Title: Psychometric properties of the Persian version of Penn Parkinson's Daily Activities Questionnaire-15

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Abstract

Introduction: There is a need to have appropriate information about the ability of Parkinson's disease (PD) patients to perform cognitive instrumental activities of daily living (IADL). The purpose of the present study was to assess the psychometric properties of the Persian version of the Penn Parkinson's Daily Activities Questionnaire-15 (PDAQ-15).

Methods: A total of 165 knowledgeable informants of PD patients completed the PDAQ-15. The Clinical Dementia Rating Scale, Hoehn and Yahr staging, Hospital Anxiety and Depression Scale (HADS) and Lawton IADL scale were included in the study. Internal consistency and test-retest reliability were evaluated by Cronbach's alpha coefficient and intraclass correlation coefficient (ICC), respectively. To examine the dimensionality of the questionnaire, exploratory factor analysis was used. The construct validity was assessed using Spearman rank correlation test. To assess the discriminative validity, PDAQ-15 scores were compared across cognitive stages.

Results: The PDAQ-15 showed strong internal consistency (Cronbach's $\alpha = 0.99$) and test-retest reliability (ICC = 0.99). Only one dimension identified for the PDAQ-15 in the factor analysis. There was strong correlation between PDAQ-15 with depression domain of HADS scale and Lawton IADL scale. ($r_s = [0.71–0.95]$). The correlation of PDAQ-15 with anxiety domain of HADS scale was moderate ($r_s = 0.66$). Discriminative validity analysis showed that the PDAQ-15 has significant power to discriminate between PD patients across cognitive stages.

Conclusion: These results suggest that the PDAQ-15 is a valid and reliable PD-specific instrument that can be useful in clinical and research settings.

Keywords: Psychometric properties, Parkinson’s disease, Cognition, Instrumental activities of daily living, Persian version
Highlights

- Cognitive impairments affect the ability to perform daily activities in PD patients.
- The PDAQ-15 is a suitable tool to assess daily cognitive function in PD patients.
- The PDAQ-15 has good ability to discriminate between PD patients across cognitive stages.

Plain Language summary

Parkinson's disease is one of the most common diseases in elderly. Cognitive impairment is a main problem in Parkinson's disease that affects their ability to perform activities of daily living and leads to disability, mortality and suffering for their caregivers. Occupational therapists as a key member of the rehabilitation team, evaluate and treat patients in their daily activities to enhance independence. The tools for measuring daily activities play an important role in assessing the level of functional independence and promoting new cognitive therapies in these patients. Therefore, the present study aimed to prepare a Persian version of PDAQ-15 questionnaire for people with Parkinson's disease in Iran. In this study, we evaluate the ability of Parkinson's disease patients with different cognitive levels. Our results showed that this questionnaire is a suitable tool to assess the cognitive and daily function in Parkinson's disease patients. It is hoped the results of this study be helpful in targeting and planning cognitive therapy strategies in Parkinson's disease.
Introduction

One of the common and important non-motor symptoms of Parkinson disease (PD) is cognitive impairment that causes disability, worse quality of life, mortality, and caregiver burden (Auclair-Ouellet, Lieberman, & Monchi, 2017; Leung et al., 2015). There is a classification for cognitive deficits in PD that includes mild cognitive impairment (PD-MCI) to PD dementia (PDD), and PD-MCI is very at risk for PDD (Federico et al., 2017). Reports from the Movement Disorder Society shows 26.7% PD-MCI and 30% to 40% PDD among PD patients (Dancis & Cotter, 2015). The cognitive domains that are affected in course of PD include attention, memory, visuospatial abilities, and executive functions (Siciliano et al., 2017). These cognitive deficits impact to perform instrumental activities of daily living (IADLs) such as driving, financial skills, and medication management and PD patients with dementia have more functional limitations (Fernández-Bobadilla et al., 2017; Martin et al., 2013; Ruzafa-Valiente et al., 2016). One of the therapeutic interventions in PD is identification of cognitive impairments aimed to improve their functions (Brennan et al., 2016a). Therefore, the existence of an instrument to assess functional changes related to cognitive impairment can improve the clinical management and evaluating new cognitive therapies in PD (Brennan et al., 2016a; Kulisevsky et al., 2013). Also, IADL measurement scales can improve rehabilitation services. Among the rehab professionals, occupational therapists are the key members who help to PD patients for the restoration, maintenance, and promotion of participation in meaningful activities (Foster & Hershey, 2011; Soltanmohamadi, Hassani Mehraban, Taghizade, Akbarfahimi, & Alahyari, 2014). Several scales are used to measure IADLs but do not take into account the specific features of PD, including cognitive impairments (Brennan et al., 2016a). Only two published functional scales have been specifically designed to assess IADL in PD. The Parkinson's disease Cognitive Functional Rating Scale (PD-CFRS) and the Penn Parkinson's Daily Activities Questionnaire-15 (PDAQ-15). The PD-CFRS is a PD specific
questionnaire that takes 5 minutes to complete and has 12 items sensitive to mild cognitive impairment that administered to a knowledgeable informant (KI) in interview. This scale provided appropriate validity and reliability in initial validation study (Brennan et al., 2016b). The initial version of PDAQ was designed in 2015 in United States by Laura Brennan et al. The PDAQ-50 is a tool that uses item-response theory (IRT) methodology to assess broad range of cognitive IADL function in PD. The average time required to complete the 50-item PDAQ is 10-15 min, therefore, the PDAQ-15 version was prepared as a brief instrument of IADL function (Brennan et al., 2016b). Our reasons for choosing the PDAQ-15 for psychometric properties analyzing is related to the advantages of this questionnaire compared to the PD-CFRS. For example, PDAQ-15 is derived from original 50-item version, which used item-response theory in developing process. And also, the strong psychometric properties of the original version in a large sample of patients is another reason for superiority of the PDAQ-15 (Brennan et al., 2016b). Due to the lack of cognitive IADL scales in PD among Iranian population, the present study aimed to measure the validity and reliability of the PDAQ-15.

