

Application of the Continuous Scale Physical Functional Performance Test to People with Parkinson Disease

Margaret Schenkman PhD, PT¹

Toni M. Cutson, MD^{2,3}

Maggie Kuchibhatla, PhD³

Burton L. Scott, MD⁴

M. Elaine Cress PhD⁵

ABSTRACT

Parkinson disease (PD) is a chronic progressive neurological disorder, often resulting in substantial limitation of function. A number of self-report and performance-based measures have been used to quantify change of disease state or function in people who have PD. These measures have limitations when used to quantify function in individuals in the early or mid-stages of PD, especially in people with pre-clinical levels of functional difficulty. The purpose of this paper is to (1) review tests and measures currently available to quantify functional limitations of those with PD; (2) determine reliability and concurrent validity of a new measure, the Continuous Scale Physical Functional Performance (CS-PFP) test applied to those with PD. Participants were 42 independent, community-dwelling adults with idiopathic PD. Mean (SD) age was 63.7 (11.5); 31.7% were women. Participants completed self-report measures of function, the CS-PFP, and 3 other performance-based tests (Functional Reach, Timed Up & Go, 360° turn). Ten participants were tested twice on the CS-PFP, one week apart. The CS-PFP was found to be a reliable measure of physical function in the early and mid-stages of PD ($k = 0.95$). The CS-PFP correlated moderately strongly with other self-report measures (eg, United Parkinson Disease Rating Scale (UPDRS) $r = -.62$, $p = .0001$; Northwestern University Disability Scale, $r = .43$, $p = .006$) and with performance based measures (eg, Functional Reach, $r = .70$, $p = .0001$; Timed Up & Go, $r = -.69$, $p = .0001$). Multivariate analysis showed the UPDRS to be a predictor of CS-PFP score. The regression model (including control variables of age, sex, depression, and pain) explained over 50% of the variance in CS-PFP; age and UPDRS scores were the significant predictors. The CS-PFP is a reliable and valid measure for determining physical function in individuals who are in the early and mid-stages of PD. This scale identified substantial functional decline to a greater extent than other scales specific to PD.

INTRODUCTION

Parkinson disease (PD) is a chronic progressive neurological disorder, often resulting in substantial limitation of

functional activity. Limitations may be relatively mild initially; however, as the disease progresses, limitations may be substantial, interfering with basic daily activities (eg, getting out of bed, getting up from the seated position)¹ as well as household activities (eg, doing laundry, cooking) and participation in societal activities. While functional limitations associated with PD are easily identified later in the disease, they are less easily quantified in the early phase after diagnosis. Quantification of subtle functional limitations may enable objective identification of physical limitations that should be treated early in the disease to delay the onset of disability. Objective quantification also provides a means to monitor the benefits of physical therapy. This article reviews available tests of physical function for individuals with PD, with particular emphasis on tests of functional limitation. It also examines the reliability and validity of a new measure applicable for research and clinical purposes.

AVAILABLE MEASURES FOR QUANTIFYING FUNCTIONAL LIMITATIONS

A number of options exist for quantifying functional activity in people with PD. These include self-report and performance-based measures, as well as measures that combine both approaches. Each measure has strengths and limitations.² Hoeymans and colleagues³ suggested that performance testing may be complementary to self-report, as both may measure different constructs. Self-report measures identify the individual's *usual performance*. Responses can be provided by the individual or the care-giver/significant other. Performance-based measures permit the examiner to observe and score a task from a variety of perspectives, including successful completion, efficiency (eg, time, distance, amount of assistance), and the quality of the performance (eg, observation of strategies). Performance-based measures typically have task constraints, so that the individual cannot use adaptive strategies to overcome impairments. Thus performance-based measures may identify impairments before actual functional losses ensue.² The period of time before overt functional loss occurs has been referred to by Fried as 'preclinical disability.'⁴

¹Physical Therapy Program, Department of Rehabilitation Medicine, University of Colorado Health Sciences Center, Denver, CO (margaret.schenkman@uchsc.edu)

²GRECC, Durham Veterans Affairs Medical Center, Durham, NC

³Center for the Study of Aging and Human Development, Duke University Medical Center, Durham, NC

⁴Division of Neurology, Department of Medicine, Duke University Medical Center, Durham, NC

⁵Department of Exercise Science and Gerontology Center, University of Georgia, Athens, GA

Both self-report and performance-based measures have been used to examine function in people with PD. Some key examples will be found below.

PD-specific Measures

A number of disease-specific measures exist for individuals with PD. These frequently involve a combination of self-report, physical examination, and in some cases, performance-based measures. The Hoehn and Yahr scale⁵ was one of the first tools developed to quantify disease state in people with PD. This 5-item scale categorizes individuals based on signs and symptoms, balance, and functional dependence. The scale was subsequently modified to include additional gradations that more clearly identify onset of balance dysfunction.⁶

The Northwestern University Disability Scale (NUDS)⁷ and Modified Schwab and England Activities of Daily Living Scale (S&E)⁸ were designed to measure observed physical function. The NUDS scores walking, dressing, hygiene, and speech (0-10) and eating and feeding (0-5). The S&E provides an estimate (10% increments) of overall functional difficulty from complete independence to vegetative function. Both tests examine 'functional limitations' as defined by disablement models.^{9,10} Neither scale discriminates subtle differences within the range between 'no difficulty' and 'just beginning to experience difficulty,' nor are they designed to detect improvements of efficiency or quality of movement. The Columbia University Rating Scale (CURS)¹¹ and Webster Rating Scale (WRS)¹² obtain information by self-report and physical examination. The categories for these tests range from *no problem* to *maximum difficulty* (with ranges from 0-4 or 0-3 respectively). Both scales include questions that relate to functional ability (eg, gait, rising from a chair) and questions related to impairments (eg, rigidity, tremor).

