Journal of Hand Therapy xxx (2016) 1–7

Contents lists available at ScienceDirect

Journal of Hand Therapy

journal homepage: www.jhandtherapy.org

Scientific/Clinical Article

"Test D'évaluation Des Membres Supérieurs Des Personnes Âgées" (TEMPA) to assess upper limb activity in Parkinson's disease

Paula Ruiz de Freitas MSc [a,b], Ana Elisa Lemos MSc [c], Mariana Palla Santos MSc [a,b], Stella Maris Michaelsen PhD [b], Clynton Lourenço Corrêa PhD [c], Alessandra Swarowsky PhD [a,b,*]

[a] Physical Therapy Department, Experimental Research Laboratory (LAPEX), University of the State of Santa Catarina (UDESC), Florianópolis, Brazil
[b] Physical Therapy Department, Physical Therapy Postgraduate Program, University of the State of Santa Catarina (UDESC), Florianópolis, Brazil
[c] Physical Therapy Department, Physical Education Postgraduate Program, Federal University of Rio de Janeiro (UFRJ), Rio de Janeiro, Brazil

ARTICLE INFO

Article history:
Received 29 February 2016
Received in revised form
16 May 2016
Accepted 12 July 2016
Available online xxx

Keywords:
Parkinson's disease
Upper limb activity limitations
Assessment
Physical therapy
Test d'evaluation des membres supérieurs of personnes âgées

ABSTRACT

Study Design: Cross-sectional and observational study.
Purpose of the Study: Assess upper limb (UL) activity limitations using the "Test d'Evaluation des Membres Supérieurs Des Personnes Agées" (TEMPA) in individuals with Parkinson's disease (PD) and verify its clinimetrics properties.
Methods: The following were evaluated: internal consistency, interrater and test-retest reliability; concurrent validity; convergent validity; know group's validity; minimal detectable change, floor and ceiling effects, and the relationship between UL activity limitations and the presence of freezing of gait.
Results: Excellent reliability and interrater agreement (intraclass correlation coefficient = 0.99 and $\kappa = 0.92$) and test-retest reliability (intraclass correlation coefficient = 0.97) were found, as well internal consistency ($\alpha = 0.99$). A moderate negative correlation was found between TEMPA and section II of the Unified Parkinson's Disease Rating Scale ($\rho = -0.58$; $P = .001$), and moderate/low between the test and the Nine Hole Peg Test values of the right UL and moderate for left UL ($\rho = 0.56$ and $\rho = 0.41$; $P = .001$) ($\rho = 0.52$ and $\rho = 0.51$; $P = .001$ and $P = .002$), respectively. No significant relationship was found with freezing episodes ($P = .057$).
Discussion: TEMPA is useful for assessing UL activity limitations in PD, have adequate clinimetrics properties and is capable of detecting the influence of motor symptoms during the carrying out of daily living tasks. No differences were found between freezers and no freezers.
Level of Evidence: N/A.

Introduction

Upper limb (UL) activity limitation is associated with a loss of functional independence in individuals with Parkinson's disease (PD).[1] This limitation is related to difficulties in bimanual tasks, digital and manual dexterity deficits,[2] and the presence of freezing of gait.[3] However, most of the information provided in the literature regarding rehabilitation in PD is focused on gait disturbance, balance, muscle strengthening, and fitness.[4-6]

Recently, research carried out by Australian therapists investigated the frequency and ways of measuring the disabilities of structure and body function and UL activity limitations in PD. Only half of the interviewees mentioned regular evaluations of UL activity, due to a lack of specific tools for the disease. Observational analysis and timed functional activities were the nonstandardized assessment procedures most used, and the Unified Parkinson's Disease Rating Scale (UPDRS) for the standardized measurements.[7]

The UPDRS has 42 items of which some are specifically related to UL activity, as presented in section II (daily living activities): handwriting (item 8), cutting food and handling utensils (item 9); section III (motor section): hand actions or postural tremors (item 21), finger percussion (item 23), hand movements (item 24), and rapid and alternating hand movements (item 25).[8,9]

In a recent review of UL evaluation measures in PD,[10] the Purdue Pegboard Test and Nine Hole Peg Test (NHPT) were considered

Conflict of interest: All named authors hereby declare that they have no conflicts of interest or financial issues to disclose.

Authors' Roles: Research Project: Paula Ruiz de Freitas (A, B, C), Alessandra Swarowsky (A, B), Stella Maris Michaelsen (B), Clynton Lourenço Corrêa (A), Ana Elisa Lemos (A, C); statistical Analysis: Alessandra Swarowsky (A, C) Paula Ruiz de Freitas (B), Mariana Palla Santos (A, B), Stella Maris Michaelsen (A, B); manuscript: Paula Ruiz de Freitas (A), Alessandra Swarowsky (B), Stella Maris Michaelsen (B), Clynton Lourenço Corrêa (B), Ana Elisa Lemos (B).

* Corresponding author. Department of Physical Therapy, Experimental Research Laboratory (LAPEX), University of the State of Santa Catarina (UDESC), Rua Pascoal Simone, 358, Florianópolis 88080350, Brazil. Tel.: +55 48 36648605.
E-mail address: alessandra.martin@udesc.br (A. Swarowsky).