**Methods**

**Subjects**

Recruited PD patients (n = 165) were a convenience sample of outpatients referred to neurology clinic in the center of Tehran city with the highest number of referrals from all over Iran cities. Inclusion criteria were: (1) standard criteria for idiopathic PD (Hughes, Daniel, Kilford, & Lees, 1992) based on the two neurologists diagnosis; (2) those who had an educated KI, such as a spouse, child, paid caregiver, or other individual that have daily contact with the patient available to complete the PDAQ-15; (3) being in levodopa on state; (4) absence of causes that interfering with cognitive status (e.g., other neurological disorder, brain surgery, psychosis, medications, etc.) by a brief semi-structured interview with KI and patient.
Procedure

The translation and face and content validity of the PDAQ-15 has been described in details (Nikbakht, Rezaee, Kalantari, & Tabatabaee, 2018) and the following steps were performed for the present study: initially, all required information, including demographic characteristics and clinical assessments such as age, education, gender, age of onset, disease duration, levodopa equivalent daily doses (LEDD), dopamine agonist (DA), Clinical Dementia Rating (CDR), Hoehn and Yahr (H&Y), Hospital Anxiety and Depression Scale (HADS), PDAQ-15 and Lawton IADL scale was identified. Then, to examine convergent validity, PDAQ-15 and Lawton IADL was completed by KI (one person) for each participant. The Lawton IADL scale was scored based on functional deficit due to cognitive loss, not physical dysfunction. The only investigator involved in rating the CDR was blinded to the obtained scores by KIs in completing PDAQ-15 as well as Lawton IADL scale. To assess the test-retest reliability, the PDAQ-15 was completed by the same KI for the second time after two weeks. All assessments were conducted in one day while in the levodopa on state. Evaluations were performed in a quiet room in the clinic and patients were given sufficient time to complete the questionnaire.

Assessments

The PDAQ is PD-specific questionnaire, consist of 15 items completed by a KI of a PD patient. Each item contains a question about the level of difficulty to perform an IADL by PD patient and was scored based on KI rating on the following scale: “none,” “a little,” “somewhat,” “a lot,” “cannot do”. Scores ranged from 0 to 4 for each item (total score range = 0-60) with higher scores indicating better cognitive IADL function. The PDAQ-15 demonstrated strong psychometric properties across cognitive stages (Brennan et al., 2016b).

Lawton IADL scale is a valid and reliable instrument to assess the ability to perform more complex activities daily living. The Lawton measures 8 domains including cooking, use of telephone, shopping, financial management, housekeeping, doing laundry, using transportation
and handling medication, which scored from 0 to 8. Low scores indicate low function or dependency and high scores indicate high function or independence. This scale can be administered by either a questionnaire or in 10 to 15 minutes’ interview. The answers can be provided by either the patient, KI or caregiver. Each ability assessed by the Lawton depends on physical and cognitive function. This scale can be scored in different ways, depending on the purpose of the evaluation and how the information is used (Graf, 2008; Lawton & BRODY, 1970). The Lawton IADL scale has already been used in PD studies (Cahn et al., 1998; Christ et al., 2013; Rasovska & Rektorova, 2011) and has shown good ability to be a valid and reliable instrument to assessment of IADL in Persian version (Soltanmohamadi et al., 2014).

