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Should gait speed be included in the clinical evaluation of Parkinson's disease?

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ABSTRACT

Background: The Unified Parkinson's Disease Rating Scale is the most commonly used scale in the clinical study of Parkinson's disease. However, it may fail to capture the essence of physical impairment in patients with Parkinson's disease and thus limit responsiveness of caregivers, patients, and/or clinicians as to increasing physical disability. This study sought to compare subjective measures of physical disability in Parkinson's disease to an objective, accurate, and proven measure of physical function-gait speed. Methods: Eighty-eight individuals with early to moderate stage Parkinson's disease were evaluated on the Unified Parkinson's Disease Rating Scale, the Parkinson's disease Questionnaire 39 and during five 8 meter walking trials. Spearman correlations coefficients were used to determine the association among all variables of interest. Results: The findings demonstrate that only a fair to moderate relationship between objectively measured gait speed and physical function as measured subjectively by the clinical rating scale and as evaluated by the patients during self report. Conclusions: The results of this study suggest that commonly utilized measures of physical function in Parkinson's disease are not highly correlated with gait speed. Because gait speed is demonstrated as a dependable proxy for physical function, the results of this study may provide a rational for the use of gait speed to provide a more accurate picture of physical function in patients with Parkinson's disease.

Keywords: Parkinson's Disease; Falls; Mobility Disability; Gait Speed; UPDRS

1. INTRODUCTION

Parkinson's disease (PD) is a neurodegenerative disorder characterized by progressive bradykinesia, rigidity, tremor and postural instability. Of these four cardinal features, perhaps none has a more debilitating impact on quality of life than postural instability/gait difficulty (PIGD) and the associated mobility disability and falls. Unfortunately, 70% to 87% of individuals with PD fall during the course of their disease [1,2]. And in fact, research demonstrates that walking is the most common fall-related activity for PD patients [3]. However, despite the commonality and severe consequences of PIGD, the Unified Parkinson's Disease Rating Scale (UPDRS)—considered the "gold standard" of PD clinical rating—includes only one motor examination item specifically focused on gait (Item 29). In addition to lack of thoroughness related to PIGD, the UPDRS may be too simplistic and may fail to capture the essence of PIGD given its 0 - 4 scale.

While the UPDRS is the most commonly used scale in the clinical study of PD [4] it should be noted that research demonstrates that some qualitative evaluation measured in the UPDRS do not accurate assess the intended outcome variable. For example, postural instability as measured subjectively by the retropulsion test (Item 30) in the motor examination of the UPDRS is not highly related postural instability as measured by the more objective dynamic posturography [5]. While the relationship between balance and the UPDRS is noteworthy, a clearer picture of the relationship between clinical gait assessments provided by the UPDRS as well as patients self-reports and objectively measured gait function is needed. Understanding the relationship between the various gait assessment tools may contribute to limiting the ambiguity in PD gait assessment. Additionally, quantifying this relationship may provide the rational for a more stringent gait assessment needed to objectively identify those at increased risk of mobility disability and/or falls.

Therefore this study sought to investigate the relationship between the UPDRS, patient self-reports, and a quantitative evaluation of gait function as measured by gait speed. Importantly, gait speed is related to both falls

and mobility disability in older adults and patients with PD [3,6]. It was hypothesized that the UPDRS, given its lack of profundity, would fail to statically correlate with the gait speed in PD. Further, it was hypothesized that participants would over estimate their walking ability on the self reports when compared to the objective, quantitative measure of gait speed.

2. METHODS

Eighty-eight individuals with early to moderate stage idiopathic PD participated in this study (Modified Hoehn & Yahr Stage between 1 to 2.5). These patients were recruited via advertisements within the University's Movement Disorders Clinic. The diagnosis of idiopathic PD was made by a neurologist with fellowship training in Movement Disorders using known diagnostic criteria (UK Brain Bank Criteria for PD). All participants were on stable doses of dopaminergics and evaluations were conducted while the patients were clinically "ON", or fully responding to their PD medications (1 to 1.5 hours of taking their antiparkinsons medicines). At the time of testing, none of the patients exhibited any dyskinesia, dystonia, or other signs of involuntary movement. Informed written consent was obtained from all participants in according with the Institutional Review Board guidelines.

2.1. Subjective Evaluation

UPDRS—For the analysis this study utilized the total UPDRS motor score as well as individual item 29 (gait).