Although the above scales have been used for some intervention studies,¹³ relatively little testing of psychomotor properties has been reported. There is inconsistency across time for the responses among various scales.^{11,14} This is not surprising, given that each scale includes different combinations of measures of impairment and functional activity.

The Unified Parkinson Disease Rating Scale (UPDRS) was developed by a committee of neurologists to overcome some of the difficulties with existing measures.^{6,15} The UPDRS relies on a combination of patient report (eg, bed mobility, transfers) and direct examination (eg, rigidity, postural instability) with 2 performance-based measures (sit-to-stand and gait). The UPDRS provides a total score as well as 4 subscores: mentation, behavior, and mood; activities of daily living (ADL); motor examination; and complications of therapy. In addition, the UPDRS includes a modified Hoehn and Yahr stage of disease. The UPDRS, in contrast to earlier scales, has undergone substantial testing including testing of reliability,^{16,18} and has become the standard for evaluation of effectiveness of pharmacological and surgical procedures.

The UPDRS has several limitations with respect to monitoring changes associated with physical intervention. First, the subscores do not clearly differentiate among categories with respect to disablement models. For example the motor subscale, predominantly is based on impairments associated with PD (eg, rigidity, tremor), but also includes several questions that relate to function (ie, rising from a chair and gait). Conversely, the ADL subscale, designed to measure aspects of physical functional ability, also includes impairments (ie, tremor and sensory complaints). It can be difficult to use the subscales specifically to differentiate between and correlate among impairments and function.

The items of the UPDRS are not designed to detect clinically important but relatively subtle changes in task performance. The gradations in the UPDRS lack sensitivity to detect changes in speed, stability, and overall efficiency of movement that are likely to occur with appropriate physical intervention in the earlier stages of PD. This period of time, before the individual exhibits overt disability, may be when physical intervention can be most effective as an adjunct to pharmacological approaches to maintaining function. Furthermore, there are limitations to linearity in UPDRS scaling. For example, not walking at all may be more than 2-fold worse than walking with some difficulty.

The Duke University Parkinson Disease Rating Scale (DUPRS)¹⁹ was developed to address some of these issues. The DUPRS was constructed with 3 distinct subscales: impairments, functional limitations, and behavior/mood. The items on the scale were constructed to have greater sensitivity to early problems associated with PD because of its intended use for those in the early and mid-stages of the disorder (as opposed to throughout the disorder). This scale, like the UPDRS, relies on a combination of patient report, direct examination, and performance. Reliability and validity are good although sensitivity to change has not yet been reported.¹⁹

Thus many PD-specific measures have only limited testing of reliability and validity. Others, though better tested (eg, UPDRS) do not have the adequate sensitivity to detect relatively subtle, yet potentially meaningful changes in function. The available measures only examine issues related to individual performance of basic ADL (eg, bed mobility, getting up from the seated position, gait). None of these measures examine more complex instrumental ADL (eg, doing laundry, cooking). Assessment of function using these PD-specific measures may therefore substantially underestimate the functional impact of PD on the individual. Finally, the available measures seek to quantify functional limitations as opposed to functional ability. When examining individuals with preclinical disability, it is important to quantify declining ability as opposed to disability.

Generic Performance-Based Measures

Several general performance-based measures have been used in the assessment of individuals with PD. These include the Functional Reach,²⁰ 360° Turn,²⁰ Six Minute

Walk,²⁰ Two Minute Walk,²¹ Timed Up & Go,²² and a battery of balance-related measures including steady standing, response to self-initiated perturbations, and response to unexpected perturbations to the body's center of mass.²³ Available evidence demonstrates that test-retest and inter-rater reliability can be good to excellent for performance-based measures applied to individuals in early and mid-stages of PD.^{20,24} Reliability may be enhanced by testing individuals at the same time of day relative to taking of medications.²⁰

Only limited information is available regarding the validity of these measures or their responsiveness to change. Smithson et al demonstrated that a small battery of tests (ie, tandem stance, single-limb stance, functional reach, and shoulder tug tests) has adequate sensitivity to discriminate between people with PD who fall and those who do not have a history of falls.²³ Schenkman and colleagues demonstrated significant improvements in Functional Reach and 360° turn following an intervention specifically designed to improve spinal range of motion and hypothesized to improve function.²⁵

These performance-based measures, as well as other selected measures of gait and balance, have been used to evaluate interventions with individuals who have PD.²⁵⁻²⁸ There are, however, limitations. First, individuals in early stages of PD may have a wide variety of impairments and functional limitations. Some individuals have more difficulty with bed mobility and transfers but have good balance and gait, while others have particular difficulty with balance yet be able to perform bed mobility or transfers with ease. Hence single item tests may underestimate functional improvements when applied to a group of individuals.

Secondly, an individual may perform at or above the ceiling when carrying out specific tasks in isolation, though the same individual may have difficulty carrying out the task in context of a series of typical daily routines. For example, an individual may have good endurance (measured by the Six Minute Walk test) or good balance (measured by Functional Reach) when these measures are administered in isolation, but might perform less well on the same measures when

administered in context of a number of activities carried out sequentially. Thus, use of a single outcome measure (eg, related to gait or balance) may overestimate an individual's usual ability and may underestimate improvement with intervention. For these reasons, the existing performance-based measures may substantially underestimate the benefits of physical intervention for individuals, especially in the early stages of PD when limitations to activities are at a subclinical level. Reliable, valid measures are needed that are sensitive to changes in functional ability of groups of individuals who are in relatively early stages of PD and may in fact have subclinical levels of disability. Such measures are needed, both for experimental investigations and for routine clinical practice.