The CDR is valid and reliable scale to rate six domains associated with dementia: Memory, Orientation, Judgment, and Problem solving, Community Affairs, Home and Hobbies, and Personal Care. This scale uses a semi-structured interview by both the subject and his/her family. In rating each of these domains, the assessment should be on the patient’s cognitive ability to function in these areas, not because of physical frailty. Although the CDR developed primarily for use in patients with Alzheimer’s disease, adjusted CDR cut-off scores for patients with PD have provided and showed acceptable validity (Morris, 1997). The CDR classify PD patients as normal cognition (PD-NC) (CDR = 0), PD-MCI (CDR = 0.5), or PDD (CDR ≥ 1) (Wyman-Chick & Scott, 2015).

The H&Y is a widely used clinical rating scale. In this scale, 5 levels are defined to determine the severity of PD progression. For example level 1 indicates normal status and level 5 indicates use of wheelchair (Mehdizadeh et al., 2019).

The HADS is a brief and widely-used 14-item scale designed to measure current anxiety and depressive in non-psychiatric hospital patients. The HADS has independent subscales for anxiety and depression. Scores on each scale are in ranges: normal (0-7), mild (8-10), moderate (11-14) and severe (15-21) (Zigmond & Snaith, 1983). The Persian version of HADS has
demonstrated high validity and reliability (Montazeri, Vahdaninia, Ebrahimi, & Jarvandi, 2003). Since anxiety and depression are two of the most important factors that involved in cognitive status of the PD patients; therefore, were evaluated in this study (Kulisevsky et al., 2013).

**Statistical analysis**

Descriptive statistics including means, percentages, and standard deviations, were calculated for demographics and clinimetric characteristics. The Shapiro-Francia test used for assess the distribution of data and the result showed total score of PDAQ-15 was not normally distributed. Acceptability was assessed, considering Ceiling and floor effects acceptable a level ≤ 15% (McHorney & Tarlov, 1995). The acceptable range for skewness is from −1 to +1 (Hays, Anderson, & Revicki, 1993).

In order to assess the internal consistency of the PDAQ-15, Cronbach’s alpha coefficient, with values > 0.70 considered adequate, was calculated (Lohr, 2002). To investigate the relationship between items, the inter-item correlation method was measured, considering correlation coefficient ≥ 0.2 acceptable (Piedmont, 2014). The values ≥ 0.20 considered as standard threshold to determine the corrected item-total correlation (Streiner, Norman, & Cairney, 2015). The test-retest reliability was checked for total score using the intraclass correlation (ICC) coefficient, with considering ICC above 0.70 as adequate reliability (Terwee et al., 2007).

The standard error of measurement (SEM) was calculated to assess the precision of the PDAQ-15. The variety of the score in repeating the measurement is determined by SEM. In the formula SEM = SD √ (1−rxx), SD is obtained from the first assessment total score, and rxx is the ICC from the test-retest. The SEM < 1.2 SD was considered acceptable in our study (Taghizadeh et al., 2018).
To check the dimensionality of the PDAQ-15, the exploratory factor analysis (principal component analysis) with varimax rotation (eigenvalues ≥1) was carried out (Gorsuch, 1997). Convergent validity was assessed using Spearman rank correlation test to examine the correlation between the total PDAQ-15 score with Lawton IADL scale and HADS. Coefficient values < 0.30 were consider weak; 0.30–0.70, moderate; and > 0.70, strong correlation (Simon, 2006).

Discriminative validity analysis was assessed using Kruskal-Wallis test and Cohen’s d effect size to determine the ability of the PDAQ-5 to differentiate between PD cognitive stages. A Cohen’s d effect size of 0.2, 0.5, and 0.8 indicate small, medium, and high magnitude of difference between stages, respectively (Husted, Cook, Farewell, & Gladman, 2000).

**Results**

Table 1 shows the demographic details and clinical characteristics for all participants (165 PD patients) as well as by cognitive diagnosis based on CDR score (i.e., normal cognition, MCI, or dementia). The CDR indicated 45.5% PD-NC (n = 75), 30.3% PD-MCI (n = 50), and 24.2% PDD (n = 40).

The ceiling and floor effects for the total PDAQ-15 score were 18.2% and 7.9%, respectively, and the skewness was −1.15.

