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Cross-cultural adaptation and psychometric evaluations of the Turkish version of Parkinson Fatigue Scale

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Abstract

Purpose The objectives of the present study were to translate and cross-culturally adapt the English version of the Parkinson Fatigue Scale into Turkish, to evaluate its psychometric properties, and to compare them with that of other language versions.
Methods A total of 144 patients with idiopathic Parkinson disease were included in the study. The Turkish version of Parkinson Fatigue Scale was evaluated for data quality, scaling assumptions, acceptability, reliability, and validity.
Results The questionnaire response rate was 100% for both test and retest. The percentage of missing data was zero for items, and the percentage of computable scores was full. Floor and ceiling effects were absent. The Parkinson Fatigue Scale provides an acceptable internal consistency (Cronbach's alpha was 0.974 for 1st test and 0.964 for a retest, and corrected item-to-total correlations were ranged from 0.715 to 0.906) and test–retest reliability (Cohen's kappa coefficients were ranged from 0.632 to 0.786 for individuals items, and intraclass correlation coefficient was 0.887 for the overall Parkinson Fatigue Scale Score). An exploratory factor analysis of the items revealed a single factor explaining 71.7% of variance. The goodness-of-fit statistics for the one-factorial confirmatory factor analysis were Tucker Lewis index = 0.961, comparative fit index = 0.971 and root mean square error of approximation = 0.077 for a single factor. The average Parkinson Fatigue Scale Score was correlated significantly with sociodemographic data, clinical characteristics and scores of rating scales.
Conclusions The Turkish version of the Parkinson Fatigue Scale seems to be culturally well adapted and have good psychometric properties. The scale can be used in further studies to assess the fatigue in patients with Parkinson's disease.

Keywords Parkinson Fatigue Scale · Fatigue · Cross-cultural adaptation · Psychometric evaluations

Introduction

Non-motor symptoms are important clinical problems that patients with Parkinson's disease (PD) are faced with [1]. Although they are widespread, non-motor symptoms can remain in the background of awareness, especially in patients with dominant motor symptoms, and can be neglected by both clinicians and patients [2]. Due to the high frequency of non-motor symptoms and serious adverse effects on the health-related quality of life of patients, studies on non-motor symptoms have increased in the last two decades and specific scales have been developed to evaluate non-motor symptoms [1, 3–6].

Fatigue is one of the most common annoying and disabling non-motor symptom in PD which can have a substantial negative affect on the health-related quality of life of patients with PD [7]. It has an estimated prevalence of 33–58% and is often referred to as 'an overwhelming sense of tiredness', 'lack of energy', or 'a feeling of exhaustion' [7]. Possible causes of fatigue in patients with PD include depression, sleep disorders, and anti-PD medications [8]. Fatigue is a multidimensional phenomenon which often involves general, mental, and physical fatigue which reduce both motivation and activity dimensions [7].

There are various measurement scales, both generic and disease-specific, used in PD to assess fatigue severity in clinical settings or trials, such as Fatigue Severity Scale, Fatigue Assessment Inventory, Functional Assessment of Chronic

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Illness Therapy-Fatigue Scale, Multidimensional Fatigue Inventory, Fatigue Severity Inventory, the Fatigue Impact Scale for Daily Use, and Parkinson Fatigue Scale (PFS) [7].

The PFS was originally developed within a British population and has been shown to be a reliable, valid, and responsive outcome measure [9]. The scale has been reported to be a suitable tool for severity rating and screening of fatigue [10]. Compared to other fatigue scales used in Parkinson's disease, the advantages of PFS are that it can be completed easily and quickly by patients and specifically developed for use in patients with PD. It was translated into many languages, including American English [11], Brazilian [12], Swedish [13] and Chinese [14]. These studies have supported it to be an appropriate outcome measurement tool to assess fatigue in patients with PD. Because of the high prevalence of fatigue in patients with PD, there is clearly a need for valid and reliable fatigue assessment tools that can be used in clinical practice and in research for Turkish population. In our previous study, we reported that the Turkish version of FSS is a valid and reliable tool in PD patients [15]. Although different fatigue assessment tools are widely used to assess the fatigue severity in various diseases, only few studies have evaluated their psychometric properties in PD [10]. Therefore, there is a need for further alternative and appropriate tools to assess fatigue in the patient with PD. The objectives of the present study were to translate and cross-culturally adapt the English version of the PFS into Turkish, to evaluate its psychometric properties, and to compare them with that of other language versions.