Thirdly, performance-based measures are geared toward identifying functional limitations as opposed to characterizing functional ability. Thus by their very nature, they are likely to have ceiling effects for those who are at the cusp of disability but are not yet disabled (ie, for preclinical disability).

The Continuous Scale, Physical Functional Performance Test

The Continuous Scale, Physical Functional Performance Test (CS-PFP) was developed to overcome these limitations of measurement for those at the threshold of functional decline.^{29,30} This performance-based measure of physical function quantifies 16 common functional activities, including making a bed, unloading groceries, climbing 3 steps onto a platform while carrying luggage (simulating getting onto a bus), and getting up and down from the floor. Tasks are quantified using time alone, time and weight, or distance (Table 1). The instrument is divided into 5 subscales including upper body strength and flexibility, lower body strength, balance and coordination, and endurance.

The CS-PFP was designed to characterize an individual's functional ability. Therefore, the test was designed to withstand floor and ceiling effects when used with individuals that range from ambulatory individuals who live in more supported, assisted living environments to high functioning

Table 1. Tasks Included in the CS-PFP and Measures Used to Quantify Performance

| Task | Means of Quantification | Task | Means of Quantification | Task | Means of Quantification |
|----------------------------|-------------------------|--------------------------------------|-------------------------|------------------------------|-------------------------|
| Carry pan of weights | Time Weight | Sweep floor | Time | Suitcase onto 'bus platform' | Weight Time |
| Pour water from jug | Time Weight | Laundry from washer to dryer | Time | Carry groceries | Time Weight |
| Put on jacket | Time | Laundry from dryer to clothes basket | Time | Six Minute Walk | Distance |
| Fasten shoe strap | Time | Make bed | Time | Climb stairs | Time |
| Pick up scarves from floor | Time | Vacuum floor | Time | | |
| Reach item on shelf | Distance | Get up from floor | Time | | |
| | | Open fire door | Time | | |

athletic older adults. The CS-PFP quantifies the individual's performance of typical household activities, beginning with easy tasks and becoming progressively more difficult. Tasks are quantified by time alone, time and weight, and distance. For each task, the individual chooses the amount of weight, speed, and distance covered, so that tasks are performed at his or her perceived capacity. (The scoring algorithm takes into account both the weight carried and time to complete the task.) Tasks are performed consecutively, thus the CS-PFP measures the cumulative effect of functional performance. While he or she may be able to perform any one task easily, it may be more difficult to perform all tasks consecutively. In summary, the CS-PFP quantifies an individual's difficulty with overall endurance and efficiency for function, as opposed to simply measuring ability to complete particular tasks. A detailed description of the CS-PFP, including specifications for the lab, data collection, and scoring, is available on the world wide web.³⁰

The CS-PFP has high test-retest reliability, validity, and greater sensitivity to change than measures such as the SF-36 and Six Minute Walk.³¹ Thus this test is ideally suited to identify functional ability as well as subclinical functional improvement or decline of individuals who have PD. Furthermore, the CS-PFP can be used with individuals who are experiencing considerable functional difficulty, and recently a modified version has been validated for individuals who use a wheel chair for mobility.³² Thus the CS-PFP potentially can be used longitudinally across a wide spectrum of PD from subclinical decline to dependence in some functional activities.

The purpose of the present investigation was to examine the applicability of the CS-PFP to those with early to mid-stage PD. Specifically we examined test-retest reliability for measures obtained a week apart as well as concurrent validity of the test by comparison with measures typically used to quantify function of individuals with PD.

METHODS

Study Design

A cross-sectional design was used with data collected during a single test session.

SUBJECTS

Participants were recruited into the study from the practice in the Movement Disorders Clinic at Duke University Medical Center of one of the investigators (BS) and from the PD database at the Aging Center, Duke University Medical Center. Those in the PD database were individuals who had participated in prior intervention and quality of life studies.

Participants were included in the study if they had PD, were in early to mid-stages of PD (1-3 of the Modified Hoehn and Yahr scale),⁶ ambulated independently, lived in the community, and consented to participate. They were excluded if they had a score of less than 23 on the Folstein Mini-Mental State exam³³ or had other disorders (eg, stroke)

that interfered with their functional ability. Participants signed an informed consent, approved by the Duke University Institutional Review Board.

RATERS

The clinical examination of the participants was performed by either a neurologist (BLS) or a geriatrician (TMC). Prior to data collection, raters scored several patients independently and compared results to assure consistency in rating. The CS-PFP tests were administered by 1 of 2 physical therapists (MS and a research assistant). Prior to data collection, the research assistant was trained and then tested 10 participants with MS to assure consistency.

PRIMARY OUTCOME MEASURE

The Continuous Scale, Physical Functional Performance Test (CS-PFP)^{23,30} was used as the primary outcome measure of overall physical functional ability. The tasks are performed sequentially, providing a realistic measure of movement efficiency and ability to accomplish sustained activity. Reliability and validity of the CS-PFP have been established for community-dwelling adults without specific diseases as well as with residents in long-term care facilities.²⁹ Test-retest correlations ranged from 0.92-0.99, and internal consistency was high (Cronbach's alpha 0.74-0.97). Sensitivity to change in function has been demonstrated during a 6-month comparison of exercise versus usual care (including community dwellers and residents in long-term care facilities). In an exercise intervention study of healthy community-dwelling older adults, the CS-PFP was sensitive to improvement, suggesting that this measure is sensitive to subclinical disability.³¹ Participants completed this test in 45 to 70 minutes, depending on their functional ability.