The PDAQ-15 showed high internal consistency (Cronbach’s alpha = 0.99; no item improved Cronbach’s alpha if removed). The inter-item correlation of the PDAQ-15 ranged 0.90 to 0.99. The corrected item-total correlations coefficient ranged from 0.94 for item 9 (How much DIFFICULTY does the patient currently have remembering new information like phone numbers or simple instructions?) to 0.98 for item 3 (How much DIFFICULTY does the patient currently have counting the correct amount of money when making purchases?) are presented in Table 2. The ICC for the total PDAQ-15 score for test-retest was high (0.99; 95% CI). The SEM of the PDAQ-15 was 1.89 (1/2 SD value = 9.46).
Factor analysis for the PDAQ-15 with varimax rotation showed only one component (eigenvalue = 14.22; total variance = 94.81; Kaiser-Meyer-Olkin = 0.96; Bartlett’s sphericity test, p < 0.001).

The correlation of the total PDAQ-15 with Lawton IADL scale and depression domain of HADS scores was 0.95 and –0.71, respectively, indicating strong convergent validity. The correlation between the total PDAQ-15 score and the anxiety domain of HADS was –0.66, which indicates moderate association.

PDAQ-15 scores for PD-NC, PD-MCI, and PDD are presented in Table 3. The Kruskal-Wallis test analysis showed significant difference between PD cognitive stages for PDAQ-15 (p < 0.001). PDAQ-15 had a moderate-high effect size (ES = 0.62) in separation of the PD-NC from PD-MCI, high effect size in separation of the PD-MCI from PDD (ES = 0.88) and PD-NC from PDD (ES = 0.93).

**Discussion**

The aim of the present study was to describe the psychometric properties of PDAQ-15. It should be noted that this questionnaire has not yet been validated in other cultures, so the initial PDAQ-15 validation study by the Brennan et al was the only available study that we had to compare to our study (Brennan et al., 2016a, 2016b).

We found that PDAQ-15 is a valid and reliable instrument to assess the cognitive IADL in PD. The ceiling effect was observed for this questionnaire, indicating the number of the highest score and better IADL function of patients. Most of PD patients in our study were in normal cognitive stage of the CDR classification, therefore this finding could be due to the combination of our sample. Nevertheless, superiority of the PDAQ-15 was observed in its ability to identifying wide spectrum of functional decline correlated to cognitive impairments in PD.
The distribution of scores indicates which items are very easy or very difficult in general. For example, item 9 and item 15 had the lowest and highest frequency of the highest score (4 points), respectively.

The present study showed high test-retest reliability indicating, high homogeneity of respondent's score in two separate situations, which is in line with the results of the study done by Brennan et al (Brennan et al., 2016a).

The strong agreement for the inter-rater reliability and high Cronbach's alpha and item total-correlation indicating, all items included in the PDAQ-15 has almost the same value to correctly detect functional impairment is similar to the results of the study done by Brennan et al (Brennan et al., 2016a, 2016b).

We found a high degree of correlation between PDAQ-15 with Lawton IADL scale which is in line with the studies done by Brennan et al (Brennan et al., 2016a, 2016b). Also, in this study the correlation between PDAQ-15 with depression domain of HADS was high. The results of our study showed that the PDAQ-15 has the ability to find PD patients with decline in IADL function and depression.

The SEM value obtained in this study is supported by the finding of the study by Brennan et al, which indicates that this questionnaire has an adequate precision (low measurement error) for PD patients with varying levels of IADL ability (Brennan et al., 2016a).

The unidimensionality of the PDAQ-15 indicating, all items of the measurement belong to a single concept (cognitive IADL), confirmed by the study conducted by Brennan et al in the initial testing of PDAQ (Brennan et al., 2016a).

The results also showed that the PDAQ-15 has good ability to discriminate between PD-NC, PD-MCI, and PDD based on their functional impairment, which is aligned with the results of Brennan et al (Brennan et al., 2016a, 2016b). These statistically significant difference finding
could be helpful for interpretation of outcomes in clinical trials examining the impact of cognition on IADLs in PD population.

However, there are some limitations in our study. Because of the PDAQ-15 is a new questionnaire, we did not have further study to compare with our study. Additionally, we did not have Persian validate of PD specific scales to assess cognition and IADL function. All evaluations were performed while in on state, and results may have been impacted if PD patients were assessed in the off state.

In summary, our results show that the PDAQ-15 appears to be a valid and reliable instrument to detect the wide spectrum of IADL functioning decline associated to cognitive impairment in PD among Iranian population. It can be used as an appropriate tool for assessment of cognitive IADL in PD both in clinical and research settings.

Future study is needed to assess the ability of PDAQ-15 to detect meaningful changes in cognition IADL function over time and relative to therapeutic interventions. Further investigation on the transcultural validation of PDAQ-15, is also warranted.

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