinesiophobia accompanied MS.

Yılmaz et al. who performed the Turkish validity and reliability study of the TSK, reported that they found the correlation coefficient (ICC) as 0.806, and the scale had excellent reliability in individuals with low-back and neck pain [15]. As a result of our study, the ICC value of the TSK-F scale was very high in PwMS. According to the results of our study, the TSK-F was found as a very reliable scale to evaluate kinesiophobia due to fatigue in PwMS. In line with the results of our study, we present an alternative assessment tool specific for MS to evaluate kinesiophobia due to fatigue.

Erim have shown that there is a positive correlation between kinesiophobia and EDSS scores in PwMS [31]. In our study, it was found that although there was a weak correlation between the TSK-F and EDSS, kinesiophobia due to fatigue was high. Even in the early stages of the disease, kinesiophobia due to fatigue is thought to affect PwMS, and kinesiophobia may be encountered even at low disability levels. For this reason, we suggest that individuals can be evaluated in terms of kinesiophobia due to fatigue in the early period.

As a result of our study, we think that the low correlation between the TSK-F and the IPAQ stems from the fact that we did not evaluate the physical activity level by an objective method, e.g., accelerometer. We recommend future studies in which physical activity is evaluated objectively and its correlation with kinesiophobia due to fatigue is also objectively examined.

Depression is not only a clinical symptom but also one of the main determinants of an individual's quality of life in PwMS [32]. Depression negatively affects cognitive functions, disrupts interpersonal relationships, and reduces adherence to treatments in PwMS [3]. In our study, a strong positive, statistically significant correlation was found between the TSK-F and the BDI. We think that, with the increase of depression level in PwMS, the level of fatigue and related kinesiophobia may increase.

The literature emphasizes that the quality of life is reduced in PwMS and their families [33]. It has been reported that fatigue and neurological insufficiency, among the primary symptoms seen in MS, reduce the quality of life [34]. In our study, when the sub-parameters of MSQoL-54 were examined, it was found that there was a strong negative correlation between physical and mental health and the TSK-F. In addition, a moderate negative correlation was found between quality of life and kinesiophobia. These results showed that fatigue-related kinesiophobia as well as fatigue can reduce the quality of life in MS patients.

The results of our study support the perceptual-behavioral model developed by Vlaeyen et al. According to the perceptual-behavioral model, following kinesiophobia, patients enter a vicious circle of avoidance of activity, long-term disability, depression, and an increase in the level of factors that cause all these. This frequency increases in chronic diseases such as MS. We believe that if fatigue progresses in PwMS, there will be deterioration in physical and mental health and an increase in kinesiophobia. Clinically, the MDC of TSK-F in kinesiophobia due to fatigue in PwMS was found to be 6.338. This minimum clinical change is important in interpreting kinesiophobia due to fatigue during treatment and evaluations of PwMS, and provides information that can guide both clinicians and researchers.

The limitations of our study were the fact that our study was carried out in a single-center, patients with low ambulation levels were not included, the physical activity level was not evaluated objectively, and the female gender ratio was higher in the sample.

Conclusion

The TSK-F scale is a highly reliable and valid (medium-to-good) scale in evaluating kinesiophobia due to fatigue in PwMS. The TSK-F scale was found to have moderate-to-good structural validity based on the correlations with physical activity, physical capacity, disease severity, depression, and fatigue. The medium-to-good level correlations found with the primary symptoms in MS show that the scale should be among the secondary measurements that can be used to determine the effectiveness of the treatment as well as the primary measurements. The number of studies that evaluate kinesiophobia in PwMS is limited in the literature [13, 30]. We offer an alternative and effective evaluation option to researchers and clinicians with this scale, whose validity and reliability were investigated specifically in MS with our study, in order to evaluate kinesiophobia due to fatigue. Our study is important because it fills a gap in the literature in the evaluation of kinesiophobia due to fatigue specific to MS.

Declarations

Ethics approval The study was approved by the institutional review board, and all written informed consent forms were obtained from all participants.

Conflict of interest The authors declare no competing interests.

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