0894-1130/$ – see front matter © 2016 Hanley & Belfus, an imprint of Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jht.2016.07.003

useful tools for the assessment of UL activity level. However, both measures only assess the fine motor skills. Without ignoring the importance of these widely used tests, the present authors question the following: what is the clinical usefulness of assessing UL activity limitations with tests or tasks that do not represent daily activities of the patients and which do not include the actual handling of objects? Based on these questionings, "Test d'Évaluation des Membres Supérieurs of Personnes Âgées" (TEMPA) is an assessment of UL activity limitation that includes tasks that are representative of daily living activities, including unilateral and bilateral tasks and a range of real objects. In addition, TEMPA has sequential tasks that can be useful to detect UL disabilities. The instrument rating form is very complete, including both quantitative (execution speed quotation) and qualitative (functional and task analysis score) parameters. Moreover, the equipment is standardized and there is an instruction manual available for review.[11,12]

Thus, due to the absence of a complete instrument capable of measuring the UL activity limitation in PD, this study aimed to apply TEMPA to individuals with PD and to verify some of its clinimetrics properties. A further objective was to investigate the influence of freezing of gait on the UL activity limitation in PD.

Methods

This was a cross-sectional evaluation study of the clinimetric properties of TEMPA in individuals with PD. The clinimetric properties of the instrument tested were evaluated following the recommendations of Consensus Standards-based Measurements Instruments—checklist.[13,14]

The study was approved by the Ethics and Research Committee on Human Beings, under the terms of Brazilian Resolution 466/2012 of the University of the State of Santa Catarina (UDESC, Florianopolis, Santa Catarina, Brazil), under the number 660 732 and of the Federal University of Rio de Janeiro (Institute of Neurology Deolindo Couto/UFRJ, Rio de Janeiro, Brazil) under the number: 744667. All the patients who took part in the study signed a free and informed consent form.

Sample

Fifty-two ($n = 52$) adult subjects with PD, of both sexes, were included. Twenty-five (25) subjects were recruited intentionally and evaluated in the Health and Sports Sciences Center (CEFID), State University of Santa Catarina (UDESC), Florianópolis, Brazil, and 27 subjects were recruited and evaluated in the Federal University of Rio de Janeiro (UFRJ), Rio de Janeiro, Brazil. As inclusion criteria, the individuals required a diagnosis of PD confirmed by a neurologist; disease stage between I and IV (Hoehn and Yahr)[15]; have the cognitive level on the mini-mental state examination[16] on education as the cut-off point as suggested by Bertolucci et al[17]; have the presence of active and free shoulder and elbow movements; and be with stable medication. The study excluded individuals who had other neurological diseases; individuals with moderate and/or severe dyskinesia (greater than 2 in item 33 of the UPDRS)[18]; orthopedic disorders and/or joint limitations affecting the UL function. All evaluations were carried out during the "on" phase of medication with an interval between the administration of at least 2 hours and a maximum of 4 hours, always in the afternoon.

Procedures

The sociodemographic and clinical data of all the participants were collected by completing an initial evaluation form. The instruments applied were the mini-mental state examination, Hoehn and Yahr (H and Y) staging scale, the UPDRS (sections II/III), NHPT, and the Freezing of Gait Questionnaire.[19]

Evaluators

Two raters (R1 and R2), physiotherapists with 2 years of clinical experience in PD, carried out theoretical and practical training, which consisted of reading the TEMPA manual, followed by discussion and the clarification of practical questions via TEMPA assessments, quoted by video, of 2 individuals with PD. Thus, the standardization of the application of tasks and the criteria used for scoring were established.

Standardization of TEMPA collections by video

The quotation of TEMPA done by video was carried out in the 2 research centers and followed the stipulated standardization as described in the following section: a camera was positioned on the left side of the patient with the focus at a height of 105 cm, the distance from the camera to the center of the table being 96 cm. The individuals sat on a standard chair (44 cm $\pm$ 2.5 height) in front of a regular table (76 cm $\pm$ 2.5 height) and the rater sat beside the table, positioned at 90°. All the materials were placed in specific, predetermined locations on a platform developed to ensure task standardization. Before starting the test, the rater explained and demonstrated each task, and to ensure proper understanding of the command, the individual practiced the task once before initiating the test. The tasks were first carried out with the dominant hand.

Clinimetrics properties

The clinimetrics properties tested are shown in Figure 1.

Relationship between UL activity limitation and the freezing of gait

The association between the UL activity limitation and the presence of freezing of gait was established by comparing the total TEMPA scores between groups that presented freezing of gait episodes and those that did not. Question 3 of FOGQ was used, which identifies whether the patient has episodes of freezing of gait or not.[3]

Assessment of UL activity level by TEMPA

The Brazilian version[20] of the instrument consists of 8 standardized tasks that simulate activities of daily living, 4 being bilateral, and 4 being unilateral tasks. The functional tasks are (1) pick up and carry a pot (unilateral); (2) open a pot and take out a full coffee spoon (bilateral); (3) take a jar and serve water in a cup (unilateral); (4) unlock a lock and open a container with pills (bilateral); (5) write on an envelope and stick a stamp on it (bilateral); (6) shuffle and deal playing cards (bilateral); (7) handle coins (unilateral); and (8) pick up and move small objects (unilateral).[13] The scores obtained by the participants in TEMPA were based on execution speed measured in tenths of a second, the functionality degree and on the task analyses. These 3 parameters were analyzed in this study. The functionality degree refers to the individual autonomy in each of the tasks, graded according to a 4-level scale: 0, the task was successfully completed without hesitation or difficulty; −1, some difficulty or hesitation in completing the task; −2, the task was partially executed or certain steps were performed with significant difficulty; part of the task may have been modified or the need for assistance by the evaluator may have existed; and −3, could not complete the task, even when assistance was provided. The task analysis quantifies the difficulty found by