Methods

Patients

In this methodological, validity and reliability study, a face-to-face interview was performed. We included consecutive PD patients undergoing optimized medication between September 2015 and June 2016 at the Movement Disorders Clinic of the University of Health Science, Diskapi Yildirim Beyazit Training and Research Hospital. Inclusion criteria were (1) patients who had a clinical diagnosis of idiopathic PD based on the United Kingdom Parkinson Disease Society Brain Bank diagnostic criteria [16], (2) 40 years of age or older, (3) literate in Turkish, and (4) Mini-mental State Examination (MMSE) Score $\geq$ 24 [17]. Patients with a previous history of deep brain stimulation surgery, dementia, and other neurodegenerative or neurological disorders were excluded.

Sociodemographic data including age, sex, employment status, marital status, education status, education time, and comorbidities, and disease characteristics including duration of disease, levodopa and levodopa equivalent doses, were recorded by the same physician (BGK).

Outcome measures

The following outcome measures were used:

- Clinician-based scales: 'Hoehn and Yahr Scale' [18], 'Unified PD Rating Scale' [19], 'Schwab and England Activities of Daily Living Scale' [20] (BGK);
- Patient-based scales: 'Hospital Anxiety and Depression Scale' [21], 'Fatigue Severity Scale' [15, 22], 'Epworth Sleepiness Scale' [23], 'Pittsburgh Sleep Quality Index' [24], 'MOS 36-Item Short-Form Health Survey' [25, 26], and '39-Item Parkinson's Disease Questionnaire' [27] (EAO).

The close relationship between fatigue and depression or sleep disorders in PD and the negative effects of fatigue on daily life activities and health-related quality of life are well known [7, 8]. Therefore, the Hospital Anxiety and Depression Scale used to show whether fatigue is related to depression, the Epworth Sleepless Scale and the Pittsburgh Sleep Quality Index used to show whether fatigue is related to sleep disorders, and the Schwab and England Activities of Daily Living Scale, the MOS 36-Item Short-Form Health Survey and the 39-Item Parkinson's Disease Questionnaire used to show whether fatigue is related to health status or health-related quality of life.

The Hoehn and Yahr (H&Y) Scale is the most widely used staging system for overall functional disability in PD. The original scale consists of 5 stages and defined different stages of progressive impairment and disability. In a modified version, intermediate stages (stage 1.5 and 2.5) to the original scale were added. A higher stage indicates a greater level of functional disability and impairment [18].

The Unified PD Rating Scale (UPDRS) is the most widely used clinical rating scale for PD. The scale has been used to assess impairment and disability in PD, and consists of four parts and 42 items: Part I, Mentation, Behaviour and Mood (four interview items, 0–16 points); Part II, Activities of Daily Living (13 interview items, 0–52 points); Part III, Motor Examination (14 examination items with 26 total scores, 0–104 points); and Part IV, Complications (dyskinesias, clinical fluctuations, and other complications, 11 items, 0–23 points). The higher UPDRS subscores indicate more problems [18].

The Schwab and England (S&E) Activities of Daily Living (ADL) Scale estimates the abilities of individuals living with PD relative to a completely independent situation. One hundred percent indicates a completely independent individual and 0% indicates an individual who is no longer functioning [20].

The Hospital Anxiety and Depression Scale (HADS) is one of the commonly used rating scales for assessing the symptoms of anxiety and depression in PD. The scale consists of 2 subscales and 14 items. Each subscale's score ranges from 0 to 21 and higher scores reflecting greater anxiety and depression. The HADS is an acceptable, consistent, valid, precise, and potentially responsive scale for use in PD [21].

The Fatigue Severity Scale (FSS) is one of the most frequently used generic scales to evaluate fatigue. The scale evaluates functional impact of fatigue and contains items on physical/mental fatigue and social aspects. The FSS consists of 9 items and each item is scored between 1 (completely disagree) and 7 (completely agree). The total FSS score represents the mean score of the nine items and a score ranging between 1 and 7. The higher scores indicate a higher level of fatigue [15, 22].

The Epworth Sleepless Scale (ESS) is an instrument designed to measure daytime sleepiness presence and severity. The scale consists of 8 items and each item scored between 0 (would never doze) and 3 (high chance of dozing). A total score is the sum of the eight items and ranges between 0 and 24. The ESS scores > 10 indicate increased daytime sleepiness. In PD, the ESS is recommended as a screening tool for daytime sleepiness and as a measure of severity [23]. The Pittsburgh Sleep Quality Index (PSQI) has been designed to assess sleep quality, sleep habits and disturbances. The scale consists of 7 components (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction) and 19 questions. Each question is scored from 0 (no difficulty) to 3 (severe difficulty). The maximum total score is 21. The higher scores reflect more severe difficulties in the different areas. In PD, the PSQI is recommended for overall sleep impairment as a screening tool and as a measure of severity [24]. The total scores of the ESS and the PSQI were used in this study.

