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The Cognition and Emotional Well-being indices of the Parkinson's disease questionnaire-39: What do they really measure?

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Abstract

Introduction—The Parkinson's disease questionnaire-39 (PDQ-39) is a common measure of health related quality of life (HRQoL) that is widely used with Parkinson disease (PD) patients. Previous evidence suggests that the PDQ-39 reflects at least 8 dimensions (i.e., Emotion, Cognitions, Mobility, etc). To date, little research has examined the external/convergent validity of the Cognitions and Emotional Well-being domains of the PDQ-39.

Methods—A convenience sample of 303 PD patients underwent a comprehensive multi-domain neuropsychological evaluation, including tests of execution function, episodic verbal memory, processing speed, language and working memory, as well as completing measures of depression, apathy, state and trait anxiety and HRQoL (PDQ-39). Hierarchical regressions were conducted in order to examine the relationship between scores on neuropsychological tests and the Cognitions index, as well as mood measures and the Emotional Well-being index of the PDQ-39.

Results—Neuropsychological test performance did not account for a significant amount of variance in the PDQ-39 Cognitions index scores. Instead, it was depression that significantly contributed to the Cognitions index, above and beyond neuropsychological performance. The

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PDQ-39 Emotional Well-being index was also related to mood measures, primarily depression and trait anxiety.

Conclusions—The PDQ-39 Cognition index may be more related to mood functioning, as opposed to cognitive functioning, and should not be considered a “proxy” for cognitive functioning. Future studies are needed to better explain the construct of this index.

Keywords

Parkinson's disease; Health related quality of life; Depression; Cognition

1. Introduction

Health related quality of life (HRQoL) refers to the broad physical, emotional and social wellness of individuals and is influenced by various health conditions including Parkinson's disease (PD) [1]. Parkinson's disease is a neurodegenerative disorder classically identified by motor symptoms (resting tremor, rigidity, bradykinesia) but also consisting of non-motor symptoms, including cognitive and mood changes. The influence of non-motor symptoms on HRQoL may be particularly important in PD as previous findings have suggested that non-motor symptoms are stronger determinants of HRQoL than motor symptoms [2] and [3].

The Parkinson's disease questionnaire-39 (PDQ-39) is one of the most widely used measures of HRQoL in individuals with PD [4]. The PDQ-39 assesses HRQoL across eight domains: mobility, activities of daily living (ADL), emotional well-being, stigma, social support, cognitions, communication and bodily discomfort. However, limited research has examined the validity of these separate domains. This is important for at least two reasons: 1) the atheoretical development of the eight indices, and 2) questionable evidence regarding the psychometric properties of some of the PDQ-39 domains.

First, the identification of the eight domains of the PDQ-39 relied on the atheoretical fit of items based on factor analysis [5]. Briefly, the development of the PDQ-39 included interviews with 20 patients in order to identify areas of life that have been negatively influenced by PD. This resulted in a 65-item questionnaire, which was mailed to a large group ($N = 359$) of PD patients. From this sample, a factor analysis was conducted, which found 10 factors. Two factors were deemed inconsistent/repetitive and were removed by the authors in order to reduce the number of items. Overall, this process resulted in a final set of 39 items representing eight factors or “domains” of the PDQ-39. Secondly, research has shown that some items have only moderate correlations with their respective domains [6] and [7]. Misfit of items may be particularly questionable for the Cognitions index, as items frequently correlate stronger with other domains [7].

To date, validation of the PDQ-39 has focused on the external/convergent validity of the overall PDQ-39 Summary Index against other HRQoL and clinical measures, including the SF-36 Health Survey Questionnaire, the Hoehn Yahr Scale and the Columbia University Rating Scale [4], [5] and [8]. To our knowledge the Cognitions and Emotional Well-being indices have not been examined for external/convergent validity. This is particularly

relevant for the Cognitions index since two of the four items comprising the subscale do not directly refer to cognition; one item refers to unexpectedly falling asleep during the day and another item refers to the presence of distressing dreams or hallucinations.