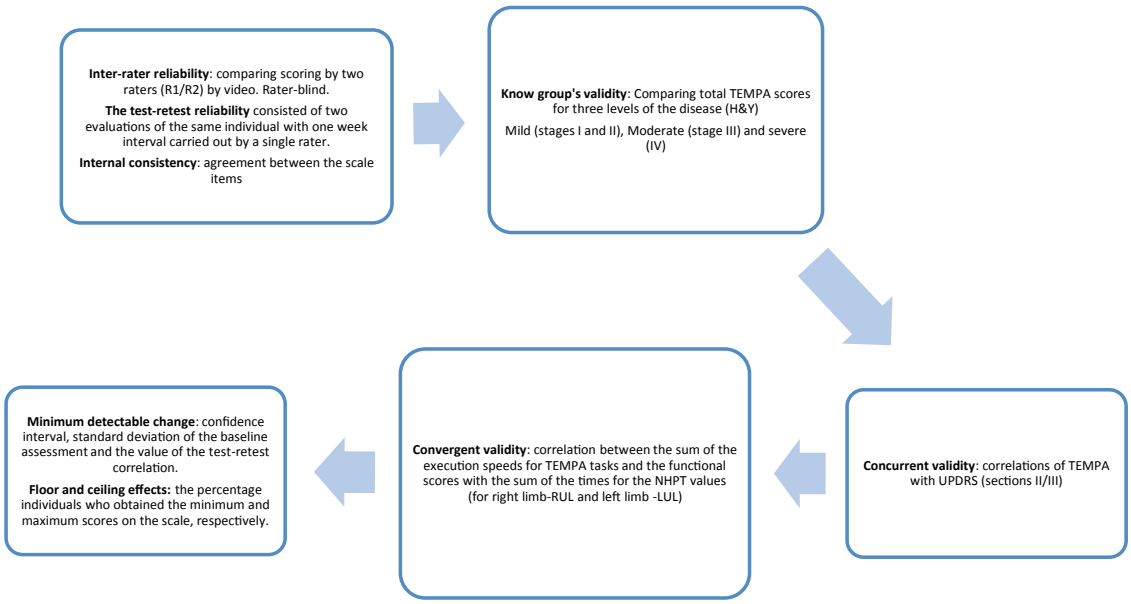

Fig. 1. Clinimetrics properties tested. H and Y = Hoehn and Yahr; UPDRS = Unified Parkinson's Disease Rating Scale; NHPT = Nine Hole Peg Test; TEMPA = Test D'évaluation Des Membres Supérieurs De Personnes Âgées.

the subject, according to 5 items relating to UL sensorimotor skills (1) strength; (2) range of motion; (3) accuracy of wide movements; (4) grasp; and (5) accuracy of fine movements.[11,12]

When the individual obtains a score of −2 at the functional level, the execution speed is not listed.

The value of the total functional score represents the sum of the right unilateral tasks (0 to −12), left (0 to −12), and bilateral tasks (0 to −12) and may therefore vary from 0 to −36. Similarly, the same summing up is made for the 5 dimensions of the tasks analysis section. Considering that the fine movement accuracy is not quoted for tasks 1-3, and the strength is not quoted for tasks 5-8, the dimension of the task analysis can range from 0 to −150. The total score represents the sum of the functional graduation and task analysis, totaling −186. Although the original scale proposes a negative quotation, with 0 indicating no disability and negative values indicative of greater disability, the values were used independent of the signal in the statistical analysis. Thus, for this study, higher values correspond to greater disability. This and other information about the instrument can be found in the application manual.[21]

Statistical analysis

The sociodemographic characteristics of the participants were described using descriptive statistics (mean ± standard deviation).

The 2-way mixed effects intraclass correlation coefficient (ICC) was used in the reliabilities evaluation, with CIs of 95%, considering: weak agreement (ICC < 0.40); moderate agreement (ICC ≤ 0.75); and excellent agreement (ICC > 0.75).[22]

The weighted kappa (Wk) test was used to assess interrater agreement for TEMPA, for both individual items. The agreement was considered excellent for Wk values from 0.81 to 1.00; substantial, 0.61-0.80; moderate, 0.41-0.60; fair, 0.21-0.40; poor, 0-0.20, and with no agreement when equal to 0.[23] For a more detailed analysis of the differences in the scores, the Bland–Altman plots were prepared for the total TEMPA scores.[24] The internal consistency was established using Cronbach's alpha, adopting a value from 0.70 to 0.90 to achieve good agreement between the scale items.[25]

The 1-way analysis of variance was used to analyze the degree in which TEMPA scores are different for patients in different stages of PD and determine the known groups' validity. The convergent and concurrent validities were determined using the nonparametric Spearman correlation.

The minimal detectable change (MDC) was measured using the MDC formula $= Z\,score_{level\ of\ confidence} \times SD_{baseline} \times \sqrt{(2\,[1\text{-}r_{test\text{-}retest})]}$ considering a 95% CI.[26]

The floor and ceiling effects were verified from the percentage (>15%) of individuals who obtained the minimum and maximum scores on the scale, respectively.

A data normality test was applied (Shapiro–Wilk) and the Mann–Whitney *U* test used to compare the values of the total TEMPA scores between the group of individuals who had freezing episodes and the group that did not. The data were analyzed by the software MedCalc 12.5.0 and SPSS 20.0, both for Windows. For all procedures, a significance level of 5% was adopted.

Results

Table 1 shows the clinical and sociodemographic characteristics of the subjects. The interrater reliability for execution speeds, functional quotation, task analysis, and total TEMPA scores were excellent (Table 2). Considering the total score, the average difference between the 2 assessments did not differ significantly from 0, and the limits of agreement represented 1.18 and 1.39% on the scale of variance, in Bland–Altman plots (Fig. 2). The interrater reliability for the functional scores for individual tasks (Table 3) as well as for execution speed was excellent (Table 4). For the task analyses, the reliabilities were excellent (ICC > 0.75) for all the unilateral and bilateral tasks with wide movement precision dimensions, grasping and the precision of the fine movements, and the weighted Kappa values were greater or equal to 0.6 for all the unilateral and bilateral tasks in all dimensions. This means that the total score of TEMPA and the individual tasks are reliable for clinical practice.