The MOS 36-Item Short-Form Health Survey (SF-36) is a generic health status measure. The scale consists of 8 domains (physical function, role-physical, bodily pain, general health, vitality, social function, role-emotion, and mental health) and 36 questions. Each domain score is calculated between 0 and 100. Two summary scales for physical and mental functioning can be calculated as well, which are weighted averages of the individual domain scales. For both domains and summary scores, the higher scores represent better health status [25, 26]. In the present study, we used to the SF-36 Physical and Mental Component Scores.

The 39-Item Parkinson's Disease Questionnaire (PDQ-39) is a disease-specific quality of life measure. It consists of 8 domains (mobility, activities of daily living, emotional well-being, stigma, social support, cognitions, communication, and bodily discomfort). Each domain score ranges from 0 to 100. A PDQ-39 Summary Index (SI) score can also be calculated and is the arithmetic mean of the domains scores. For both domain and SI scores, the higher scores represent the worse quality of life [27]. The PDQ-39 SI score was used in the current study.

Parkinson Fatigue Scale

The PFS has been developed specifically for use in patients with PD by Brown et al. [9]. It is a 16-item patient-rated scale that has been developed to assess the presence of fatigue and its effect on daily activities in PD patients. The frequency and severity of fatigue symptoms are not specifically measured. While the presence of the subjective experience of fatigue is addressed by 7 questions, the effect of fatigue on daily functioning and activities is evaluated by 9 items, and ratings are based on experiences over the previous 2 weeks. Each item score ranges from 1 (strongly disagree) to 5 (strongly agree). There are three different scoring options for the PFS; (1) 'an average score', the average item score across all 16 items, ranges from 1 to 5, (2) 'a binary scoring', positive scores for each item generated by 'agree' and 'strongly agree' responses, ranges from 0 to 16, and (3) 'a total PFS score', sum of scores for the 16 individual items, ranges from 16 to 80 [10]. Also, an average score of 3.3 or greater optimally identifies patients who perceive fatigue as a problem with a sensitivity of 84.7% and a specificity of 82.1% [9].

Translation and cross-cultural adaptation

The original version of the PFS was obtained with the permission of Dr. Brown. The translation and cross-cultural adaptation of the PFS to Turkish followed the rules of a previously published guideline [28]. This process consisted of five stages: (1) 'translation' from English to Turkish by 4 trained bilingual translators independently (3 rehabilitation specialist/physiatrist [EAO, EU and AC] and one neurologist [BGK]); (2) 'synthesis' of four translated versions of PFS and creation of a single consensus text; (3) 'back translation' of a single consensus text by two persons with the source language (English) as their mother tongue; (4) 'expert committee review', and produce the pre-final version; and (5) 'pretesting' of the pre-final version in 20 PD patients to assess the appropriateness and the comprehensibility. The final version of the PFS was refined and corrected based on the feedback obtained from the patients.

Data analysis

Descriptive data were presented as mean and standard deviations (SD) or number (%). The following psychometric properties of the Turkish version of the PFS were assessed using

standard methods [29] and based on previous studies [30, 31]:

- Data quality: the missing data (%) and computable scores (%) were identified.
- Scaling assumptions: item mean scores (SD), a coefficient of variation, skewness, inter-item correlations, corrected item-to-total correlations were identified.
- Acceptability: score range, mean and median scores, floor and ceiling effects, and skewness identified.
- Reliability: Cronbach's alpha and 95% confidence intervals (CI), 'Cronbach's alpha when one item is deleted', and corrected item-to-total correlations were calculated for 'internal consistency'; Cohen's kappa coefficients for individual items and intraclass correlation coefficient (ICC) for the overall PFS score were calculated for *test–retest reliability*. Ten to 14 days later, the retest was performed under the same conditions. A Cronbach's alpha of 0.70 or higher [29] and an item-to-total correlation of 0.30 and/or higher [32] were considered to indicate adequate reliability. A kappa coefficient of 0–0.4 was considered poor, 0.41–0.60 fair to good and 0.61–1.00 excellent [33]. The ICC was classified as 0.70–1.0 was considered high, 0.30–0.69 moderate, and <0.30 low [34].
- Validity: The validity was evaluated by construct (factorial, convergent and divergent) validity. Initially sampling adequacy was assessed using the Kaiser–Meyer–Olkin (KMO) test and the Bartlett's test of sphericity [35]. Exploratory factor analysis was conducted to examine whether a single factor could be identified, a one-factorial confirmatory factor analysis (CFA) for categorical data was used to test whether each set of items measured a single unidimensional construct. Items with factor loadings below 0.40 were eliminated [36]. The Tucker Lewis Index (TLI: >0.90 acceptable, >0.95 excellent), the Comparative Fit Index (CFI: >0.90 acceptable, >0.95 excellent) and the Root Mean Square Error of Approximation (RMSEA: <0.08 acceptable, <0.05 excellent) were used as goodness-of-fit statistics [35]. Spearman's rank or Pearson's correlation coefficients were calculated for *convergent* and *divergent validity*. Convergent validity was evaluated by correlation between the average scores of two different fatigue assessment tools (PFS and FSS), and divergent validity was assessed by correlations between an average score of PFS with the disease characteristics, including age, education time, MMSE score, H&Y stage score, disease duration, medication doses, and UPDRS scores, and rating scale scores, including S&E ADL scale score, HADS score, ESS and PSQI scores, SF-36 score, and PDQ-39 SI score. Correlation coefficients were classified as 0.70–1.0 was considered high, 0.30–0.69 moderate, and <0.30 low [34].

