Turkish adaptation of Parkinson fatigue scale and investigating its psychometric properties

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Parkinson's disease (PD) is one of the most common chronic degenerative diseases of the nervous system. In PD, nonmotor symptoms are seen as frequently as motor symptoms. Fatigue can occur in all stages of PD and leads to significant disabilities. The aim of this study was to investigate the psychometric properties of the Turkish version of Parkinson fatigue scale (PFS). Ninety-six patients with idiopathic PD were included in this study with a cross-sectional and test–retest design. Structural validity, internal consistency and test–retest reliability of PFS were analyzed. For convergent validity, fatigue severity scale and modified fatigue impact scale were used. Internal consistency was determined by the Cronbach's α coefficient. For test–retest reliability, PFS was repeated after a 7–14-day period. Significant strong correlations were found between the PFS and the fatigue severity scale ($r_s = 0.844$) and the modified fatigue impact scale ($r_s = 0.764$), which indicate a high convergent validity. The Cronbach's α coefficient, which indicates the internal consistency of the scale, was calculated as 0.947. The test–retest reliability was found to be high (intraclass correlation coefficient = 0.928). This study suggests that the Turkish version of PFS is valid and reliable. PFS is suitable for use by researchers and healthcare professionals to assess fatigue in Turkish-speaking patients with PD. *International Journal of Rehabilitation Research* 00:000–000 Copyright © 2018 Wolters Kluwer Health, Inc. All rights reserved.

International Journal of Rehabilitation Research 2018, 00:000–000

Keywords: fatigue, Parkinson's disease, reliability and validity

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Received 9 June 2018 **Accepted** 10 August 2018

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Introduction

Fatigue was defined as 'a sense of physical tiredness and lack of energy, distinct from sadness or weakness' (Krupp *et al.*, 1988). As one of the most common complaints in the community, fatigue affects about half of all patients with Parkinson's disease (PD) and one-third of all patients with PD describe fatigue as the most debilitating symptom for them. Additionally, components of fatigue including cognitive motor slowness and tiredness are the most relevant psychosocial difficulties in patients with PD (Schiavolin *et al.*, 2017). Fatigue can occur in both early and late phases of the PD and occur as a pre-symptom before the onset of the disease (Friedman *et al.*, 2007). In studies of fatigue assessment, it has been observed that fatigue is persistent in the majority of patients with PD. A community-based, prospective study of fatigue reported that fatigue increased from 35.7 to 55.7% in patients with PD who were followed throughout the 8-year study period (Alves *et al.*, 2004).

In PD, fatigue has been found to be associated with decreased physical activity, decreased functionality, sleep disorders, gait disturbances, motor symptoms, autonomic symptoms, increased levodopa dose, and motor fluctuations (Garber and Friedman, 2003; Hagell and Brundin, 2009; Nakamura *et al.*, 2011). According to the studies, fatigue appears to be higher in patients with PD compared with the age-matched control groups, regardless of the PD stage (Herlofson and Larsen, 2002). Within nonmotor symptoms, fatigue is defined as one of the most disabling manifestations by patients and has a significant negative impact on quality of life (Herlofson and Larsen, 2003; Koerts *et al.*, 2016). In addition to the major symptoms, fatigue is one of the most common and obstructive symptoms in reducing work production (Martikainen *et al.*, 2006; Murphy *et al.*, 2013).

A proper instrument to measure fatigue in PD could accelerate the progress in fatigue researches and management methods. Although there is no gold standard to assess fatigue, self-reported measures are commonly used. To address this issue, the Parkinson fatigue scale (PFS) was developed to specifically assess fatigue in PD (Brown *et al.*, 2005). The use of PFS has been largely accepted and it has been translated into several languages (Kummer *et al.*, 2011; Hagell *et al.*, 2012; Baghoori *et al.*, 2017; Fu *et al.*, 2017). Therefore, the PFS is a suitable option for use in international studies for PD; however, the PFS has not been validated in Turkish. Although the fatigue severity scale (FSS), as generic fatigue scale, has been recently validated into Turkish in patients with PD, there is a lack of disease-specific fatigue scale in Turkish

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DOI: 10.1097/MRR.0000000000000314

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(Ozturk *et al.*, 2017). The aim of this study was to perform the cultural adaptation of the PFS into Turkish and to examine its psychometric properties.