The test-retest reliability for R1 and R2 for the total scores, execution speed, functional and task analysis total scores, and agreement between the total scores were excellent, except for execution speed to R2 (moderate 0.69; Table 5).

Table 1
Clinical and sociodemographic characteristics of the participants

Characteristics	Means ± SD %	Range
Sex		
Male	33 (63.4%)	
Female	19 (36.5%)	
Age (y)	64.88 ± 9.12	37-82
Disease duration (y)	85.76 ± 69.90	4-320
Handedness		
Right	52 (100%)	
Left		
Side of onset of motor symptoms		
Right	30 (57.7%)	
Left	22 (42.3%)	
H&Y		
I and II (mild)	28 (53.84%)	
III (moderate)	19 (36.53%)	
IV (severe)	5 (9.61%)	
MMSE	25 ± 4.44	13-30
UPDRS—subsection II	13.59 ± 6.95	2-30
UPDRS—subsection III	22.01 ± 11.97	3-55
FOG-Q		
Freezers	28 (53.84%)	
Nonfreezers	24 (46.15%)	
NHPT (s)		
Dominant hand	38.69 ± 16.41	20.6-125.3
Nondominant hand	39.69 ± 18.6	19.6-141.8
TEMPA—total Score	14.6 ± 13.3	1-58

H&Y = Hoehn and Yahr; MMSE = mini-mental state examination; UPDRS = Unified Parkinson's Disease Rating Scale; FOG-Q = Freezing Gait Questionnaire; NHPT = Nine Hole Peg Test; TEMPA = Test D'évaluation Des Membres Supérieurs De Personnes Âgées.

In the test-retest agreement between the total scores, the average difference between the 2 assessments did not differ significantly from 0, and the limits of agreement represented 1.61% and 1% of the scale variance, in Bland–Altman plots (Fig. 2). In the same way, the test-retest reliability indicates that TEMPA may be assessed with an interval of time safely.

The internal consistency of TEMPA was considered to be excellent with a Cronbach's alpha coefficient equal to ($\alpha = 0.99$), providing a scale with excellent agreement between items.

The results obtained for known groups' validity showed that the higher the stage, the higher the total score obtained in TEMPA, although the 1-way analysis of variance showed no significant differences between the groups. Regarding concurrent validity, the total TEMPA scores showed a moderate negative correlation with section II of Unified Parkinson's Disease Rating Scale ($\rho = -0.58$; $P < .001$); however, there was no significant correlation with section III of UPDRS. This means that TEMPA can not been used to differentiate between stages of disease and that can not replace UPDRS.

As for convergent validity, the sum of the right and left unilateral tasks for the TEMPA execution speed score showed a moderate positive correlation with the NHPT values for right UL (RUL) and left UL (LUL) ($\rho = 0.56$ and $\rho = 0.51$; $P = .001$ for both). Similar results were found for the functional graduation score ($\rho = 0.52$ and $\rho = 0.51$; $P = .001$ and $P = .002$). Low positive correlations were found for the sum of the bilateral tasks for execution speed and the NHPT scores (RUL, $\rho = 0.47$; $P = .001$ and LUL, $\rho = 0.44$; $P = .001$), functional graduation (RUL, $\rho = 0.42$, $P = .002$ and LUL, $\rho = 0.39$, $P = .004$), and NHPT. All the execution speed values for the unilateral individual tasks showed moderate correlations with the RUL and LUL NHPT values. For RUL, the highest correlation was for task 1 ($\rho = 0.59$; $P = .001$) and for LUL, it was for task 8 ($\rho = 0.62$; $P = .001$).

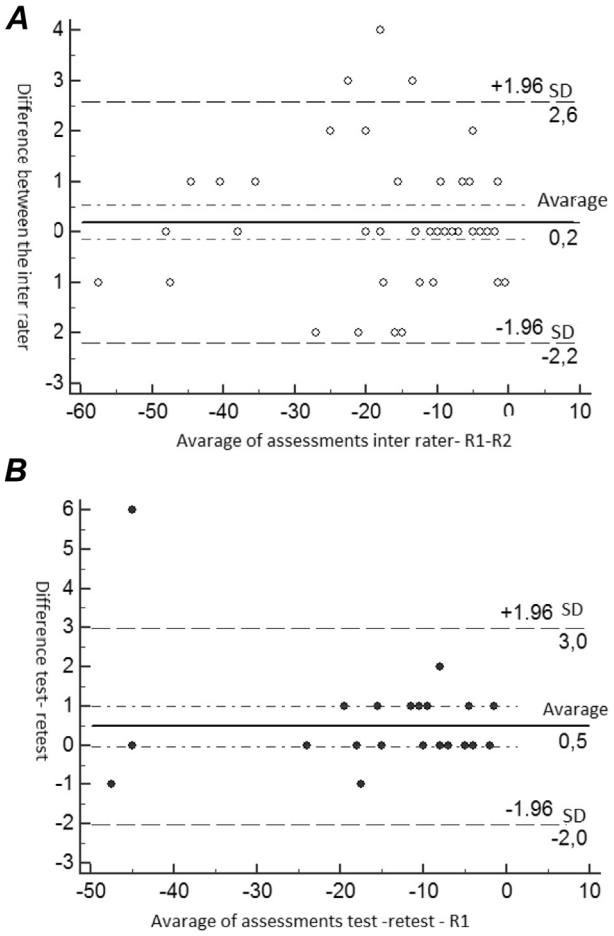

Fig. 2. The Bland–Altman plots, the interrater agreement, considering the total TEMPA score. (**A**) The average difference between the 2 assessments did not differ significantly from 0. (**B**) The average difference between the 2 assessments did not differ significantly from 0.