All statistical analyses were performed using the R Software. Differences were considered significant if $p<0.05$.

Results

Sociodemographic data and disease characteristics of patients

During the term months, 186 patients were evaluated for the study. After consideration of the exclusion criteria, 42 of the patients were excluded from the study (12 patients with an MMSE score <24, 5 patients with secondary Parkinsonism and other neurodegenerative or neurological disorders, 25 patients with insufficient cooperation or incomplete data). Finally, a total of 144 patients were enrolled in our study. Their sociodemographic and disease characteristics are presented in Table 1. The mean age and the mean duration of disease were 62.9 (SD 9.6) years and 60.7 (SD 36.1) months, respectively. The mean Hoehn and Yahr stage was 2.2 (SD 1.0). The mean levodopa dose and the mean levodopa equivalent dose were 392.0 (SD 266.7) mg/day and 777.5 (SD 337.5) mg/day, respectively. The mean UPDRS score was 47.9 (SD 25.9), the mean Schwab and England ADL score was 82.4 (SD 11.5).

Characteristics of the PFS-16

Data quality

The questionnaire response rate was 100% for both test and retest. The percentage of missing data was zero for items, and the percentage of computable scores was full.

Scaling assumptions

The means scores of items were between 2.70 (SD 1.18) (Item 12. I feel totally drained) and 3.50 (SD 1.30) (Item 9. If I was not so tired I could do more things) in Test 1. The 2nd test was similar to the 1st test, and the lowest score was the 12th item (2.61 [SD 1.20]) and the highest score was the 9th item (3.60 [SD 1.21]).

In Test 1, the coefficient of variation ranged from 36.1 (Item 10. Everything I do is an effort) to 46.0 (Item 6. Fatigue makes me reluctant to socialize). Skewness was ranged from -0.856 (Item 10. Everything I do is an effort) to 0.262 (Item 12. I feel totally drained). The inter-item correlations and corrected item-to-total correlations were between 0.446 and 0.897, and 0.715 (Item 12. I feel totally drained) and 0.906 (Item 11. I lack energy for much of the time), respectively (Tables 2, 3).

Table 1 Sociodemographic and disease characteristics of the patients

Variable	
Age, years [mean (SD) (range)]	62.9 (9.6) (42–83)
Sex (%)	
Female	58 (40.3)
Male	86 (59.7)
Employment status (%)	
Employed	6 (4.2)
Unemployed	89 (61.8)
Housewife	49 (34.0)
Marital status (%)	
Single	6 (4.2)
Married	115 (79.9)
Divorced	2 (1.4)
Widow	21 (14.6)
Education status (%)	
Primary	15 (10.4)
Secondary	79 (54.9)
High school	32 (22.2)
University	18 (12.5)
Education time [year (SD) (range)]	9.1 (2.5) (5–14)
Comorbidities (%)	
Cardiac	59 (41.0)
Pulmonary	8 (5.6)
DM	33 (22.9)
Thyroid	9 (6.3)
Rheumatologic	46 (32.0)
Psychiatric	19 (13.2)
Mini-mental Status Examination Score [mean (SD) (range)]	27.3 (2.7) (24–30)
Hoehn and Yahr stage (%)	
1	45 (31.3)
2	40 (27.8)
3	43 (29.9)
4	16 (11.1)
Hoehn and Yahr stage [mean (SD) (range)]	2.2 (1.0) (1–4)
Duration of disease, month [mean (SD) (range)]	60.7 (36.1) (12–204)
Levodopa dose, mg/day [mean (SD) (range)]	392.0 (266.7) (0–1400)
LED [mean (SD) (range)]	777.5 (337.5) (100–1972.5)
Unified Parkinson's Disease Rating Scale Score [mean (SD) (range)]	
Part I	2.6 (2.0) (0–11)
Part II	11.2 (7.2) (2–31)
Part III	31.6 (17.0) (2–71)
Part IV	2.4 (2.8) (0–12)
Total	47.9 (25.9) (14–176)
Schwab and England ADL scale score [mean (SD) (range)]	82.4 (11.5) (50–100)
Hospital Anxiety and Depression Scale Score [mean (SD) (range)]	
Anxiety subscale	8.0 (4.0) (1–20)
Depression subscale	8.4 (4.4) (0–20)
36-Item Short Form Health Survey Score [mean (SD) (range)]	
Physical Component Score	34.1 (10.3) (17.8–58.3)
Mental Component Score	42.9 (8.4) (21.6–59.9)
39-Item Parkinson's Disease Questionnaire Score [mean (SD) (range)]	
Summary Index	36.8 (16.5) (2.86–82.34)