Postural instability/gait difficulties (PIGD) sub score-Calculated utilizing the summed total of UPDRS items 27 - 30.

Parkinson's Disease Questionnaire-39 (PDQ-39). The PDQ-39 measures "quality of life" in eight discrete domains as measured by patient self report. For the analysis item 4 (had problems walking a half mile), item 5 (had problems walking 100 yards), and item 9 (felt frighten or worried over falling in public) were utilized.

2.2. Objective Evaluation

Gait Speed—Gait trials were performed along an 8 m walkway, containing a force platform surrounded by a ten camera (180 Hz) Peak Motus 3D Optical Capture system (Peak Performance Technologies, Inc., Centennial, CO). Ground reaction forces were collected using a multi-component force platform (Bertec Instruments, Columbus, OH) mounted flush with the walkway. Forces and moments along the 3 principal axes were sampled at 360 Hz (Peak Performance Technologies, Englewood, CO). The cameras and force platform recordings were time synchronized using the Peak Motus video analysis system. Passive retro-reflective markers were placed over landmarks in accordance with the Helen Hayes marker system.

Participants began each trial standing quietly in a relaxed position. In response to a verbal cue, the participants initiated walking and continued walking for 8 meters. For each participant, one to two practice trials were followed immediately by five data collection trials. Gait speed was calculated and averaged across all trials.

2.3. Analysis

Data were analyzed using SPSS version 20 software. Spearman correlations coefficients were used to determine the association among item 29 of the UPDRS as well as the UPDRS motor score and gait speed. Additionally, gait speed was analyzed in comparison to the PIGD sub score and items 4, 5 and 9 of PDQ-39. Lastly the subjective measures (UPDRS and PDQ-39) were compared. The criteria used to evaluate Spearman correlation coefficients were: fair (values of 0.25 - 0.50), moderate to good (values of 0.50 - 0.75), and excellent (values of .75 and above) [7].

3. RESULTS

All demographic data as well as means and standard deviations of all variables of interest are seen in **Table 1**.

The findings demonstrate that there is only a fair to moderate relationship between gait speed and physical function as measured subjectively by the clinical rating scale and as evaluated by the patients during self report (**Table 2**).

Interestingly, the subjective measures of physical function provided by the clinician (UPDRS) and the subjective measures provided by the patients (PDQ-39 items 4, 5 and 9) were moderately and highly correlated (**Table 3**).

Table 1. Means and standard deviations on variables of interest.

Age (yr)	69.45 ± 7.07
Disease duration (yr)	9.70 ± 4.59
Avg. age at onset	58.24 ± 8.79
UPDRS motor score	23.61 ± 6.70
UPDRS Item 29-Gait	0.71 ± 0.64
PIGD score	0.79 ± 0.43
PDQ-39 (Item 4)	1.25 ± 1.31
PDQ-39 (Item 5)	0.59 ± 0.98
PDQ-39 (Item 9)	0.75 ± 0.95
Gait speed (m/s)	1.10 ± 0.24

4. DISCUSSION

Our findings demonstrate that there is only a fair relationship between gait as measured by item 29 of the UPDRS and gait performance as measured by gait speed. Similarly, motor function as measured by the overall UPDRS motor score only fairly correlated with gait speed. Our results did show a moderate correlation between our objective measure of gait speed and the PIGD sub score. The subjective measures of physical function provided by the clinician and the patients were moderately and highly correlated. However, neither of these measures was found to be highly correlated with the reliable and validated objective measure of gait function. These results suggest that those with early staged PD may overestimate their walking ability and their ability move safely through their environment. This false sense of security my predispose individuals with PD to put themselves in situations of high risk for a fall event. Equally troublesome is that clinicians may also not identify subtle gait predispositions that may place a patient at an increased risk of a fall and/or mobility disability. As such, the clinician may be less likely to refer and suggest patients participant in intervention strategies aimed to improve physical function (e.g. exercise).

An integral component in the prevention of falls and mobility disability in a high-risk group is an understanding by the patient, caregiver, and provider as to the risk factors. Interestingly, in the case of falls for example, Braun demonstrated that although community dwelling older adults recognized the risks of falling they did not consider themselves to be susceptible to falls [8]. More specific to PD, Sadowski and colleagues examined awareness of risk factors associated with falling among a group of community dwelling adults with PD using the Falls Risk Awareness Questionnaire [9]. Surprisingly, this cohort recognized their increased probability of a fall, however, were unaware of specific risk factors that may increase the chances of a fall (e.g. medication use).