The current study had two goals. The first goal was to examine the convergent validity of the PDQ-39 Cognitions index against standardized measures of neuropsychological performance. It was predicted that if the Cognitions index is sensitive to domains of HRQoL negatively affected by cognitive impairment then there should be a strong link between the Cognitions index and neuropsychological measures. This would be especially robust for measures of memory, executive function, and processing speed; all areas affected by PD. Thus, worse performance on memory, executive, and/or processing speed measures would be associated with higher scores on the Cognition Index (meaning worse endorsement). The second goal was to examine the convergent validity between the Emotional Well-being scale and standard measures of psychological distress, including apathy, depression and anxiety. It was predicted that if the Emotional Well-being scale is a measure of HRQoL affected by mood disturbances common in PD then there would be a strong relationship between the Emotional Well-being index and measures of apathy, depression and anxiety.

2. Methods

2.1. Design & participants

A cross-sectional design included a convenience sample of 303 patients with idiopathic Parkinson's disease according to UK Brain Bank criteria [9]. The study received approval from the University of Florida Institutional Review Board. Consent was attained prior to patient participation. All patients underwent a comprehensive neuropsychological assessment, including completion of mood and HRQoL questionnaires, between January 2006 and September 2010 as part of their routine clinical care through the University of Florida Center for Movement Disorders and Neurorestoration. Exclusion criteria included the presence of the following: 1) history of brain surgery, including deep brain stimulation, 2) severe psychiatric disturbance (e.g. schizophrenia), or 3) severe cognitive impairment defined as a score below the 5th percentile on the Dementia Rating Scale-II (DRS-II).

2.2. Self-report health related quality of life and mood measures

Health Related Quality of Life was assessed using the PDQ-39 [4]. For each of the 39 items participants used a 5-point Likert scale (ranging from “Never” to “Always/Cannot Do”) to indicate how much difficulty they have experienced, due to PD, in certain tasks/domains of life. The Cognitions domain consists of 4 items (items 30–33), while the Emotional Well-being domain consists of six items (items 17–22). Scores within a domain are converted into a scale ranging from 0 to 100, with higher scores indicating more difficulties in a certain task/domain.

Psychological distress was measured with three self-report measures of depression, apathy, and anxiety. The Beck Depression Inventory-II (BDI-II) was used to assess depressive symptoms [10]. The BDI-II contains 21 items/symptoms rated for severity on a 4-point

Likert scale. Scores above 13 or 14 have been validated as a clinically significant marker for depression within PD samples [11].

Apathy was assessed using the Apathy Scale, a 14-item questionnaire assessing motivational, affective and cognitive symptoms of apathy on a 4-point Likert scale (higher scores indicate increased apathy) [12]. A Movement Disorder Society task force recommended the Apathy Scale as a valid measure of apathy within PD samples, and a clinical cut-off score of 14 [13].

Chronic and situational anxiety were assessed with the State-Trait Anxiety Inventory (STAI) [14]. The STAI consists of 40 items on a four point Likert scale (1–4), with higher scores indicating increased amounts of anxiety. The STAI has been endorsed as an appropriate anxiety measure among individuals with PD [15].

2.3. Neuropsychological measures

Five neurocognitive domains were examined in the present study: attention/working memory, delayed verbal episodic memory, language, executive functions, and processing speed. The attention/working memory tests consisted of the Forward Span and Backward Span scores of the Digit Span subtest from the Wechsler Adult Intelligence Scale-III (WAIS-III). Verbal memory measures included the 20 min delay recall scores from the Hopkins Verbal Learning Test-II (HVLT-II) and the 30 min delayed recall of the Logical memory Stories-II from the Wechsler Memory Scale-III (WMS-III). The Boston Naming Test (total correctly named without cue) and an Animal Fluency test comprised the language domain. Tests of executive functioning included the Trail Making Test- Part B, the color-word interference trial of the Stroop Color-Word, and the letter fluency test of the Controlled Oral Word Association test. Lastly, the processing speed domain included the Trail Making Test- Part A, and the Word reading section of the Stroop Color-Word task.