Table 1 (continued)

Variable	
Epworth Sleepless Scale Score [mean (SD) (range)]	7.7 (4.6) (1–21)
Pittsburgh Sleep Quality Index Score [mean (SD) (range)]	
Total	9.7 (4.7) (2–20)

SD standard deviation, *DM* Diabetes mellitus, *LED* levodopa equivalent dose, *ADL* activities of daily living

Acceptability

The average PFS score was 3.20 (SD 1.09, range 1.06–4.81) in Test 1 and 3.18 (SD 1.01, range 1.06–4.63) in Test 2. The median PFS score was 3.56 in Test 1 and 3.50 in Test 2. The floor and ceiling effects were not determined for the PFS total score in both tests (Table 2).

Reliability

The Cronbach's alpha was 0.974 for 1st test and 0.964 for a retest. The Kappa values for individual items ranged from 0.632 (Item 9. If I wasn't so tired I could do more things) to 0.786 (Item 13. Fatigue makes it difficult for me to cope with everyday activities), and the ICC was 0.887 (95% CI 0.847–0.917) for the overall score of the PFS (Table 2).

Validity

The KMO test and Bartlett's test of sphericity showed that the data were adequate for factorial analysis (0.949 and $p < 0.001$, respectively). An EFA of the items revealed a single factor explaining 71.7% of variance with factor loadings in the range 0.747–0.921. The goodness-of-fit statistics for the one-factorial CFA were TLI = 0.961, CFI = 0.971 and RMSEA = 0.077 for a single factor. Convergent validity was demonstrated by high and statistically significant correlation between the PFS and FSS scores (Pearson's correlation coefficient [PCC] 0.717, $p < 0.001$). When the sociodemographic and disease characteristics, and scores of rating scales were compared with the average score of the PFS (divergent validity), there was a statistically significant correlation between the PFS score and age (Spearman's rank correlation coefficient [SCC] 0.184, $p = 0.027$), education time (SCC 0.229, $p = 0.006$), MMSE score (SCC −0.185, $p = 0.027$), H&Y stage (SCC 0.174, $p = 0.037$), disease duration (SCC 0.183, $p = 0.028$), levodopa dose (SCC 0.197, $p = 0.018$) and LED (SCC 0.187, $p = 0.025$), UPDRS Part I score (SCC 0.169, $p = 0.043$), UPDRS Part II score (SCC 0.203, $p = 0.015$), UPDRS part III score (SCC 0.196, $p = 0.019$), UPDRS total score (SCC 0.215, $p = 0.010$), S&E ADL score (SCC −0.180, $p = 0.031$), HADS Anxiety (SCC 0.171, $p = 0.041$) and Depression subscores (PCC 0.296, $p < 0.001$), ESS score (SCC 0.294, $p < 0.001$), PSQI total score (SCC 0.191, $p = 0.024$), SF-36 Physical Component Score (SCC −0.538, $p < 0.001$) and Mental Component Score (PCC −0.386, $p < 0.001$), and PDQ-39 SI score (PCC 0.483, $p < 0.001$) (Table 4).

Discussion

The purposes of the present study were to translate the PFS-16 into Turkish language and to evaluate its psychometric properties. The use of average PFS score was preferred in the current study. We demonstrated that the Turkish version of the PFS-16 is a valid and reliable tool for assessing fatigue in PD patients. Also, current results suggest that the psychometric properties of the Turkish version were comparable to other language versions of the PFS-16, including the original British English [9], American English [11], Brazilian [12], Swedish [13], and Chinese [14]. Current study differs from these studies in that it has the highest number of samples. Table 5 summarizes the psychometric properties of different language versions of the PFS in patients with PD.

In the current study, there was no lack of response to the questionnaire. No missing data were observed. This may be due to the fact that the questionnaires or rating scales were answered via face-to-face interviews. The scaling assumptions and acceptability were generally acceptable to good. The average score of the Turkish version of PFS was 3.20. When this score was compared to that of other versions, it remains between the non-English (Brazilian, Swedish and Chinese [12–14]) and English (British and American [9, 11]) version scores. As stated in the original paper, it is important that an average score of 3.3 or greater indicates the existence of fatigue [9]. According to this cut-off value, an average PFS score in two English-based studies [9, 11] was above 3.3. On the contrary, in the other three non-English studies [12–14], it remained below 3.3. Therefore, it should be remembered that the cut-off value of 3.3 may not essentially be useful in all populations. Also, these results demonstrate that the sociodemographic and disease characteristics of study samples may be an important factor affecting the PFS score. Accordingly, the cut-off value should not be considered as a standardized constant and needs to be justified for different cultures. Except for the Chinese version [14], consistent with the other two studies [12, 13], no ceiling and floor effect was detected in the current study.