Materials and methods

Study design and setting

This study had a cross-sectional and test–retest design. The study was carried out at Movement Disorders Clinic, Department of Neurology, Dokuz Eylül University Hospital, Izmir, Turkey.

Participants

Between October 2016 and May 2017, 96 patients with PD who were followed up regularly in the clinic were enrolled in the study. Patients diagnosed as idiopathic PD and aged older than 40 years were included. Atypical Parkinsonism diagnosis, patients who had scored lower than 22 for educated or 18 for uneducated versions in the modified mini-mental status examination (Keskinoglu *et al.*, 2009), and patients at stage 5 according to modified Hoehn and Yahr (HY) stage were excluded from the study.

Although there is no internationally accepted consensus about the minimum required sample size for validation studies, 2–20 participants per item are generally recommended (Kline 1979; Hair *et al.*, 1995). In this study, *a priori* sample size was determined as six participants per item (i.e. 96 participants for the 16-item PFS).

Ethical approval according to the Helsinki Declaration was obtained from the Ethics Committee of Dokuz Eylül University (approval number: 2016/17-27). Verbal and written explanations were provided to patients about the study. An informed consent was signed by patients who volunteered to participate in the study.

Translation and cross-cultural adaptation

The standard guidelines for the process of cross-cultural adaptation of self-report measures were followed in this study (Beaton *et al.*, 2000). The permission for the Turkish validation study was obtained by Dr Richard Brown at King's College London, London, UK, who was the first author of the original version of the PFS. The original PFS was translated into Turkish by two persons who speak English at an advanced level and speak Turkish as their mother tongue. Subsequently, these two translations were compared and converted into a common single translation, with each item of the scale being the most appropriate counterpart. The back translation was obtained by two advanced Turkish-speaking people who speak English natively. The obtained English form was compared with the original one and the final version of the translation was completed. A pilot study was conducted on patients with PD ($n = 10$). On the basis of the pilot study, necessary adjustments were made without any change in the meaning of the questionnaire and cultural adaptation of the questionnaire was provided. Then the actual study started to examine the psychometric properties of the final version.

Outcome measures

The PFS is a patient-reported outcome measure to assess fatigue in patients with PD (Brown *et al.*, 2005). The PFS is consists of 16 items related to presence of fatigue (e.g. fatigue is one of my three worst symptoms) and its impact on daily function (e.g. fatigue makes it difficult for me to cope with everyday activities). All items are scored by patients using a five-point Likert-type scale including response options ranging from '(1) strongly disagree' to '(5) strongly agree'. The PFS takes around 5 min to administer. There are two suggested scoring methods including full Likert scoring and binary scoring. In full Likert scoring method, total score is calculated as the average of the responses given to all the items. In binary scoring method, 'strong disagree', 'disagree', and 'neither agree nor disagree' options are accepted as '0' and the other two options are accepted as '1'. Then, all the options are summed. The total score ranges from 1 to 5 in full Likert scoring method and 0–16 in binary scoring method (Brown *et al.*, 2005).

The FSS is a generic, patient-reported, valid and reliable outcome measure to evaluate the severity of fatigue (Friedman *et al.*, 2010). The FSS includes nine items related to how fatigue interferes with certain activities and its severity using a seven-point Likert-type scale including response options ranging from '(1) strongly disagree' to '(7) strongly agree'. Total score is calculated as the average of the responses given to all the items where the minimum score is 1 and maximum is 7. The Turkish version of FSS was found as valid and reliable in patients with PD (Ozturk *et al.*, 2017).

