

# Impact of changes in balance and walking capacity on the quality of life in patients with Parkinson's disease

Impacto das alterações de equilíbrio e da capacidade de marcha na qualidade de vida de pacientes com doença de Parkinson

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## ABSTRACT

Parkinson's disease (PD) is characterized by motor symptoms that cause the decline of functional capacity and affect the quality of life (QoL). **Objective:** To evaluate the impact of changes in balance and walking capacity on the PD. **Methods:** The instruments used were: Unified Parkinson's Disease Rating Scale (UPDRS), modified Hoehn and Yahr Scale (HY), Schwab and England scale (SE), quality of life questionnaire (PDQ-39), Berg balance Scale (BBS) and six-minute walk test (6MWT). **Results:** Thirty-six patients with mean disease duration of 7.3 years were assessed. Lower scores on the BBS and shorter distances walked during the 6MWT correlated with a poorer perception of QoL. This correlation occurred at the expense of the mobility and daily living activities domains. **Conclusion:** Our results indicated that the impairment in balance while performing functional activities and the reduction in walking capacity are important factors that negatively affect the perception of QoL in PD patients.

**Key words:** Parkinson's disease, quality of life, postural balance.

## RESUMO

A doença de Parkinson (DP) é caracterizada por sintomas motores que causam declínio da capacidade funcional e afetam a qualidade de vida (QV). **Objetivo:** Avaliar o impacto das mudanças no equilíbrio e na capacidade de marcha em doentes com DP. **Métodos:** Foram utilizados instrumentos específicos para avaliação clínica da DP: Escala Unificada de Avaliação da Doença de Parkinson (UPDRS), Escala de Hoehn e Yahr (HY) modificada, Escala de Schwab e England (SE), questionário de qualidade de vida (PDQ-39), Escala de Equilíbrio de Berg (EEB) e teste de caminhada de seis minutos (TC6M). **Resultados:** Foram avaliados 36 pacientes, com duração média da doença de 7,3 anos. Menores pontuações na EEB e menores distâncias percorridas durante o TC6M mostraram correlação com pior percepção da QV. Essa correlação ocorreu em detrimento dos domínios de mobilidade e atividades de vida diária. **Conclusão:** Nossos resultados indicaram que o prejuízo no equilíbrio durante a realização de atividades funcionais e a redução na capacidade de caminhar são fatores importantes que afetam negativamente a percepção da QV em pacientes com DP.

**Palavras-Chave:** doença de Parkinson, qualidade de vida, equilíbrio postural.

Parkinson's disease (PD) is the second most common neurodegenerative disorder and it affects 0.3% of the population at large<sup>1</sup>. Pathologically, PD is characterized by the loss of the dopaminergic neurons from the *substantia nigra* pars compacta, causing the reduction of the striatal dopamine levels<sup>2</sup>. Clinically, PD is marked by the presence of tremors at rest, rigidity and bradykinesia<sup>2</sup>. With the PD progression, other impairments occur, such as postural instability<sup>3</sup> and gait dysfunctions<sup>4</sup>. These

impairments result in a greater propensity to falls<sup>5-7</sup>, as well as a reduced capacity to walk<sup>8</sup>, and lead to progressive functional restraints. These physical aspects contribute to worsen the quality of life (QoL) in patients with PD<sup>9-13</sup>.

QoL is a multidimensional concept that refers to an individual's subjective perception concerning their life and other aspects, such as familial relationships, the patient's own health, financial issues, housing, social life and leisure

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**Conflict of interest:** There is no conflict of interest to declare.

Received 17 June 2011; Received in final form 09 September 2011; Accepted 16 September 2011

activities<sup>14</sup>. Several studies were carried out with the aim to assess the impact of motor symptoms on QoL in patients with PD. Most of these studies used PD specific instruments, as the Unified Parkinson's Disease Rating Scale (UPDRS), modified Hoehn and Yahr Staging Scale (HY) and modified Schwab and England Capacity for Daily Living Scale (SE), to assess motor symptoms<sup>10,11,13</sup>. For instance, PD patients who had postural instability, history of falls and difficulty to walk according to the UPDRS obtained worse scores in Parkinson's disease quality of life questionnaire (PDQ-39) when compared with patients who did not report any of these problems<sup>10</sup>. The gait dysfunction in the sub-item 29 of the UPDRS was recently identified as one of the main determining factors contributing to a worse perception of QoL, correlating itself with the dimensions mobility and daily living activities of the PDQ-39<sup>11</sup>.