PD-SPECIFIC MEASURES

The UPDRS was used to characterize overall disease-state.^{6,15-18} The total score and the Motor Exam and ADL subscales, were used for comparison with the CS-PFP. The modified Hoehn and Yahr scale, which is included with the UPDRS, was used to stage the participants. The NUDS⁷ and the S&E⁸ were used as comparison measures of function.

Generic Measures for Comparison

Three performance-based measures of physical ability also were used for comparison: Functional Reach, 360° turn, and Get-Up-and Go. These measures were chosen because of their relationship to known functional limitations associated with PD and because data are available demonstrating reliability.

The Functional Reach test³⁴ provides a measure of balance control, is predictive of falls,³⁵ and can be used reliably with individuals who have PD.²⁰ Participants performed 2 practice trials and 3 test trials.

The number of steps and time to complete the 360° turn²⁰ was chosen because of patient's specific difficulty turning while standing. This measure is sensitive to change

in people with PD who are undergoing physical intervention.²⁵ Participants completed 1 practice and 2 trials in each direction. Only data from turns to the right are reported in this study.

The Timed Up & Go Test (TUG) test²² was chosen because it incorporates 3 critical elements of movement: a transition from sitting to standing, walking, and turning while standing. Reliability has been demonstrated for use with people who have PD.^{22,36} Participants completed 1 practice and 2 test trials.

GENERAL MEASURES TO CHARACTERIZE THE SAMPLE

Age, sex, weight, height, and general demographic information were obtained by questionnaire. The Folstein Mini-Mental State exam³³ was used to determine cognitive status for purposes of inclusion. The West Haven Yale Multidimensional Pain Inventory (WHYMPI)³⁷ was used to determine pain. This 30-item questionnaire is based on a 7 point Likert scale (from none to extreme). Scores range from 0-180. The CES-D³⁸ was used to characterize depression. This 20-item scale is scored from 1 (rarely - less than one day) to 4 (often - 5 or more days) with scores ranging from 0 to 60.

PROTOCOL

Individuals who agreed to participate in the study were mailed a packet of questionnaires within a week of their appointment. They brought completed questionnaires (CES-D, WHYMPI) with them to their appointment. On arrival, they signed an informed consent form. They then were evaluated by a TMC or BLS to determine their cognitive status (Folstein) and overall disease-state (UPDRS, NUDS, S&E, and Hoehn and Yahr scales). Those who were evaluated by the neurologist at the Movement Disorders Clinic completed the study evaluation within 1 week for other measures; those who were evaluated by the geriatrician completed all evaluations on the same day. A research assistant reviewed the questionnaires for completeness after which he or she administered the CS-PFP followed by the other performance measures. The total test time was approximately 2 hours. In a few cases, participants were too fatigued or did not have time to complete all tests. In those cases, the performance tests other than the CS-PFP were omitted. The first 10 participants came back for a second test session for test-retest reliability of the CS-PFP, one week after the initial examination.

DATA ANALYSIS

Descriptive statistics were determined for all variables. Test-retest reliability was determined for 10 of the participants, using the kappa statistic. Bivariate correlations (CS-PFP with other measures of PD) were performed using the Pearson's Correlation Coefficients for continuous variables and Spearman Correlation Coefficient for categorical data.³⁹ The findings were interpreted using guidelines of the APTA (ie, 0.80 or greater - fairly strong, 0.6-.79 - moderate

and 0.2-.59 - weak correlations).⁴⁰ Analysis of variance (ANOVA) was used to determine differences in CS-PFP scores by stage of PD.³⁹ Differences were further examined using Tukey's post hoc analysis.

Regression analysis³⁹ was used to examine the relative contributions to variance in CS-PFP score. For the regression analysis, the outcome variable was CS-PFP score. The predictor variable was UPDRS score (or subscore) and the control variables were age, sex, depression (CES-D), and pain (WHYMPI). Age and sex were chosen because of their known influence on function;²⁹ pain and depression were included because of their influence on disability and function and because these impairments commonly are associated with PD.⁴¹⁻⁴⁴ Age and sex were entered into the model first, followed by depression, and then by pain and the UPDRS score.

RESULTS

Forty-two individuals participated in this study (Table 2). Participants were nearly equally divided between Hoehn and Yahr Stages 1 and 1.5 (combined), 2, 2.5, and 3. The mean age was 63.7 (11.5) and 31.7 % were women. Depression was relatively low in this sample, although pain was moderate for some participants. Regarding comorbid conditions, 20% had cardiovascular disease (angina, prior myocardial infarct, hypertension), 17% had arthritic conditions, 7% had diabetes mellitus, 5% had pulmonary disease, and 5% had a history of breast cancer. Regarding medications for PD, 70% were on SinemetTM, 58% on EldeprylTM, 54% on Dopamine agonists, and 4% were not taking PD medications.