Pickering and colleagues evaluated the relationship between fall rates and increased UPDRS scores hypothesizing that as disease severity increased so would fall episodes [10]. Interestingly, fall episodes did increase as disease severity increased to a plateau for UPDRS values of about 50. However, there was a slight decline in risk of falling observed among cases thereafter. The most logical explanation is that patients beyond this threshold were immobile as a result of overt mobility disability. However, an alternative or concurrent suggestion may be that until this threshold is reached, clinicians, caretakers, and perhaps patients themselves fail to recognize increase fall risk and therefore fail implement a fall prevent plan. As such, prior to an obvious increase in fall risk deemed by disease severity, no fall prevention plan or intervention strategies are executed. Interestingly, the Pickering study also demonstrated that UPDRS items of posture, gait, balance, and rising from a chair were not independently associated with falls. The group added that a possible explanation could be, "current clinical tests for balance and gait are imperfect predictors of falls in everyday life [10]."

Importantly, the PIGD sub score of the UPDRS (summed items 27 - 30) did exhibit the highest (moderate correlation) to our objective measure of gait speed. This sub score seeks to further describe patients' postural stability, gait and the collective relationship to balance difficulty. The PIGD score has been utilized to give a more comprehensive clinical evaluation of postural stability and gait function in PD [11]. Importantly, the PIGD score

Table 2. Spearmen's correlations with *p* values between objective and subjective measures.

	Gait Speed	Correlation Criteria
UPDRS		
Motor	–0.306 (0.009)	Fair
Item 29	–0.408 (0.000)	Fair
PIGD Sub Score	–0.581 (0.000)	Moderate
PDQ-39		
PDQ-4	–0.136 (0.258)	Not significant
PDQ-5	–0.145 (0.229)	Not significant
PDQ-9	–0.206 (0.121)	Not significant

Table 3. Spearmen's correlations with *p* values between subjective measures.

	UPDRS Motor	Item 29	PIGD Sub Score	PDQ-39 (Item-4)	PDQ-39 (Item-5)	PDQ-39 (Item-9)
UPDRS						
Motor	-	0.408 (0.000)	0.698 (000)	0.145 (0.229)	0.136 (0.258)	0.287 (0.015)
Item 29	0.408 (0.000)	-	0.657 (0.000)	0.306 (0.009)	0.281 (0.018)	0.392 (0.001)
PIGD Sub Score	0.698 (000)	0.657 (0.000)	-	0.0217 (0.070)	0.206 (0.085)	0.362 (0.002)
PDQ-39						
PDQ-4	0.145 (0.229)	0.306 (0.009)	0.0217 (0.070)	-	0.702 (0.000)	0.485 (0.000)
PDQ-5	0.136 (0.258)	0.281 (0.018)	0.206 (0.085)	0.702 (0.000)	-	0.470 (0.000)
PDQ-9	0.287 (0.015)	0.392 (0.001)	0.362 (0.002)	0.485 (0.000)	0.470 (0.000)	-

has been shown to correlate with the Activities-Specific Balance Confidence scale (the ABC scale, a patient-rated questionnaire assessing balance confidence during activities of daily living, including walking) [11]. As such, in conjunction with our findings, although not completely inclusive, this sub score may be viewed as a more compressive measure of physical function in PD.

Although clinically the use of motion analysis may not be practical, there are more "clinic-friendly" assessments that can provide a more robust examination of gait and physical function. For example, we have previously demonstrated that both the Functional Reach and the Six-Minute walk tests correlated with dynamic postural stability in patients with PD [12]. As such, more easily obtainable patient information, from a stopwatch for example, may be a valuable option for clinicians to provide informative assessments.

In conclusion, our findings suggest that subjective measures of the UPDRS may not adequately evaluate physical function when compared to an objective measure of gait speed. As such, the ability of the UPDRS and patient self report may not adequately identify those that may be at risk for a falls and/or mobility disability. While the PIGD sub score of the UPDRS did moderately correlate with our objective measure of gait speed, the results of this study suggest that a quantitative measure may provide a more accurate picture of physical function in patients with PD. Future research is needed to more definitively identify gait speeds at which PD patients are at risk for falls and mobility disability.

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