The modified fatigue impact scale (MFIS) is a generic, patient-reported, valid and reliable outcome measure to evaluate the effects of fatigue in terms of physical, cognitive, and psychosocial functioning (Fisk *et al.*, 1994). The MFIS is consists of 21 items with a five-point Likert-type scale including response options ranging from '(0) never' to '(4) almost always'. The total score is the sum of the scores for the 21 items.

The modified HY scale is a staging system that the progression of the disease is determined and its severity can be assessed. In PD, it is widely used to determine the clinical condition and symptoms of the patient. The grade of the disease is evaluated between 1 and 5 (Hoehn and Yahr, 1967).

The unified Parkinson's disease rating scale (UPDRS) assesses the disease severity. It evaluates the mental and psychological state, activities of daily living, motor performance, side effects of levodopa treatment (motor fluctuations, movement disorders), and autonomic dysfunction. Forty-two items of the scale are valued between 0–4. As the total value increases, the severity of the

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disease increases (Movement Disorder Society Task Force on Rating Scales for Parkinson's Disease, 2003).

Procedure

Patients were assessed in the 'ON' state. In addition to the demographic data, the disease stage was determined according to modified HY scale. UPDRS was applied to determine the disease symptoms and side effects of the treatment. PFS, FSS, and MFIS were applied to the patients. For the assessment of test–retest reliability, patients were referred to the clinic after 7–14 days and PFS was administered second time.

Statistical analysis

Data were analyzed using IBM SPSS statistics for Windows (Version 23; IBM Corp., Armonk, New York, USA). Normal distribution of data was tested by Kolmogorov–Smirnov test and visual examinations of the histograms. Psychometric properties of both scoring methods were examined.

To analyze the internal consistency of the PFS, the Cronbach's α coefficient and corrected item-total score correlations were calculated. Cronbach's α coefficients were interpreted as acceptable if greater than 0.70 and corrected item-total score correlations were interpreted as acceptable if greater than or equal to 0.30 (Andresen, 2000; Bowling, 2009). In test–retest assessment, the intraclass correlation coefficient for the full Likert scoring method of PFS and Cohen's κ coefficients for the binary scoring method were calculated. Reliability estimates are ranked as values of intraclass correlations and κ coefficients greater than or equal to 0.75 are excellent (Andresen, 2000).

For the construct validity, convergent and discriminant validities were determined by calculating the correlation coefficients of the PFS with the other variables. In order to evaluate convergent validity, it was expected that the FSS and MFIS would have a direct, significant, and strong correlation with PFS. On the other hand, we expected that age, disease duration, modified HY stage, UPDRS-total, UPDRS-II (activities of daily life), UPDRS-III (motor symptoms), UPDRS-items 32–35 (dyskinesia), and UPDRS-items 36–39 (motor fluctuations) would have a nonsignificant or less correlation with PFS. Because fatigue is a nonmotor symptom of PD, we expected to obverse less correlation with motor symptoms. Therefore, motor parts of the UPDRS were examined specifically. Spearman's correlation coefficients were interpreted as strong greater than 0.5, moderate between 0.3 and 0.5, and less than 0.3 weak (Cohen, 1988). Exploratory and confirmatory factor analyses were performed. Goodness-of-fit was interpreted with acceptable fit defined as the normed χ^2 value of less than 3 ($\chi^2/df < 3$), lower-bound and upper-bound limits of the 90% confidence interval for the root mean-square error of approximation being less than 0.05 and 0.10, respectively, and the comparative fit index being greater than 0.90 (Kline, 2005).

PFS score greater than or equal to 3.3 was accepted to determine the fatigued patients, and χ^2-test was conducted to determine the association between high/low fatigue and high/low disease severity according to the modified HY stage (cut-off: 2.0). The fatigue levels assessed by different fatigue measures were compared between the groups (high/low disease severity with using Mann–Whitney U-test to determine whether differences between groups are stronger when fatigue is measured with PFS than with MFIS and FSS). Cohen's d effect sizes were calculated to see which measure has the strongest difference determination level. The significance level was accepted as P less than 0.05 in all statistical tests.