Table 2. Characteristics of the Sample, n= 42 (mean, SD, unless noted)

| General Characteristics | | |
|-------------------------|-------------|-------------|
| Sex (% female) | 31.7 | |
| | mean (SD) | range |
| Age (years) | 63.7 (11.5) | 41-87 |
| Height (cm) | 173.7 (8.4) | 156.2-192.0 |
| Weight (kg) | 80.8 (20.5) | 53.2-118.4 |
| CES-D (20-80) | 10.8 (5.6) | 4-23 |
| WHYMPI (0-180) | 48.5 (27.4) | 23-128 |

Characteristics of the sample were examined further using several standard PD-specific measures of function (Table 3). Overall the sample had relatively mild PD, consistent with the finding that three quarters were in Stage 2.5 of Hoehn and Yahr or less. Performance-based measures were obtained for a subset of participants, n=34 (Table 3). Not all participants could be scheduled or had the endurance to complete the functional testing. The mean (SD) CS-PFP score for these participants was 47.6 (15.6). On average the sample had little problem with balance control (as indicated by their functional reach distances, mean (SD) = 16.3 (3.3) inches), but had more difficulty with efficient performance of more complex movements as indicated by the time to complete the Timed Up & Go (18.6 [6.0]) and the steps in the 360° Turn (14.8 [6.5]).

Table 3. PD State and Functional Ability of the Sample (mean, SD, unless noted)

| PD Specific Measures (n = 42) | | |
|---|--------------|------------|
| Hoehn & Yahr (number) | | |
| Stage 1/1.5 | 13 | |
| Stage 2 | 10 | |
| Stage 2.5 | 8 | |
| Stage 3 | 11 | |
| | Mean (SD) | Range |
| H & Y Total (0-5) | 2.07 (.79) | 1.5-3 |
| UPDRS Total (0-142) | 29.7 (14.0) | 8-58 |
| UPDRS Motor (0-56) | 15.0 (7.1) | 3-32 |
| UPDRS ADL (0-52) | 11.4 (5.5) | 2-25 |
| Northwestern (0-50) | 40.7 (5.6) | 26-49 |
| Schwab & England (0-100) | 85.8 (9.3) | 60-100 |
| General Performance-Based Measures (n=34) | | |
| Functional Reach (inches) | 16.34 (3.3) | 4.3-21.2 |
| Timed Up & Go (sec) | 18.65 (5.96) | 13.1-47.3 |
| 360° Turn to right (steps) | 14.8 (6.5) | 10-49 |
| 360° Turn to right (sec) | 8.21 (6.01) | 4.73-41.06 |

Participant function was examined using the CS-PFP (Table 4). The CS-PFP total score was 44.3 (17.6) while subscores generally fell around or below 50. The lowest subscores were for balance/coordination and lower body strength (below 40) while the highest subscores were for upper body strength and flexibility (above 50).

Table 4. Continuous Scale Physical Functional Performance (CS-PFP) scores (mean, SD)

| CS-PFP (n=42; 0-100) | mean (SD) | range |
|------------------------|-------------|-------|
| Total score | 44.3 (17.6) | 4-75 |
| Upper body strength | 55.7 (19.9) | 14-96 |
| Lower body strength | 39.3 (19.7) | 1-75 |
| Upper body flexibility | 54.7 (19.2) | 9-88 |
| Balance/coordination | 38.5 (16.8) | 1-71 |
| Endurance | 44.1 (18.4) | 1-75 |

To examine test-retest reliability, 10 of the 42 participants were tested on 2 occasions, 1 week apart. Test-retest reliability was excellent with a Kappa of 0.95.

Several approaches were used to examine the validity of the CS-PFP. First, the total CS-PFP score was compared to other measures of function using Pearson's Correlation Coefficients (Table 5). The results indicated moderate (UPDRS, S&E, Hoehn and Yahr) to weak (Northwestern) correlations with the comparisons scales. Likewise, results

Table 5. Bivariate Associations Between The Total CS-PFP Score and Other Measures of Physical Function (r, probability)

| PD-Specific Measures (n = 42) | |
|---|--------------|
| UPDRS | -.62 (.0001) |
| NUDS | .43 (.006) |
| S&E | .72 (.0001) |
| H&Y | -.69 (.0001) |
| General Performance-Based Measures (n = 34) | |
| Functional Reach | .70 (.0001) |
| Timed Up and Go | -.68 (.0011) |
| 360 turn (steps) | -.54 (.0009) |
| 360 turn (time) | -.53 (.001) |

indicated moderate (functional reach, timed up and go) to weak (360° turn) correlations with the performance-based measures.

Next, the CS-PFP scores were examined for group differences by the Hoehn and Yahr score (Table 6). The ANOVA revealed a significant group effect ($F=12.30, p < .0001$). Tukey's post hoc analysis revealed differences in performance on the CS-PFP between those in Hoehn and Yahr stage 3 with those in all other stages (2.5, 2, and 1).

Table 6. Comparison of CS-PFP Scores by Stage of PD (mean, SD)

| Stage | n | CS-PFP Total |
|-------|----|---------------|
| 1 | 13 | 55.75 (12.06) |
| 2 | 10 | 50.90 (13.18) |
| 2.5 | 8 | 41.75 (13.28) |
| 3 | 11 | 25.36 (12.68) |

Finally, regression analysis was used to examine the relative contributions of age, sex, pain, depression, and disease-state to performance on the CS-PFP. Three models were tested, using the UPDRS total score, Motor Subscale, and ADL subscale respectively (Table 7). Results of the 3 models were essentially the same: the model explained 41% of the variance when age, sex, and depression were entered into the model. The addition of pain and UPDRS (total or subscore) added an additional 10% or more, so that the full model accounted for over 50% of the variance. Age and UPDRS score (or subscore) were the significant contributors. Sex also contributed significantly to the model when the motor subscale was used, but not in the other 2 cases.