Scores for each neurocognitive measure were normed for age/education according to test-specific manuals or from the Heaton comprehensive norms manual [16]. An attempt was made to include more than one measure per domain to improve reliability [17]. Normed scores were converted to z-scores in order for measures to be on a common metric. Scores within the same domain were averaged together to compute a “composite” score.

Advantages to using composite scores include better reliability with multiple measures per construct of interest and fewer overall analyses/family-wise error rate.

2.4. Statistical analyses

A series of Pearson's correlations were computed to examine the relationship between PDQ-39 Cognitions Index and neuropsychological composite scores. Similar correlations were computed to inspect the relationship between mood questionnaires and the PDQ-39 Emotional Well-being domain. Assumptions of normality were checked and confirmed by visual inspection of the distributions of neuropsychological composite scores, mood questionnaires and the Cognitions and Emotional Well-being indices of the PDQ-39.

Individual items within the PDQ-39 were treated as ordinal data. Spearman's correlations were conducted to examine the relationship between individual items within the PDQ-39

Cognitions domain and neuropsychological tests. Similar analyses were repeated to examine correlations between PDQ-39 Emotional Well-being item data and mood functioning.

To examine the unique contribution of the neuropsychological domains to PDQ-39 Cognition scores, multiple hierarchical regression analyses were used. The five separate cognitive domains (attention/working memory, verbal memory, processing speed, executive functions and language) were regressed upon the Cognitions subscale. Similar hierarchical regressions were conducted in which depression, apathy, state anxiety and trait anxiety scores were regressed on Emotional Well-being scores.

3. Results

3.1. Sample characteristics

Table 1 shows the sample characteristics of the 303 Parkinson patients. Overall, the sample was 69% male and 88% Caucasian; with a mean age of 64.7 and 15 years of education. Average duration of motor symptoms was 9.7 years and a mean UPDRS motor (on medication) score of 26.3. The average Dementia Rating Scale-II score and PDQ-39 Summary Index were 137.2 and 29.5, respectively.

3.2. PDQ-39 cognitions and neuropsychological domains

Pearson's correlations revealed a significant, although small correlation between the PDQ-39 Cognitions score and the neurocognitive composite scores for delayed episodic memory (Pearson's $r = -.132$, $p = .012$) and processing speed (Pearson's $r = -.121$, $p = .019$). The remaining correlations with executive functioning, language or attention/working memory were not statistically significant.

Spearman's correlations inspected the relationship between the four individual PDQ-39 Cognitions items and neuropsychological composite domains (See Table 2). The memory item (item 32) significantly correlated with the delayed episodic memory composite, but not other domains. The remaining three Cognitions items (sleep, concentration, dream/hallucinations) did not significantly correlate with any neuropsychological domain.

A hierarchical regression analysis was used to examine which neuropsychological domains were uniquely related to PDQ-39 Cognitions scores. Due to a high correlation between the executive functioning and processing composite score (Pearson's $r = .715$, $p < .001$), a residualized processing speed variable was computed. As such, there was no significant multicollinearity among predictors (Tolerance $> .5$ and Variation Inflation Factor < 2). Overall, neuropsychological scores did not account for a significant amount of variance in the PDQ-39 Cognitions score ($F(5, 298) = 1.46$, $p = .203$).

3.3. PDQ-39 Emotional Well-being and mood questionnaires

Pearson's correlations between PDQ-39 Emotional Well-being scores and mood questionnaires revealed that low Emotional Well-being scores (i.e., fewer difficulties with Emotional Well-being) were related to lower amounts of self-reported trait anxiety (Pearson's $r = .525$, $p < .001$), depression (Pearson's $r = .450$, $p < .001$), state anxiety (Pearson's $r = .442$, $p < .001$) and apathy (Pearson's $r = .321$, $p < .001$).

Correlational analyses of individual items within the Emotional Well-being scale revealed that lower scores on items 17 (depressed), 18 (isolated) and 20 (anger/bitter) were related to lower ratings on measures of depression, apathy, trait anxiety and state anxiety (See Table 2). Items 19 (weepy/tearful), 21 (anxious) and 22 (worry about future) were significantly related to measures of depression, state and trait anxiety, but not apathy.