The MDC found for the total TEMPA score was 3.2 points, representing, in other words, the error of scale.

Floor and ceiling effects were not observed for TEMPA (total score), showing to be adequate to evaluate the activity limitation of ULs in PD.

Regarding the UL activity limitation with respect to the freezing of the gait, there was a tendency to present a significant difference ($P = .057$) between the groups when comparing the total TEMPA scores.

Table 2
Interrater reliability for the total TEMPA score, execution speed, total functional, and task analysis scores

$N = 52$	Rater 1; median (min-max)	Rater 1; means (±SD)	Rater 2; median (min-max)	Rater 2; means (± SD)	ICC (CI 95%) or Wk (CI 95%)
Total score (points)	10.5 (1-58)	14.6 (13.3)	10 (1-57)	15 (13.7)	ICC = 0.99 (0.98-0.99)
Speed of execution (SEG)	236.4 (141-531)	252.9 (87.6)	231.1 (138-527)	245.5 (81.9)	ICC = 0.98 (0.97-0.99)
Functional rating (points)	2 (0-14)	3 (3.2)	2 (0-14)	3.0 (3.1)	Wk = 0.88 (0.81-0.95)
Task analysis (points)	8 (1-44)	11 (10.2)	8.5 (0-43)	12 (10.8)	Wk = 0.89 (0.85-0.93)

ICC = intraclass correlation coefficient; CIs = confidence intervals; Wk = weighted kappa; SD = standard deviation.

Table 3
Interrater reliability for the functional rating of individual TEMPA tasks

Functional rating						
$N = 52$	Rater 1; median (min-max)	Rater 1; means ± SD	Rater 2; median (min-max)	Rater 2; means ± SD	ICC (CI 95%)	Wk (CI 95%)
Unilateral Tasks						
Pick up and move a jar (1)						
Right hand	0 (0-2)	0.13 (0.39)	0 (0-2)	0.13 (0.40)	1 (1-1)	1 (1-1)
Left hand	0 (0-2)	0.13 (0.39)	0 (0-1)	0.13 (0.34)	1 (1-1)	1 (1-1)
Pick up a pitcher and pour water into a glass (3)						
Right hand	0 (0-2)	0.3 (0.54)	0 (0-3)	0.29 (0.60)	0.95 (0.92-0.97)	0.87 (0.75-0.99)
Left hand	0 (0-3)	0.28 (0.66)	0 (0-3)	0.27 (0.66)	0.98 (0.98-0.99)	0.95 (0.85-1)
Handle coins (7)						
Right hand	0 (0-1)	0.21 (0.37)	0 (0-1)	0.19 (0.40)	0.96 (0.94-0.98)	0.94 (0.82-1)
Left hand	0 (0-1)	0.16 (0.3)	0 (0-1)	0.06 (0.23)	0.84 (0.73-0.91)	0.73 (0.37 -1)
Pick up and move small objects (8)						
Right hand	0 (0-1)	0.15 (0.3)	0 (0-1)	0.15 (0.36)	0.92 (0.86-0.95)	0.85 (0.65 -1)
Left hand	0 (0-1)	0.02 (0.13)	0 (0-1)	0.02 (0.14)	1 (1-1)	1 (1-1)
Bilateral Tasks						
Open a jar and take out a spoonful of coffee (2)	0 (0-3)	0.51 (0.72)	0 (0-3)	0.50 (0.75)	0.97 (0.95-0.98)	0.91 (0.82-1)
Unlock a lock and open a pill container (4)	1 (1-2)	0.78 (0.57)	1 (1-2)	0.67 (0.65)	0.88 (0.8-0.93)	0.81 (0.65-0.97)
Write on an envelope and stick on a stamp (5)	0 (0-2)	0.38 (0.52)	0 (0-2)	0.33 (0.51)	0.83 (0.71-0.90)	0.8 (0.63-0.97)
Shuffle and deal playing cards (6)	0 (0-2)	0.3 (0.5)	0 (0-2)	0.27 (0.49)	0.92 (0.87-0.96)	0.91 (0.79-1)

ICC = intraclass correlation coefficient; CIs = confidence intervals; Wk = weighted kappa; SD = standard deviation.

Discussion

To date, few measurement tools are available to assess the specific UL activity limitation for PD.[10] Thus, the main objective of this research was to evaluate the UL activity limitation using TEMPA and to verify if some of its clinimetric properties were suitable for PD, providing a valid and reliable instrument for clinical practice.

The interrater reliability, verified by the ICC value, was excellent for all the total TEMPA scores. These findings are in agreement with previous studies that show ICC values ranging between 0.7 and 1.[11,20] The interrater agreement, verified by the Wk value, was excellent for all total scores. These high-reliability coefficients possibly occurred due to the detailed description of the instrument on the quotation form and the high standardization required to carry out the test. It is also worth mentioning that both evaluators had experience with PD and prior training with the application of the instrument was offered to them.

The greatest limitation for UL activity was observed for task 4, (unlock locks and remove pills—functional quotation) due to its complexity and sequencing. In this task, the subject needs to have a precise reach, hit the target, perform the forearm pronation, and have appropriate digital dexterity. Bimanual coordination deficits and difficulty in sequential tasks are common in individuals with PD,[27,28] which may explain the difficulty presented in bilateral tasks because these are more complex and require greater coordination than unilateral tasks. The present authors suggest that symptoms such as bradykinesia, rigidity, and tremor interfered consistently in this task.