Results

The study sample consisted of 41 (43%) female and 55 (57%) male patients with PD. Sociodemographic data and disease variables of the participants are shown in detail in Table 1.

The confirmatory factor analysis indicated that a single factor for PFS has relatively adequate fit; $\chi^2/df = 2.377$, lower-bound and upper-bound limits of the 90% confidence interval for the root mean-square error of approximation = 0.101 and 0.140, respectively, and comparative fit index = 0.860. Only Item 10 has small loading (0.270); the other items have adequate loading (>0.400). Factor loadings of the confirmatory factor analysis are presented in Table 2. The exploratory factor analysis revealed a single factor explaining 55.8% of variance with factor loadings in the range from 0.51 to 0.84. Kaiser–Meyer–Olkin measure of sampling adequacy (0.92) and Bartlett's test of sphericity ($P < 0.001$) results

Table 1 Descriptive statistics

	Mean ± SD	Minimum–maximum
Male/female [*n* (%)]	55 (57.3)/41 (42.7)	
Age (years)	66.43 ± 9.20	42–83
Disease duration (years)	6.34 ± 5.30	0–29
Modified HY stage	2.01 ± 0.78	1–4
UPDRS total	38.84 ± 20.20	10–140
UPDRS-II (activities of daily life)	10.47 ± 6.06	2–41
UPDRS-III (motor symptoms)	19.36 ± 11.21	6–69
UPDRS items 32–35 (dyskinesia)	2.59 ± 2.73	0–13
UPDRS items 36–39 (motor fluctuations)	0.82 ± 1.81	0–12
MFIS total	42.75 ± 21.24	2–84
MFIS psychosocial	4.14 ± 2.50	0–8
MFIS physical	19.06 ± 8.95	0–36
MFIS cognitive	19.34 ± 11.40	0–40
FSS	4.06 ± 1.72	1–7
PFS (full Likert scoring method)	3.21 ± 0.86	1.44–5.0
PFS (binary scoring method)	9.20 ± 5.41	0–16

FSS, fatigue severity scale; HY, Hoehn and Yahr; MFIS, modified fatigue impact scale; PFS, Parkinson fatigue scale; UPDRS, Unified Parkinson's Disease Rating Scale.

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showed that the respondent data for factor analysis was suitable.

It was found that there was clinically significant fatigue (PFS ≥ 3.3) in 53 (55.2%) patients. Participants with high disease severity were significantly more fatigued with a proportion of 64.3% ($\chi^2 = 4.478$, $P = 0.034$). Fatigue levels assessed by PFS, MFIS, and FSS were significantly different between the participants with low and high disease severity ($P < 0.05$). The PFS (for both scoring methods) has slightly larger effect size compared with the MFIS and FSS (Table 2).

The internal consistency was found to be high for both the full Likert scoring (Cronbach's $\alpha = 0.947$) and binary scoring methods (Cronbach's $\alpha = 0.919$). All the corrected item-total correlations were adequate for both scoring methods, thus there was no need to remove any item. Both scoring methods had high test–retest reliability. Table 3 presents the reliability analysis results.

In the analysis of the construct validity, the correlation coefficients between the PFS and the FSS were $r_s = 0.844$ for the full Likert scoring and $r_s = 0.805$ for the binary method. Significant strong correlations were found between the PFS, MFIS total score, and subscales. Correlations between PFS with disease stage and severity were, $r_s = 0.409$ and $r_s = 0.468$ in the method of full Likert valuation. These values are calculated as $r_s = 0.429$ and $r_s = 0.469$ when the binary method was used. Weak correlations were found between the total score of original valuation of the PFS and UPDRS second part, third part, 32–35, and 36–39 items. In both methods of valuation of the PFS, no correlation was found between fatigue scores with age and duration of illness (Table 4).

Discussion

Turkish adaptation of the PFS was performed and psychometric properties were examined in this study. The results suggest that the Turkish version of the PFS is valid and reliable.