Table 2 Descriptive characteristics of the scale

Item	Test 1					Test 2		Test–retest
	Mean (SD)	Median (minimum–maximum)	Coefficient of variation	Corrected item-total correlation	Cronbach's α if item deleted	Mean (SD)	Median (minimum–maximum)	Cohen's kappa coefficients
1. I have to rest during the day	2.92 (1.22)	3 (1–5)	41.8	0.759	0.973	3.02 (1.18)	3 (1–5)	0.653
2. My life is restricted by fatigue	3.15 (1.16)	3 (1–5)	36.8	0.735	0.973	3.10 (1.12)	3 (1–5)	0.685
3. I get tired more quickly than other people I know	3.40 (1.27)	4 (1–5)	37.4	0.792	0.972	3.24 (1.26)	4 (1–5)	0.691
4. Fatigue is one of my three worst symptoms	3.21 (1.30)	4 (1–5)	40.5	0.864	0.971	3.13 (1.25)	4 (1–5)	0.667
5. I feel completely exhausted	3.05 (1.29)	3 (1–5)	42.3	0.817	0.972	3.08 (1.31)	3 (1–5)	0.710
6. Fatigue makes me reluctant to socialise	3.09 (1.42)	4 (1–5)	46.0	0.833	0.972	3.03 (1.36)	4 (1–5)	0.758
7. Because of fatigue it takes me longer to get things done	3.38 (1.36)	4 (1–5)	40.2	0.868	0.971	3.41 (1.27)	4 (1–5)	0.736
8. I have a feeling of 'heaviness'	3.33 (1.34)	4 (1–5)	40.2	0.877	0.971	3.26 (1.32)	4 (1–5)	0.727
9. If I wasn't so tired I could do more things	3.50 (1.30)	4 (1–5)	37.1	0.780	0.973	3.60 (1.21)	4 (1–5)	0.632
10. Everything I do is an effort	3.49 (1.26)	4 (1–5)	36.1	0.784	0.972	3.49 (1.25)	4 (1–5)	0.718
11. I lack energy for much of the time	3.21(1.35)	4 (1–5)	42.1	0.906	0.971	3.25 (1.31)	4 (1–5)	0.777
12. I feel totally drained	2.70 (1.18)	2 (1–5)	43.7	0.715	0.973	2.61 (1.20)	2 (1–5)	0.715
13. Fatigue makes it difficult for me to cope with everyday activities	3.21 (1.32)	4 (1–5)	41.1	0.855	0.971	3.18 (1.27)	4 (1–5)	0.786
14. I feel tired even when I haven't done anything	2.96 (1.33)	3 (1–5)	45.0	0.899	0.971	3.00 (1.30)	3 (1–5)	0.712
15. Because of fatigue I do less in my day than I would like	3.31 (1.27)	4 (1–5)	38.4	0.867	0.971	3.31 (1.19)	4 (1–5)	0.706
16. I get so tired I want to lie down wherever I am	3.36 (1.30)	4 (1–5)	38.7	0.812	0.972	3.19 (1.31)	4 (1–5)	0.675

SD standard deviation

The absence of floor or ceiling effects indicates acceptable measurement standards [37].

The internal consistency of the Turkish version of the PFS evaluated by both Cronbach's alpha (0.974) and corrected item-to-total correlations (0.715–0.906) was satisfactory. The Cronbach's alpha coefficient ranged from 0.94 [12] to 0.98 [9] in other versions and our result was very similar to them. The corrected item-to-total correlations were 0.37–0.79 in the Brazilian version [12], ≥ 0.4 in the Swedish version [13], and 0.62–0.87 in the Chinese version