Hierarchical regressions examined the unique contribution of depression, apathy, trait and state anxiety to Emotional Well-being scores. Due to large correlations between state and trait anxiety (Pearson's $r = .704$, $p < .001$), and between trait anxiety and depression (Pearson's $r = .688$, $p < .001$), trait anxiety was residualized on state anxiety and depression to reduce multicollinearity. There were no significant multicollinearity among predictors (Tolerance $> .5$ and Variation Inflation Factor < 2). Regression analyses revealed that mood questionnaires accounted for a significant amount of variance (29%) in Emotional Well-being scores (Table 3). Depression ($\beta = 0.43$) and trait anxiety ($\beta = 0.32$) were independent significant contributors to Emotional Well-being scores.

3.4. PDQ-39 cognitions and mood questionnaires

Because performance on standard neurocognitive measures did not contribute to PDQ-39 Cognitions scores, additional post-hoc analyses were conducted to examine if mood was a stronger contributor to the Cognitions scores. Neuropsychological domains were initially regressed upon Cognitions scores, followed by a block of predictors containing depression, apathy, state and trait anxiety. Consistent with previous analyses, residualized variables of processing speed, and trait anxiety were entered; resulting in no significant multicollinearity among predictors (Tolerance $> .5$ and Variation Inflation Factor < 2). The initial block of neuropsychological performance was non-significant. The addition of the block of mood questionnaires accounted for a significant amount of variance (15%) among the PDQ-39 Cognitions scores (See Table 4). Depression was the only unique contributor to Cognitions scale ($\beta = 0.30$). Specifically greater amounts of depression were associated with greater amounts of reported difficulties on the Cognitions scale.

3.5. Mild cognitive impairment (MCI) and depression subgroups

Additional analyses were conducted to learn whether individuals with MCI would obtain worse scores on the Cognitions index than those without MCI. Mild cognitive impairment (MCI) status was determined based on Movement Disorder Society (MDS) criteria, which requires scores falling at least 1 standard deviation below normal on at least 2 tests [18]. Using the MDS criteria, 69% of the PD sample met criteria for MCI. Analyses revealed the MCI and the cognitively intact groups did not significantly differ in their PDQ-39 Cognitions scores ($p = .143$; Supplementary Table 1). A second set of analyses examined whether individuals with potential clinical depression had worse scores on the Cognitions index than those without depression symptoms. Patients were assigned to depressed and non-depressed groups based on BDI-II scores exceeding 13 [11]. The depressed group reported significantly greater difficulties in the PDQ-39 Cognitions Index compared to the non-depressed group ($p < .001$; Supplementary Table 2).

4. Discussion

There are two main findings resulting from this study. First, this study found that the PDQ-39 Cognitions index was not broadly related to performance across multiple neuropsychological domains, and only minimally correlated with tests of delayed verbal memory and processing speed. Instead, mood, especially depression, showed a stronger relationship to the PDQ-39 Cognitions index score than did the neurocognitive measures. Secondly, the PDQ-39 Emotional Well-being domain was significantly related to separate independent measures of mood, and was primarily influenced by symptoms of depression and long-standing anxiety.

The finding that neuropsychological tests do not significantly account for PDQ-39 Cognitions scores was counter to our hypothesis. Past studies have shown cognitive performance to have a modest influence on HRQoL when assessed by broad measures of HRQoL [19], [20], [21] and [22]. However, it is important to note that only two of these studies inspected the relationship of cognitive performance to the specific domains of HRQoL (particularly the PDQ-39 dimensions). One study examined the influence of mild cognitive impairment (MCI) status and cognitive decline on the PDQ-39 dimensions [22]. While Parkinson individuals with MCI reported worse HRQoL in the domains of social support and communication, there was no significant difference between the MCI and the cognitively intact group in terms of the Cognitions domain. A separate study with 20 PD patients examined the relationship between PDQ-39 dimensions with various items on the Mini-Mental State Examination (MMSE) and the Consortium to Establish a Registry for Alzheimer's Disease (CERAD) [21]. The PDQ-39 Cognitions dimension did show a moderate correlation with the Attention-Calculation item on the MMSE, and the verbal fluency component of the CERAD, but not with the total MMSE, or any other tests within the CERAD (word list recall & recognition, and construction/praxis). Both of these studies are consistent with our findings that the PDQ-39 Cognitions dimension is not strongly related to neurocognitive performance.