The total score and all the interrater reliabilities for the execution speeds were excellent due to the analytical precision of the time registered by the video. Regarding the performance of the participants, they were a little slower in the right unilateral tasks. The authors suggest this may be due to specific characteristics of the sample because all the patients were dominant on the right side and in a mild stage of PD. In this stage, people with PD are more asymmetric and the symptoms are presented on the dominant side,[29] which may explain these results. In the test-retest, the total score for execution speed was ICC = 0.89 and 0.69, respectively. Given the daily fluctuations in motor performance that may occur in individuals with PD, test-retest reliability is particularly important in this population.[12]

The MDC found for the total TEMPA score (3.2 points) was considered to be excellent, representing the minimum amount of change required for the total score (CI = 95%) to be considered a real change in the period of time reviewed by the same examiner.[26] Therefore, the MDC achieved indicated that the change in the total TEMPA scores between 2 ratings above or below 3.2 representing a chance of less than 5% to be due to random variation or measurement error. The MDC is a very important property for clinical practice because it reflects the real change in the patient's performance. When known, it helps the therapist to estimate the improvement in the items evaluated. The authors suggest that the MDC found could be sensitive to clinical change after physical therapy intervention, although their responsiveness should be tested.

Regarding the know groups' validity, despite the higher average scores verified in the severe group, in the present study, the total TEMPA score did not discriminate between the 3 stages of the disease and the statistical analysis showed no differences between the groups. The discriminating capacity of the scales in the degree of involvement is important because the physiotherapist frequently finds it difficult to differentiate the mild from the moderate stage, which is necessary to designate the treatment in specific and effective ways. However, the Hoehn and Yahr staging scale is strongly directed to postural instability as the main index of disease severity but does not adequately detect other motor characteristics of PD such as the UL motor deficiencies presented in this study.[30] Another fact that contributed to this result was that more than half of the sample was in the mild group, and according to some studies, the UL deficits tend to appear more strongly at the onset of the symptoms.[29] Also the presentation of UL motor disabilities was heterogeneous in these individuals, the activity limitations ranging from a slight decrease in dexterity to an inability to perform self-care tasks, for example.[2,10]

This study showed an adequate convergent validity with moderate positive correlations between the TEMPA execution speed and the NHPT scores for both hands. The results indicated that the longer the time taken to complete the digital dexterity task, the greater the time spent to complete the TEMPA tasks. Earhart et al.,[31] in a study using the NHPT in people with PD showed that bradykinesia was the factor that most contributed to the worst performance in the test and the same may have occurred with the present

Table 4
Interrater reliability for the execution speed of individual TEMPA tasks

Speed of execution						
$N = 52$	Rater 1; median (min-max)	Rater 1; means ± SD	Rater 2; median (min-max)	Rater 2; means ± SD	ICC IC (95%)	Wk IC (95%)
Unilateral Tasks						
Pick up and move a jar (1)						
Right hand	3.6 (1.8-14.7)	4.2 (2.4)	3.5 (1.9-14.7)	4.2 (2.4)	0.99 (0.99-0.99)	0.88 (0.84-0.91)
Left hand	3.3 (1.6-16.3)	4.1 (2.4)	3.4 (1.4-16.0)	4.1 (2.5)	0.99 (0.99-0.99)	0.88 (0.85-0.92)
Pick up a pitcher and pour water into a glass (3)						
Right hand	16.9 (9.3-50.3)	19.8 (9.4)	16.8 (9.3-50.3)	19 (8.4)	0.99 (0.99-0.99)	0.93 (0.91-0.95)
Left hand	14.8 (9.8-46.4)	17.3 (8.1)	14.9 (10.4-46.4)	17.2 (8.0)	0.99 (0.99-0.99)	0.91 (0.88-0.94)
Handle coins (7)						
Right hand	17 (10.4-45.1)	19.7 (8.2)	16.9 (10.5-45.2)	19.7 (8.3)	0.99 (0.99-0.99)	0.94 (0.92-0.96)
Left hand	16.3 (7.4-37.7)	17.7 (5.8)	16.4 (7.4-37.6)	17.8 (5.7)	0.99 (0.99-0.99)	0.94 (0.92-0.96)
Pick up and move small objects (8)						
Right hand	12.3 (6.7-32.4)	13.4 (5.0)	11.9 (6.3-30.6)	13.4 (5.0)	0.99 (0.99-0.99)	0.94 (0.92-0.96)
Left hand	10.8 (6.5-25.4)	11.9 (4.0)	10.9 (6.4-25.9)	12.0 (4.0)	0.99 (0.99-0.99)	0.91 (0.88-0.94)
Bilateral Tasks						
Open a jar and take out a spoonful of coffee (2)	19.1 (9.5-69.6)	23.9 (14.8)	18.9 (9.5-69.6)	24.7 (16.2)	0.96 (0.93-0.97)	0.91 (0.82-1)
Unlock a lock and open a pill container (4)	32.4 (17.3-72.4)	35.2 (14.7)	31.0 (17.5-72.4)	33.8 (13.0)	0.97 (0.92-0.98)	0.96 (0.94-0.97)
Write on an envelope and stick on a stamp (5)	35.4 (18-82.6)	39.4 (16.1)	35.0 (18.7-82.6)	39.3 (16.0)	0.99 (0.99-0.99)	0.95 (0.94-0.96)
Shuffle and deal playing cards (6)	40.0 (19.9-126.7)	45.7 (22.1)	39.4 (19.7-126.7)	45.6 (22.1)	0.99 (0.99-0.99)	0.96 (0.94-0.97)