Table 3 Inter-item correlations for the Turkish version of PFS

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Item 12	Item 13	Item 14	Item 15	Item 16
Item 1	1.000	0.575	0.590	0.699	0.596	0.591	0.652	0.707	0.645	0.570	0.701	0.608	0.727	0.709	0.664	0.651
Item 2		1.000	0.708	0.673	0.719	0.690	0.681	0.557	0.498	0.446	0.669	0.583	0.648	0.658	0.685	0.600
Item 3			1.000	0.755	0.665	0.648	0.700	0.626	0.691	0.686	0.721	0.524	0.713	0.700	0.750	0.610
Item 4				1.000	0.763	0.725	0.763	0.772	0.714	0.666	0.786	0.617	0.715	0.788	0.776	0.727
Item 5					1.000	0.737	0.678	0.767	0.590	0.605	0.770	0.610	0.681	0.789	0.708	0.698
Item 6						1.000	0.832	0.769	0.630	0.655	0.737	0.628	0.687	0.746	0.720	0.768
Item 7							1.000	0.793	0.715	0.729	0.772	0.665	0.743	0.751	0.770	0.724
Item 8								1.000	0.750	0.748	0.811	0.672	0.759	0.855	0.727	0.756
Item 1									1.000	0.799	0.706	0.488	0.658	0.717	0.715	0.608
Item 10										1.000	0.751	0.508	0.693	0.702	0.745	0.644
Item 11											1.000	0.729	0.820	0.897	0.791	0.774
Item 12												1.000	0.665	0.728	0.570	0.549
Item 13													1.000	0.791	0.810	0.719
Item 14														1.000	0.792	0.717
Item 15															1.000	0.745
Item 16																1.000

Table 4 Correlations coefficients of the total score of the PFS with various variables

Variables	Correlation coefficients	95% confidence interval	*p* value
Age	0.184[a]	0.022–0.338	0.027
Education time	0.229[a]	0.068–0.379	0.006
Mini-mental State Examination Score	−0.185[a]	−0.338 to −0.0202	0.027
Hoehn and Yahr stage	0.174[a]	0.011–0.328	0.037
Duration of disease	0.183[a]	0.020–0.337	0.028
Levodopa dose	0.197[a]	0.034–0.349	0.018
LED	0.187[a]	0.024–0.340	0.025
Unified Parkinson's Disease Rating Scale Score			
Part I	0.169[a]	0.005–0.323	0.043
Part II	0.203[a]	0.041–0.355	0.015
Part III	0.196[a]	0.033–0.348	0.019
Part IV	0.140[a]	−0.024 to 0.297	0.094
Total	0.215[a]	0.053–0.366	0.010
Schwab and England ADL scale score	−0.180[a]	−0.333 to −0.016	0.031
Hospital Anxiety and Depression Scale Score			
Anxiety subscale	0.171[a]	0.007–0.325	0.041
Depression subscale	0.296[b]	0.139–0.439	< 0.001
Fatigue Severity Scale Score	0.717[b]	0.626–0.788	< 0.001
Epworth Sleepless Scale Score	0.294[a]	0.137–0.437	< 0.001
Pittsburgh Sleep Quality Index Score			
Total	0.191[a]	0.026–0.346	0.024
36-Item Short Form Health Survey Score			
Physical Component Score	−0.538[a]	−0.645 to −0.411	< 0.001
Mental Component Score	−0.386[b]	−0.519 to −0.237	< 0.001
39-Item Parkinson's Disease Questionnaire Score			
Summary Index	0.483[b]	0.347–0.599	< 0.001

LED levodopa equivalent dose, *ADL* activities of daily living

[a]Spearman's rank correlation coefficient

[b]Pearson's correlation coefficient

[14]. In addition, the Turkish version of PFS indicated the excellent test–retest reliability (0.632–0.786 for individual items). One of the factors that can affect the results of the test–retest reliability may be the time to repeat the test. In the current study, the test–retest interval is 10–14 days. The test–retest interval was 2 weeks in the original British English (0.52–0.72) [9] and Swedish versions (≥ 0.93) [13], and 7 days in the Chinese version (0.74–0.85) [14]. The results from the current study were comparable with other language versions. Patient or disease characteristics, cultural differences, differences in the level of education and especially study design (face-to-face interview in our study) [38] can be among the factors explaining this difference.

The present study analysed associations between the average PFS score and disease characteristics or rating scale scores for convergent and divergent validity. There was a low correlation between the average score of the PFS and sociodemographic variables (age, education time and MMSE) as well as disease characteristics (disease stage and duration, medical treatment, the UPDRS total and subscale scores except the Part IV, and Schwab and England ADL score), and rating scales (the HADS Anxiety and Depression subscore, ESS score, and PSQI total score). There was a moderate correlation between the average score of the PFS and the SF-36 PC/MC scores and PDQ-39 SI score. In addition, a high correlation was found between the two fatigue scales. Although there may be differences in the scales used to measure symptoms, similar results have been obtained in previous studies [9, 11–14]. In our previous study, which showed the validity and reliability of the Turkish version of FSS in PD, a significant correlation between total FSS score and disease characteristics was also found [15]. Similar results have been obtained in other versions of PFS, demonstrating that disease progression has a negative effect on fatigue.