The question arises as to what the PDQ-39 Cognitions Index actually relates to or is influenced by. In the present study, the Cognitions index demonstrated questionable divergent validity from measures of mood (particularly depression and long-standing anxiety). The relationship between depression and the PDQ-39 has been well documented as many studies have shown depression to be one of the strongest predictors of PDQ-39 Summary Index [2], [3], [23] and [24]. However, none of these studies examined the relationship between mood and the individual indices of the PDQ-39. In addition to depression being a possible confounder, inspection of individual items may help explain the underlying construct of the Cognitions index. The memory item, but not the attention, dream/hallucination or daytime-sleepiness items, was the only item significantly correlated to any neuropsychological test. It is likely that the attention, dream/hallucination and daytime-sleepiness items may have a stronger relation to a construct other than cognition (possibly symptoms of depression such as fatigue or arousal/sleep difficulties).

In contrast to the Cognitions index, the Emotional Well-being index demonstrated modest convergent validity (29% of the variance was explained by mood measures), and was

primarily related to depression and trait anxiety. As mentioned above, this is consistent with past findings that depression is a strong predictor of HRQoL. Additionally, the finding of a significant relationship between long standing anxiety and the PDQ-39 Emotional Well-being is consistent with past findings of anxiety being a significant predictor of the PDQ-39 Summary Index [25].

It is important to note that the current study utilized both objective (neuropsychological tests) and subjective measures (mood and HRQoL questionnaires). It is possible that the finding of the PDQ-39 Cognitions Index relating to mood questionnaires but not objective neuropsychological measures may be due to differences in the assessment methods/modalities (objective versus subjective measures) rather than differences in the underlying construct (cognitions versus moods). Past studies in PD have shown subjective ratings of cognition to have a stronger correlation to subjective measures of depression, rather than objective neuropsychological measures [26]. However, it is important to note that depression was the only self-reported mood symptom to show a significant relationship with the PDQ-39 Cognitions Index, while self-reported apathy and anxiety were not significantly related to the Cognitions Index. Thus, it appears unlikely that the similarities in modality (i.e., both the PDQ-39 and BDI-II are subjective measures) is fully explaining the relationship between depression and the Cognitions Index.

This study examined the external validity of the Cognitions and Emotional Well-being indices of the PDQ-39; however limitations are present in the current study. First, this study utilized a cross-sectional sample of PD patients; therefore the directionality of the relationships cannot be determined. Additionally, this study utilized a convenience sample of patients from an outpatient movement disorders center; possibly limiting the generalizability of the findings. Data was limited in its ability to establish the external validity of all of the PDQ-39 indices. Future studies are needed to examine the external validity of the mobility, ADL, stigma, social support, communication and bodily discomfort subscales. As mentioned in the previous paragraph, the current study assessed cognition with objective neuropsychological tests, while mood and HRQoL were assessed with subjective self-report measures. Despite the fact that the measures of mood and cognition have been validated, one might expect self-report measures to correlate more with other self-report measures rather than objective measures. Future studies may benefit from objective/behavioral and subjective measures of mood and cognition. The current study utilized MDS criteria to examine PDQ-39 Cognition scores in individuals with and without MCI. It should be noted that other criteria may lead to different occurrences of MCI [17]. Lastly, the neuropsychological battery did not utilize non-verbal memory or untimed measures of executive functioning. Even so, the domains assessed are representative of typical cognitive deficits in PD.