The confirmatory factor analysis revealed that the Turkish version of PFS has relatively adequate fit for a single factor because of item 10 has inadequate loading. The exploratory factor analysis showed that it has a single factor explaining of 55.8% variance, which is close to the original version (58.2%). As neither the original study nor other language validation studies conducted a confirmatory factor analysis, we cannot compare our results. However, according to Suhr (2006), if unacceptable model fit is found, an exploratory factor analysis can be performed. Additionally, none of the other language validation studies removed any item; it was decided

Table 2 Comparison of fatigue levels assessed by different fatigue measures in participants with low versus high disease severity

	Low modified HY stage ($n = 40$)	High modified HY stage ($n = 56$)	P	d
PFS (full Likert scoring method)	2.75 (2.14–3.48)	3.62 (2.95–3.92)	0.001*	0.756
PFS (binary scoring method)	6.5 (2.0–11.0)	11.5 (7.0–14.0)	< 0.001*	0.790
MFIS	30.0 (15.8–48.0)	51.5 (36.0–59.8)	0.001*	0.711
FSS	3.22 (2.14–3.48)	4.60 (3.44–5.85)	0.001*	0.746

Values are presented as median (interquartile range).
FSS, fatigue severity scale; HY, Hoehn and Yahr; MFIS, modified fatigue impact scale; PFS, Parkinson Fatigue Scale.

Table 3 Reliability results and factor loadings of the confirmatory factor analysis

	Full Likert scoring method			Binary scoring method			
Item	Corrected item-total correlation	Cronbach's α on item deletion	Test–retest reliability	Corrected item-total correlation	Cronbach's α on item deletion	Test–retest reliability[a]	Factor loadings
1	0.615	0.945	0.655	0.523	0.917	0.482	0.400
2	0.611	0.945	0.830	0.514	0.917	0.602	0.400
3	0.664	0.944	0.734	0.545	0.916	0.558	0.460
4	0.803	0.941	0.864	0.759	0.909	0.644	0.660
5	0.739	0.942	0.713	0.603	0.914	0.517	0.570
6	0.706	0.943	0.770	0.677	0.912	0.597	0.530
7	0.742	0.942	0.780	0.664	0.912	0.673	0.590
8	0.716	0.943	0.745	0.658	0.912	0.400	0.550
9	0.714	0.943	0.807	0.624	0.914	0.746	0.540
10	0.505	0.947	0.807	0.414	0.919	0.675	0.270
11	0.823	0.941	0.816	0.774	0.909	0.551	0.720
12	0.712	0.943	0.829	0.521	0.916	0.598	0.530
13	0.763	0.942	0.817	0.744	0.910	0.640	0.630
14	0.752	0.942	0.846	0.640	0.913	0.733	0.600
15	0.714	0.943	0.871	0.633	0.913	0.724	0.540
16	0.675	0.944	0.818	0.535	0.916	0.579	0.480
Total			0.928			0.915	

[a]The data are presented as κ coefficients.

*$P < 0.05$.

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Table 4 Correlations between Parkinson fatigue scale and other study variables

	Full Likert scoring method		Binary scoring method	
	Spearman's r_s	*P*	Spearman's r_s	*P*
Age	−0.010	0.920	0.066	0.525
Disease duration	−0.010	0.919	0.039	0.707
Modified HY stage	0.409	<0.001*	0.429	<0.001*
UPDRS total	0.468	<0.001*	0.469	<0.001*
UPDRS-II (activities of daily life)	0.396	<0.001*	0.405	<0.001*
UPDRS-III (motor symptoms)	0.342	0.001*	0.361	<0.001*
UPDRS items 32–35 (dyskinesia)	0.386	<0.001*	0.316	0.002*
UPDRS items 36–39 (motor fluctuations)	0.235	0.021*	0.191	0.062
MFIS total	0.764	<0.001*	0.746	<0.001*
MFIS psychosocial	0.628	<0.001*	0.598	<0.001*
MFIS physical	0.760	<0.001*	0.756	<0.001*
MFIS cognitive	0.693	<0.001*	0.669	<0.001*
FSS	0.844	<0.001*	0.805	<0.001*

FSS, fatigue severity scale; HY, Hoehn and Yahr; MFIS, modified fatigue impact scale; PFS, Parkinson fatigue scale; UPDRS, unified Parkinson's disease rating scale.
*$P < 0.05$.

not to remove item 10 to keep the same structure for international comparison.