Table 7. Regression Analysis Identifying Relative Contributions to CS-PFP

| Variable | Model tested with UPDRS Total | | Model tested with UPDRS Motor Subscale | | Model tested with UPDRS ADL Subscale | |
|------------|-------------------------------|------|--|------|--------------------------------------|------|
| | Parameter estimate | P | Parameter estimate | P | Parameter estimate | P |
| | $R^2 = 52.9, p < .0001$ | | $R^2 = 56.7, p < .0001$ | | $R^2 = 54.47, p < .0001$ | |
| Age | -.56 | .014 | -.46 | .038 | -.65 | .005 |
| Sex | -.88 | .06 | -.99 | .031 | -7.298 | .12 |
| CES-D | .345 | .46 | .39 | .38 | .09 | .84 |
| Total pain | .265 | .26 | -.12 | .22 | -.072 | .49 |
| UPDRS | -.562 | .009 | -1.036 | .02 | -1.187 | .02 |

An examination of parameter estimates indicated that the UPDRS motor and ADL subscales contributed almost twice as much to the variance in the CS-PFP score as did the total UPDRS score. For example, a change of 10% on the CS-PFP is predicted to result in a change of 10 unit on the ADL or motor exam subscores, while a 10% change on the CS-PFP is predicted to result in a 5 unit change on the UPDRS total score.

DISCUSSION

The results of this investigation showed that the CS-PFP is a reliable and valid measure that can be used to quantify physical functional ability of individuals relatively early in

PD. The sample for this study was comprised of individuals who lived in the community. They were largely without depression (CES-D of 10.8, SD 5.6), contrary to other reports of community-dwelling adults with PD. Some of the participants had relatively strong pain as indicated by their scores on the WHYMPI (48.5, SD 27.4). Overall, they had little functional difficulty in comparison to individuals with PD as a whole, as demonstrated by their scores on the UPDRS, S&E, and NUDS.

The results for the CS-PFP revealed a strikingly different picture with regard to function. The mean score for participants in this study was low when compared to data for community-dwelling adults without disease.³¹ For example, Cress and colleagues³¹ reported a total CS-PFP score of 55.3 (1.5) for a sample of individuals without PD who were 70 years or older (mean age, SD of 75.6 [3.6]). The mean CS-PFP score for this sample of individuals with PD (age 63.7 [11.5]) was 44.3 (17.6). Furthermore the mean CS-PFP scores for this sample was above the mean reported score for people with self-reported limitation living in long-term care (LTC) communities (CS-PFP total 26), was similar to those without self-reported limitation living in retirement communities (CS-PFP total 46), and was less than that of individuals living independently in the community (CS-PFP total 57).³¹ Furthermore, the CS-PFP scores were significantly different for those in Stage 3 of Hoehn and Yahr (25.36 [12.68]), compared with individuals in earlier stages (55.75 [12.06] to 41.75 [13.28]). Those in Stage 3 of Hoehn and Yahr were more comparable to individuals living in LTC communities who had self-reported functional limitations. Thus this sample of individuals, who were on average over 10 years younger than the community dwelling adults without PD, demonstrate considerably lower physical functional ability as indicated by the CS-PFP.

The CS-PFP subscores suggested that individuals with PD were most impaired for lower body strength, balance and coordination, while upper body strength, upper body flexibility, and endurance were relatively less impaired. This finding is consistent with the definition of Stage 3 of Hoehn and Yahr, which includes "inability to catch oneself in response to postural perturbation," an indication of difficulty with balance. Approximately one quarter of the sample was in Stage 3, perhaps accounting for the finding that the balance/coordination subscore was the lowest CS-PFP subscore for this sample.

Test-retest reliability of the CS-PFP scores were high with Kappa = .95. This result is consistent with reports of community-dwelling adults without specific disorders in which test-retest correlations were between the 0.92-0.99.²⁹ Together with other data in the literature,^{20,23,24} the high reliability obtained with a single measure of the CS-PFP emphasizes the consistency of performance that can be obtained with those in the earlier stages of PD.

The validity of the CS-PFP was established from several perspectives. First, scores on the CS-PFP correlated moderately with other measures typically used to characterize PD

(ie, UPDRS, NUDS, S&E), demonstrating concurrent validity for this measure. Similarly, the total CS-PFP score correlated moderately with most of the general measures of physical performance.

More revealing were the results of the regression analyses. The models tested explained over half the variance in the CS-PFP scores, with age and UPDRS (total or subscore) as the significant contributors. Other factors (eg, motivation, general health, preferred work rate) most likely contribute significantly to the remaining variance, although these issues were not investigated in the present study.

The parameter estimates also demonstrate that PD symptoms contribute significantly to CS-PFP score. According to the parameter estimates, a 10% difference in CS-PFP score is equivalent to a 5.6 point difference in total UPDRS score. Similarly, a 10% difference in CS-PFP score is equivalent to 10.4 or 11.9 difference in UPDRS motor or ADL subscore, respectively. That the parameter estimate was higher for the 2 subscores than for the total score is consistent with the fact that the subscores are more closely related to function while the total score incorporates issues related to mentation /behavior/mood and complications of therapy.

Previous studies have established that the CS-PFP is a robust and sensitive measure of change in community-dwelling adults without specific disorders, even when the individuals tested do not exhibit functional difficulties.^{29,31} To fully evaluate the efficacy of the CS-PFP as an outcome measure for individuals with PD, it will be necessary to determine the sensitivity of this measure to change for those in early and mid-stages of the disease.