ICC = intraclass correlation coefficient; CIs = confidence intervals; Wk = weighted kappa; SD = standard deviation.

sample. Together, these data suggest that digital dexterity is an important component for carrying out manual tasks, and is therefore required to show good performance in PD, although suffering a direct interference by bradykinesia.[32] Similar correlations were observed between the functional graduation score and digital dexterity of the participants. Using these two instruments, high correlations were found in the TEMPA validation study for subjects with multiple sclerosis.[33]

With respect to concurrent validity, the total TEMPA score presented a moderate negative correlation with the UPDRS section II score, but did not correlate with section III. The authors believe this was because 40% of the questions in section III are based on the execution speed for carrying out the tasks. Thus further analyses should be carried out using only the section III questions related to cardinal symptoms that influence the level of UL activity. On the other hand, the good correlation between the total TEMPA score and section II was probably due to the fact that both address how the UL limitations interfere with daily issues.

It is not yet clear from the literature if people who have freezing of gait also exhibit this phenomenon during UL activities.[34] Conceptually, the UL motor block shows similarities with freezing of gait episodes, and for this reason it was defined as UL freezing.[3]

Table 5
Test-retest reliability for the total TEMPA score, execution speed, functional rating, and total task analysis scores

$N = 25$, Florianópolis	Rater 1; median (min-max)	Rater 1; means ± SD	ICC (CI 95 %)
Total score	14 (1-57)	15.7 (13.8)	0.97 (0.95-0.99)
Speed of execution	247.5 (138.6-548.1)	259 (93.8)	0.89 (0.7-0.97)
Functional rating	2 (0-13)	3.5 (2.6)	0.97 (0.94-0.98)
Task analysis	12 (1-57)	12.3 (10.4)	0.95 (0.94-0.98)
$N = 27$, Rio de Janeiro	Rater 2; median (min-max)	Rater 2; means ± SD	ICC (CI 95 %)
Total score	8 (1-48)	13.1 (12.9)	0.99 (0.99-0.1)
Speed of execution	191.1 (109.7-370.6)	200.9 (59.4)	0.69 (0.42-0.85)
Functional rating	2 (0-10)	2.7 (2.8)	0.98 (0.95-0.99)
Task analysis	6 (1-38)	10.4 (10.4)	0.99 (0.99-1)

ICC = intraclass correlation coefficient; CIs = confidence intervals; Wk = weighted kappa; SD = standard deviation.

Although observed in some individuals, the present study did not quantify the presence of UL freezing, seeking only to relate the UL activity limitation with the presence of freezing of gait. Based on this concept and the study of Earhart et al,[31] it was hypothesized that the major difficulties encountered in carrying out TEMPA tasks occurred in people who showed freezing of gait. The present results showed that, although no significant differences were found between the groups, there was a tendency to present freezing of gait. It appears that in the present study, the participants who exhibited freezing of gait could have created compensatory mechanisms or even adaptive strategies for performing the daily life tasks such as those included in TEMPA, therefore avoiding UL motor blocks.

It is noteworthy that this is the first study in the literature that aimed to relate the freezing of gait with the UL activity limitation in tasks that corresponded to daily living activities. However, more studies are required to check whether the presence of freezing of gait correlates with limitations in UL activity, and if the people who exhibit this phenomenon also have UL freezing, or whether they are separate events. Perhaps kinematic analyses of the UL distal and proximal components could be carried out while applying TEMPA to check for the presence of UL freezing and hence clarify these issues.

Conclusions

TEMPA is a valid and reliable test to assess UL activity limitations in PD, showing good clinimetric properties and capable of detecting the influence of motor symptoms during the carrying out of daily living tasks. Future studies could establish a cut-off point for the total TEMPA score, or, in some tasks, such as numbers 4 and 6 (bilateral) and 3 and 7 (unilateral), attempt to assess of UL activity limitation in the disease in a faster way. In addition, the influence of freezing on the UL activity limitation remains to be clarified.

Study limitations

The results found in this study have to be analyzed with caution in individuals with severe stage of disease due to a small number of participants with these characteristics.