The internal consistency was found to be high for both the full Likert scoring and binary scoring methods for the Turkish version of PFS. Additionally, all the corrected item-total correlations were adequate for both scoring methods. Test–retest was also found to be high. These results are very similar to the original and other language versions of PFS, including Swedish, Brazilian, Persian, and Chinese (Brown *et al.*, 2005; Kummer *et al.*, 2011; Hagell *et al.*, 2012; Baghoori *et al.*, 2017; Fu *et al.*, 2017). These findings suggest that PFS is a reliable measure in all validated languages.

In our study, fatigue was evaluated with FSS and MFIS, which are not disease-specific outcome measures. The PFS showed strong significant correlations with MFIS and FSS. In the original study of PFS and other language validation studies also examined correlations between PFS and other generic fatigue assessment measures (Brown *et al.*, 2005; Kummer *et al.*, 2011; Hagell *et al.*, 2012; Baghoori *et al.*, 2017; Fu *et al.*, 2017). Unlike previous studies, we evaluated fatigue levels assessed by PFS, MFIS, and FSS and found that the PFS has slightly larger effect size compared with the MFIS and FSS, which show that it is a PD-specific fatigue measure.

There was no or small-to-moderate correlations between PFS, and other variables, which were interpreted as an evidence for discriminant validity. It was also found that patients with high disease severity were significantly more fatigued. These results are comparable to the other validation studies suggesting the Turkish version of PFS is also valid in patients with PD.

There are two scoring method for PFS proposed by the original study (Brown *et al.*, 2005). The psychometric properties of the two scoring methods for the Turkish version of PFS are broadly comparable to the original study. Unlike the original study, we also compared the fatigue levels assessed by PFS in patients with low and high disease stage, and found that the effect size of binary scoring method was slightly higher. However, according to the original study, full Likert scoring method has greater sensitivity in measuring change (Brown *et al.*, 2005). All these findings suggest that binary scoring method can be preferable as a screening tool.

The FSS as a generic fatigue measure has been recently validated into Turkish in patients with PD (Ozturk *et al.*, 2017). The Turkish version of FSS showed good psychometric properties. There is no significant difference in terms of Turkish versions of PFS and FSS. Since PFS was originally developed to be used in patients with PD, it can be preferable. However, we cannot make a firm conclusion that the PFS is superior to FSS to be used in PD according to our findings. Future studies should compare the two scales in terms of other psychometric properties such as responsiveness and item response theory based characteristics.

There are several limitation of our study. Patients who participated in our study were in early and middle stages of PD. According to the modified HY stage, only four patients were in stage 4. Patients in stage 5 were not included in our study. The difference from other studies in terms of disease progression may be due to this detail. We also excluded the patients with dementia. There are studies in the literature indicating that dementia and fatigue are related to PD and dementia is known to be associated with fatigue (Karlsen *et al.*, 1999; Dogan *et al.*, 2015). The exclusion of demented patients with PD may have caused the fatigue levels in our study to be less than in the general population of patients with PD. Our study is a single-centered study, and therefore, most of the patients were from the same region. These factors may limit the generalizability of the results.

The Turkish version of the PFS is a valid and reliable disease-specific instrument to assess fatigue for Turkish-speaking patients with PD. It can be used to assess levels of

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fatigue, and measure possible side effects of medications and any changes that treatment or lifestyle changes may effect in international multicentered studies. The PFS can serve as a common outcome measure in meta-analysis studies.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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