Consistent with previous studies [12–14], the current study suggests that there is a close relationship between fatigue and mood or sleep disorders. Unlike the others, we

Table 5 Psychometric characteristics of the different language versions of the PFS questionnaire

	Age	Disease duration	Hoehn and Yahr stage	Mean PFS score	Floor/ceiling effect	Cronbach's alpha	Corrected item-to-total correlations	Test–retest	Significant correlations
British English[a] ($n=105$)	70.4 (9.5)[g]	ND	ND	3.50 (2.94)	ND	0.98	ND	0.52–0.72	RFS
American English[b] ($n=50$)	71.7 (1.39)	ND	ND	3.39 (2.18)	ND	0.97	ND	ND	FSS, FR
Brazilian[c] ($n=87$)	56.9 (10.3)	8.7 (4.9)	ND	2.90 (0.80)	0/0	0.94	0.37–0.79	ND	Age, education level, BDI, HAMD, HAMA, UPDRS, H&Y, S&E, MMSE, FAB, ESS
Swedish[d] ($n=30$)	60.0 (6.7)	6.4 (3.4)	ND	2.71 (0.95)	0/0	0.96	≥0.4	≥0.93	FACIT-F, age, disease, duration, levodopa dose, MMSE, MADRS-S, UPDRS
Chinese[e] ($n=107$)	62.8 (9.6)	5.3 (4.5)	1.8 (0.7)	2.81 (1.06)	5.21/0.90	0.97	0.62–0.87	0.94 (0.74–0.85)	FSS, HAMD, HAMA, disease duration, MDS-UPDRS
Turkish[f] ($n=144$)	63.0 (9.8)	6.3 (5.9)	2.2 (1.0)	3.20 (1.09)	0/0	0.97	0.72–0.91	0.63–0.79	Age, education time, duration of disease, levodopa dose, LED, MMSE, H&Y, UPDRS, S&E, HADS-A/D, FSS, SF-36 MCS/PCS, ESS, PSQI, PDQ-39

PFS Parkinson Fatigue Scale, *RFS* Rhoten Fatigue Scale, *FSS* Fatigue Severity Scale, *FR* one question fatigue rating, *BDI* Back Depression Inventory, *HAMD* Hamilton Depression Rating Scale, *HAMA* Hamilton Anxiety Rating Scale, *UPDRS* Unified Parkinson's Disease Rating Scale, *H&Y* Hoehn and Yahr, *S&E* Schwab and England Activities of Daily Living Scale, *MMSE* Mini-mental State Examinations, *FAB* Frontal Assessment Battery, *ESS* Epworth Sleepiness Scale, *FACIT-F* Functional Assessment of Chronic Illness Therapy—Fatigue Scale, *MADRS-S* Montgomery Asberg Depression Rating Scale, *MDS-UPDRS* Movement Disorders Society—Unified Parkinson's Disease Rating Scale, *LED* levodopa equivalent dose, *HADS-A* Hospital Anxiety and Depression Scale—Anxiety, *HADS-D* Hospital Anxiety and Depression Scale—Depression, *SF-36 MCS* MOS 36-Item Short-Form Health Survey Mental Component Score, *SF-36 PCS* MOS 36-Item Short-Form Health Survey Physical Component Score, *PSQI* Pittsburgh Sleep Quality Index, *PDQ-39* 39-Item Parkinson's Disease Questionnaire, *ND* no data

[a]Brown et al. [9]

[b]Grace et al. [11]

[c]Kummer et al. [12]

[d]Hagell et al. [13]

[e]Fu et al. [14]

[f]Present study

[g]$N=495$

have found that a similar relationship exists between fatigue and the health status and health-related quality of life of the patients. In a multi-center cross-sectional study of 361 non-demented patients with PD and assessing fatigue severity with PFS, the presence of fatigue was shown to be significantly associated with the scores of PDSS and PDQ-39 [39]. Therefore, instead of evaluating fatigue as a separate entity, it would be appropriate to consider it as a problem that interacts with other non-motor symptoms and findings and, consequently, negatively affects the standard of living of the patients.

The FSS is a generic fatigue scale commonly used in PD. In previous studies, including the Turkish version, it has been shown that the FSS is a valid and reliable tool to assess fatigue severity in PD [11, 15, 40–42]. A strong correlation between the scores of the PFS, which is a disease-specific fatigue scale, and the FSS is consistent with previous studies [11, 14]. These findings suggest that the instrument is a highly reliable measure with a strong convergent validity.

The present study has several limitations. It is a single center study. Therefore, the results may not represent the Turkish population well. Also, there was no control group in the study not allowing comparison of the fatigue severity between PD patients and healthy individuals.

Conclusion

The Turkish version of the PFS seems to be culturally well adapted and have good psychometric properties. The scale can be used in further studies to assess fatigue in patients with Parkinson's disease.

Compliance with ethical standards

Conflict of interest There are no conflict of interest.

Ethical approval The study protocol was approved by the local ethics committee and it was carried out in accordance with the Declaration of Helsinki. Each participant was informed about the purpose of the study before participation and the completion of the questionnaires was voluntary. All participants provided written consent.

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