References

1. Van den Berg C, Beek PJ, Wagemar RC, Van Wieringen PC. Coordination disorders in patients with Parkinson's disease: a study of paced rhythmic for arm movements. *Exp Brain Res*. 2000;134:174–186.
2. Quinn L, Busse M, Dal Bello-Hass V. Management of upper extremity dysfunction in people with Parkinson disease and Huntington disease: facilitating outcomes across the disease lifespan. *J Hand Ther*. 2013;26:148–154.
3. Nieuwboer A, Vercruysse S, Feys P, Levin O, Spildooren J, Swinnen S. Upper limb movement interruptions are correlated to freezing of gait in Parkinson's disease. *Eur J Neurosci*. 2009;29:1422–1430.
4. Allen NE, Sherrington C, Paul SS, Canning CG. Balance and falls in Parkinson's disease: a meta-analysis of the effect of exercise and motor training. *Mov Disord*. 2011;26:1605–1615.
5. Morris ME, Martin CL, Schenkman ML. Striding out with Parkinson disease: evidence-based physical therapy for gait disorders. *Phys Ther*. 2010;90:280–288.
6. Tomlinson CL, Patel S, Meek C. Physiotherapy versus placebo or no intervention in Parkinson's disease. *Cochrane Database Syst Rev*. 2013:CD002817.
7. Proud EL, Miller KJ, Martin CL, Morris ME. Upper-limb assessment in people with Parkinson disease: is it a priority for therapists, and which assessment tools are used? *Physiother Can*. 2013;65:309–316.
8. Goetz CG, Tilley BC, Shaftman SR, et al. Movement Disorder Society-sponsored revision of the Unified Parkinson's Disease Rating Scale (MDS-UPDRS): scale presentation and clinimetric testing results. *Mov Disord*. 2008;2:2129–2170.
9. Shulman LM, Gruber-Baldini A, Anderson KE, et al. The evolution of disability in Parkinson disease. *Mov Disord*. 2008;23:790–796.
10. Proud EL, Miller KJ, Bilney B, Balachandran S, McGinley JL, Morris ME. Evaluation of measures of upper limb functioning and disability in people with Parkinson disease: a systematic review. *Arch Phys Med Rehabil*. 2015;96:540–551.
11. Desrosiers J, Hébert R, Dutil E, Bravo G. Development and reliability of an upper extremity function test for the elderly: the TEMPA. *Can J Occup Ther*. 1993;60:9–16.
12. Nedelec B, Dion K, Correa JA, Desrosiers J. Upper extremity performance test for the elderly (TEMPA): normative data for young adults. *J Hand Ther*. 2011;24:31–42.
13. Mokkink LB, Terwee CB, Patrick DL, et al. The COSMIN checklist for assessing the methodological quality of studies on measurement properties of health status measurement instruments: an international Delphi study. *Qual Life Res*. 2010;19:539–549.
14. Mokkink LB, Terwee CB, Patrick DL, et al. The COSMIN study reached international consensus on taxonomy, terminology, and definitions of measurement properties for health-related patient-reported outcomes. *J Clin Epidemiol*. 2010;63:737–745.
15. Hoehn M, Yahr M. Parkinsonism: onset, progression and mortality. *Neurology*. 1967;17:427–442.
16. Folstein MF, Robins L, Helzer NJ. The Mini-Mental State Examination. *Arch Gen Psychiatry*. 1983;40:812.
17. Bertolucci PH, Brucki S, Campacci SR, Juliano Y. O mini-exame do estado mental em uma população geral: impacto da escolaridade. *Arq Neuropsiquiatr*. 1994;52:17.
18. Movement Disorder Society. Task Force on Rating Scales for Parkinson's disease. The Unified Parkinson's Disease Rating Scale (UPDRS): status and recommendations. *Mov Disord*. 2003;8:738–750.
19. Giladi N, Tal J, Azulay T, et al. Validation of the freezing of gait questionnaire in patients with Parkinson's disease. *Mov Disord*. 2009;24:655–661.
20. MichaelsenSM, Natalio MA, Silva AG, Pagnussat AS. Confiabilidade da tradução e adaptação do Test d' EvaluationdesMembressuperieursdesPersonnesAgees' (TEMPA) para o português e validação para adultos como hemiparesia. *Rev Bras Fisioter*. 2008;12:511–519.
21. Desrosiers J, Hébert R, Dutil E. *TEMPA: Manuel d'administration administration manual*. Sherbrooke (PQ): Centre de recherche en gérontologieetgériatrie; 1993.
22. Streiner LD, Norman GR. *Health Measurement Scales; A Practical Guide to their Development and Use*. 2th ed. New York: Oxford; 1995.
23. Landi S, Koch GG. The measurement of observer agreement for categorical data. *Biometrics*. 1977;33:159–174.
24. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet*. 1986;1:307–310.
25. Fleiss JL, Levin BA, Paik MC. *Statistical Methods for Rates and Proportions*. 3rd ed. Hoboken, NJ: John Wiley & Sons; 2003.
26. Haley SM, Fragala-Pinkham MA. Interpreting change scores of tests and measures used in physical therapy. *Phys Ther*. 2006;86:735–743.
27. Ponsen MM, Daffertshofer A, Van den Heuvel E, Wolters E, Beek PJ, Berendse HW. Bimanual coordination dysfunction in early, untreated Parkinson's disease. *Parkinsonism Relat Disord*. 2006;12:246–252.
28. Harrington DL, Haaland KY, Yeo RA, Marder E. Procedural memory in Parkinson's disease: impaired motor but not visuoperceptual learning. *J Clin Exp Neuropsychol*. 1990;12:323–339.
29. Becker G, Müller A, Braune S, et al. Early diagnosis of Parkinson's disease. *J Neurol*. 2002;249:40–48.
30. Goetz CG, The Movement Disorder Society Task Force on rating scales for Parkinson's disease. Movement Disorder Society Task Force report on the Hoehn and Yahr staging scale: status and recommendations. *Mov Disord*. 2004;19:1020–1028.
31. Earhart GM, Cavanaugh JT, Ellis T, Ford MP, Foreman KB, Dibble L. The 9-hole PEG test of upper extremity function: average values, test-retest reliability, and factors contributing to performance in people with Parkinson disease. *J Neurol Phys Ther*. 2011;35:157–163.
32. Sage MD, Bryden PJ, Roy EA, Almeida QJ. The relationship between the Grooved Pegboard Test and clinical motor symptom evaluation across the spectrum of Parkinson's disease severity. *J Parkinsons Dis*. 2012;3:207–213.
33. Feys P, Duportail M, Kos D, Van Asch P, Ketelaer P. Validity of the TEMPA for the measurement of upper limb function in multiple sclerosis. *Clin Rehabil*. 2002;16:166–173.
34. Vercruysse S, Gilat M, Shine JM, Heremans E, Lewis S, Nieuwboer A. Freezing beyond gait in Parkinson's disease: a review of current neurobehavioral evidence. *Neurosci Biobehav Rev*. 2014;13:213–227.