5. Conclusion

While the Emotional Well-being index of the PDQ-39 showed a moderate relationship to measures of depression and anxiety, the Cognitions index was unrelated to cognitive functioning. Rather than measuring HRQoL specific to cognitive functioning, the Cognitions index may be measuring a separate construct (possibly depression or arousal/

sleep efficiency). An important take home message is that the Cognitions index is not a “proxy” for cognitive functioning, and future studies are needed to better understand the construct of this index.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- We examined the convergent and divergent validity of two subscales of the PDQ-39.
- PDQ-39 Cognitions scale did not show a relationship with neuropsychological tests.
- The PDQ-39 Cognitions scale was significantly related to depression.
- The PDQ-39 Emotional Well-being scale was related to depression and anxiety.
- PDQ-39 Cognitions scale should not be considered a proxy for cognitive functioning.

Table 1

Sample characteristics.

<i>N</i> = 303 Parkinson's disease patients			
88% Caucasian			
69% male, 31% female			
	Mean	Standard deviation	Range
Age (years)	64.7	10	30–90
Years of education	15.0	3	7–20
Years with symptoms	9.7	6	1–33
UPDRS motor score, on medication	26.3	10	7–54
Percent tremor predominant	82		
Levodopa equivalency dose	771	532	0–2950
Dementia rating scale-II total score	137.2	5	119–144
Neurocognitive domain Z-scores ^a			
Executive composite score	−0.6	0.9	−29 – 1.9
Verbal memory composite score	−0.4	1.1	−3.7– 1.8
Processing speed composite score	−0.7	0.9	−3.2– 1.9
Language composite score	0.2	1.2	−4.0–3.2
Working memory composite score	0.2	0.3	−1.9–2.7
PDQ-39			
Summary index	29.5	16	2.3–100
Cognitions	29.1	20	0–100
Emotional well-being	28.1	22	0–100

^aZ-scores based on normative data from test manuals and published norms: normative mean = 0, standard deviation = ± 1 ; UPDRS = Unified Parkinson's Disease Rating Scale; PDQ-39 = Parkinson's disease questionnaire-39.

Table 2

Spearman's correlations of individual PDQ-39 items, neuropsychological domains and mood questionnaires.

	Executive function	Delayed episodic memory	Attention	Processing speed	Language	BDI-II	AS	STAI-S	STAI-T
Sleep ^a	-.016	-.058	-.02	-.049	-.016				
Concentration ^a	-.056	-.105	-.046	-.107	-.003				
Memory ^a	-.027	-.171 [*]	-.014	-.06	-.092				
Hallucinations ^a	-.071	-.086	.011	-.074	-.027				
Depressed ^b						.419 ^{**}	.316 ^{**}	.366 ^{**}	.515 ^{**}
Isolated ^b						.446 ^{**}	.329 ^{**}	.422 ^{**}	.538 ^{**}
Weepy ^b						.332 ^{**}	.105	.273 ^{**}	.367 ^{**}
Anger ^b						.352	.156 [*]	.298 ^{**}	.443 ^{**}
Anxious ^b						.342 ^{**}	.124	.361 ^{**}	.456 ^{**}
Worry/future ^b						.313 ^{**}	.126	.429 ^{**}	.437 ^{**}

*
p < .05;

**
p < .001.

BDI-II = Beck Depression Inventory-II; AS = Apathy Scale; STAI-S = State-Trait Anxiety Inventory-State subscale; STAI-T = State-Trait Anxiety Inventory-Trait Subscale.

^aRefers to items from the PDQ Cognitions Scale.

^bRefers to item from the PDQ-39 Emotional Well-being scale.

Table 3

PDQ-39 emotional well-being regressed on mood questionnaires.

Dependent variable: PDQ-39 emotional well-being				
	<i>F</i>	<i>R</i> ²	Beta	Sig
Final model	17.937	0.285		<.001
Depression			.430	<.001
Apathy			.009	.911
State anxiety			.080	.208
Trait anxiety			.318	<.001

PDQ-39 = Parkinson's disease questionnaire-39.

Table 4

PDQ-39 cognitions regressed on neuropsychological domains and mood questionnaires.

Dependent variable: PDQ-39 cognitions				
	<i>F</i>	<i>R</i> ²	Beta	Sig
Neuropsychological domains	1.187	0.033		.318
Mood questionnaires	8.096	.153		<.001
Depression			.300	.001

Only significant predictors shown. PDQ-39 = Parkinson's disease questionnaire-39.