In summary, results of this preliminary investigation suggest that the CS-PFP has utility for quantifying functional activity in people in the early and mid-stages of PD (Modified Hoehn and Yahr Stages 1-3). The results highlight the considerable physical functional decline of individuals even in the early and mid-stages of PD. The sensitivity of this measure for high functioning individuals without PD³¹ supports use of this test with individuals who are at the cusp of functional decline, as well as individuals who have commenced progressive decline in movement and function.

ACKNOWLEDGEMENTS

We gratefully acknowledge the participants who gave generously of their time to this study and Sharon Gonzales, DPT who assisted with testing of these participants. This work was supported by the National Institutes of Health, National Institute on Aging, Claude D. Pepper Older Americans Independence Center, Grant # 5 P60 11268.

REFERENCES

- 1 Cutson TM, Laub KC, Schenkman M. Treatment of Parkinson Disease: Pharmacologic and non-pharmacologic interventions. *Phys Ther*. 1995;75:363-373.
- 2 Schenkman M, Scherer S, Riegger-Krug C, Cutson TM. Measurement of impairments and functional limita-

- tions. Conceptual issues and practical applications. *Crit Rev Phys Rehabil Med*. In press.
- 3 Hoeymans N, Wouters ER, Feskens EJ, et al. Reproducibility of performance-based and self-reported measures of functional status. *J Gerontol A Biol Sci Med Sci*. 1997;52A:M363-M368.
 - 4 Fried LP, Herdman SJ, Kuhn KE, et al. Preclinical disability. Hypotheses about the bottom of the iceberg. *J Aging Health*. 1997;3:285-300.
 - 5 Hoehn MM, Yahr MD. Parkinsonism: Onset, progression, and mortality. *Neurol*. 1967;17:427-442.
 - 6 Fahn S, Elston RL, and Members of the UPDRS Development Committee. In: Fahn S, Marsden CD, Calne D, Goldstein M, eds. *Recent Developments in Parkinson Disease*. Vol 2. Florham Park, NJ. Macmillan Healthcare Information; 1987:153-163, 293-304.
 - 7 Canter CJ, de la Torre R, Mier M. A method for evaluation of disability in patients with Parkinson disease. *J Nerv Ment Dis*. 1961;133:143-147.
 - 8 Schwab JF, England AC. Projection technique for evaluating surgery in Parkinson disease. In: Billingham FH, Donaldson MC, eds. *Third Symposium on Parkinson Disease*. Edinburgh, Scotland: Churchill Livingstone; 1969:152-157.
 - 9 Nagi S. Some Conceptual Issues in Disability and Rehabilitation. In: Sussman M, ed. *Sociology and Rehabilitation*. Washington, DC: American Sociological Association; 1965:100-113.
 - 10 *Enabling America*. Washington, DC: National Academy Press; 1997.
 - 11 Geminiani G, Cesana BM, Tamma F, et al. Inter-observer reliability between neurologists in training of Parkinson's disease rating scales. A multi-center trial. *Mov Disord*. 1991;6:330-335.
 - 12 Webster DD. Clinical analysis of the disability in Parkinson's disease. *Mod Treatment*. 1968;5:257-282.
 - 13 Bridgewater KJ, Sharpe MH. Trunk muscle performance in early Parkinson disease. *Phys Ther*. 1998;78:566-576.
 - 14 Diamond SG, Markham CH. Evaluating the evaluations: or how to weigh the scales of Parkinsonian disability. *Neurol*. 1983;33:1098-1099.
 - 15 Martinez-Martin P, Gil-Nagel A, Morlan G, et al. Unified Parkinson's Disease Rating Scale: Characteristics and structure. *Mov Disord*. 1994;9:76-83.
 - 16 Richards M, Marder K, Cote L, Mayeux R. Interrater reliability of the Unified Parkinson Disease Rating Scale motor examination. *Mov Disord*. 1994;9:89-91.
 - 17 van Hilten JJ, van Der Zwan AD, Zwinderman AH, Roos RAC. Rating impairment and disability in Parkinson disease: Evaluation of the Unified Parkinson Disease Rating Scale. *Mov Disord*. 1994;9:84-88.
 - 18 Louis ED, Lynch T, Marder K, Fahn S. Reliability of patient completion of the historical section of the Unified Parkinson's Disease Rating Scale. *Mov Disord*. 1996;11:185-192.
 - 19 Cutson TM, Sloan R, Schenkman M. Development of a clinical rating scale for persons with Parkinson Disease. *J Am Geriatric Soc*. 1999;47:763-764.
 - 20 Schenkman M, Cutson TM, Chandler J, et al. Reliability of physical measures in Parkinson disease. *Phys Ther*. 1997;77:19-27.
 - 21 Light KE, Behrman AL, Thigpen M, Triggs WJ. The 2-minute walk test: A tool for evaluating walking endurance in clients with Parkinson disease. *Neurol Rep*. 1997;21:136-139.
 - 22 Thompson M, Medley A. Performance of individuals with Parkinson disease on the Timed Up & Go. *Neurol Rep*. 1998;22(1):16-21.
 - 23 Smithson F, Morris ME, Iansek R. Performance on clinical tests of balance in Parkinson disease. *Phys Ther*. 1998;78:577-592.
 - 24 Kuchibhatla M, Pieper C, Schenkman M. An application of generalizability theory to a study of physical performance. *Aging*. 2000;12:29-34.
 - 25 Schenkman M, Cutson TM, Kuchibhatla M, et al. A randomized controlled exercise trial in patients with Parkinson disease. *J Am Geriatric Soc*. 1998;46:1207-1216.
 - 26 Comella CC, Stebbins GT, Brown-Toms J, Goetz CG. Physical therapy and Parkinson disease: A controlled clinical trial. *Neurol*. 1994;44:376-378.
 - 27 Patti F, Reggio A, Nicoletti F, et al. Effects of rehabilitation therapy on Parkinsonians' disability and functional independence. *J Neurologic Rehabil*. 1996;10:223-241.
 - 28 Deane KH, Jones D, Ellis-Hill C, et al. A comparison of physiotherapy techniques for patients with Parkinson's Disease (Cochrane Review). *Cochrane Database Syst Rev*. 2001;1:CD002815.
 - 29 Cress ME, Buchner DM, Questad KA, et al. Continuous-scale physical functional performance in healthy older adults: A validation study. *Arch Phys Med Rehabil*. 1996;77:1243-1250.
 - 30 Continuous-scale physical functional performance test. Available at: <http://www.coe.uga.edu/cs-pfp>. Accessed June 13, 2002.
 - 31 Cress ME, Buchner DM, Questad KA, et al. Exercise: Effects on physical functional performance in independent older adults. *J Gerontol A Biol Sci Med Sci*. 1999;54A:M242-M248.
 - 32 Cress ME, Kinnie S, Patrick DL, Maher E. Physical functional performance in persons using a manual wheelchair. *J Orthop Sports Phys Ther*. 2002;32:104-113.

- ³³ Folstein MF, Folstein SE, McHugh PR. "Mini-mental State": A practical method for grading the cognitive state of patients for the clinician. *J Psychiat Res.* 1975;12:189-198.
- ³⁴ Duncan PW, Weiner Dk, Chandler J, Studenski SA. Functional reach: A new clinical measure of balance. *J Gerontol A Biol Sci Med Sci.* 1990;45:M192-M195.
- ³⁵ Duncan PW, Studenski S, Chandler S, Prescott B. Functional reach: Predictive validity in a sample of elderly male veterans. *J Gerontol A Biol Sci Med Sci.* 1992;47:M93-98.
- ³⁶ Morris S, Morris ME, Ianssek R. Reliability of measurements obtained with the timed "Up & Go" test in people with Parkinson disease. *Phys Ther.* 2001;81:810-818.
- ³⁷ Kerns RD, Turk DC, Rudy TE. The West Haven-Yale Multidimensional Pain Inventory (WHYMPI). *Pain.* 1985;23:345-356.
- ³⁸ Radloff LS. The CES-D Scale: A self-report depression scale for research in the general population. *Appl Psych Meas.* 1977;1:385-401.
- ³⁹ Kleinbaum DG, Kupper LL, Mueller KE. *Applied Regression Analysis and Other Multivariable Methods.* 2nd ed. Belmont, Calif: Duxbury Press; 1987.
- ⁴⁰ American Physical Therapy Association. *Reading Tips for Reading Reports on Research. An Anthology.* Alexandria, Va: American Physical Therapy Association; 1986.
- ⁴¹ Bruce ML, Seeman TE, Merrill SS, et al. The impact of depressive symptomatology on physical disability: MacArthur studies on successful aging. *Am J Public Health.* 1994;84:1796-1799.
- ⁴² Kaplan GA, Strawbridge WJ, Camacho T, et al. Factors associated with change in physical functioning in the elderly: A six year prospective study. *J Aging Health.* 1993;5:140-153.
- ⁴³ Mudrick NR. Predictors of disability among midlife men and women: Differences by severity of impairment. *J Community Health.* 1988;13:70-84.
- ⁴⁴ Schenkman M, Zhu CW, Cutson TM, Whetten-Goldstein K. Longitudinal evaluation of economic and physical impact of Parkinson's disease. *Parkinsonism Related Disord.* 2001;8:41-50.
- ⁴⁵ Cress ME. Quantifying physical functional performance in older adults. *Muscle Nerve.* Supplement. 1997: S17-S20.

Earn a degree while you earn a living.

At the nationally ranked Krannert School of Physical Therapy, you can earn a postprofessional degree while working full-time, and enjoy such features as:

- Weekend courses
- Web-based & Web-enhanced instruction
- Credit available for prior learning
- Individualized programs of study

Areas of clinical emphasis are:

- Orthopedic physical therapy
- Adult neurologic physical therapy
- Pediatric physical therapy
- Geriatric physical therapy

Visit our Web page at www.uindy.edu/~pt or contact Jill Stikeleather by e-mail at stikeleather@uindy.edu or by phone at (317) 788-3502 or 1-800-232-8634.

University of
Indianapolis

Krannert School of
Physical Therapy

Postprofessional
Degrees in PT:

MS, MHS, DHS, DPT (transitional)

1-800-237-1162

Chair All in One

- * Chair
- * Stretcher
- * Recliner
- * Wheelchair
- Clinical Implications
- * Surgical
- * Neuro
- * Orthopedic
- * Cardiac
- * Immobile
- * Bariatrics
- * Transport/Transfer
- Patient Outcome
- * Reduces # of transfers.
- * Improves lower limb flexibility.
- * Ability to accommodate up to 800 lbs.

"YOUR PARTNER IN MOBILITY"

"Ergonomically designed to reduce caregiver back injuries"

Visit our website www.stretchair.com to view our chairs in action & obtain a free CD.

Neurology Report Vol. 25, No.1, 2001 "Acute Care Physical Therapy Management Of A Patient With A C2 Fracture Resulting In Tetraplegia"