However, these instruments, especially the UPDRS, are generally used in specialized centers dedicated to movement disorders and they depend on specific training. Thus, studies to assess motor symptoms through the application of specific instruments and common to physical therapy practice, and the impact of these impairments on QoL in patients with PD are important to optimize the rehabilitation. In this context, high test-retest reliability of scores for the Berg Balance Scale (BBS), six-minute walking test (6MWT), comfortable gait speed and timed up and go test were determined and showed that minimal detectable change values are useful to therapists in rehabilitation<sup>15</sup>.

The BBS has been the main instrument used to identify and to assess balance impairments in different populations. This instrument has been a valid tool for screening and assessing PD patients and it is most effective at discriminating PD fallers from nonfallers. Higher inter-rater reliability and internal consistency of the BBS in PD patients were shown and the balance performance was negatively affected by longer duration of disease, severity of symptoms and greater impairment on subscales II and III of the UPDRS, advanced stage of disease and worst level of functional independence<sup>16</sup>.

The simplicity of the 6MWT has led to its use in the assessment of patients with functional disability caused by neurologic disorders<sup>17,18</sup>. However, few studies reported walking capacity during 6MWT in people with PD and these studies didn't assess how the patients perceive the reduction of mobility in QoL<sup>8</sup>. Thus, the aim of this study was to assess the impact of the balance dysfunctions and walking capacity in perception of QoL in patients with PD.

## METHODS

PD patients undergoing treatment during the period between February and July 2009 at the Physiotherapy Clinic in college Estácio de Sá in Belo Horizonte were invited to participate in this study. The patients had idiopathic PD as clinical

diagnosis, had a cognitive functioning level assessed using Mini-Mental State Examination (MMSE)<sup>19</sup>, that allows them to answer the questionnaires, and were able to stand up and walk independently. Individuals with dementia and/or delirium, comorbid neurological disease, history of previous neurosurgical procedures, history of a heart condition limiting their activity level and that have experienced a fall as a result of dizziness or fainting within the previous 2 months were excluded. The study was approved by the Committee for Ethics in Research (12/2008) and all participants signed a term of free agreement for participation prior to data collection.

A demographic questionnaire and other clinical assessments were completed on the same day. All patients using levodopa were tested during the "on" period, i.e. under the effect of the drug. The patients underwent a series of clinical tests, including: Unified Parkinson's Disease Rating Scale, modified Hoehn and Yahr Staging Scale, modified Schwab and England Capacity for Daily Living Scale, Berg Balance Scale, six-minute walk test and Parkinson's disease quality of life questionnaire. All examiners were trained according to the standardized instructions to apply the tests and were not informed about the objective of the study.

The UPDRS is currently the most widely accepted scale for measuring the different components of PD. It has 3 subscales: UPDRS I – Mentation, behavior and mood (range 0–16); UPDRS II – Activities of daily living (ADL) (range 0–52); and UPDRS III – Motor examination (range 0–108). Each item is scored on a scale from 0 to 4. The total amounts to 176 points, in which 176 represents maximal (or total) disability and 0 represents no disability<sup>20</sup>. HY is designed to give an estimate of PD disease staging according to the distribution of the symptoms in the body and to the level of dependency. Patients in stage I are mildly affected, while in stage V they are bedridden<sup>21</sup>. The SE is widely used to assess disability in performing ADL for people with PD. It is a percentage scale divided into deciles, with 100% representing completely normal function and 0% representing total helplessness<sup>21</sup>.

The BBS is widely used as a functional balance measure and consists of 14 items, which evaluate the ability to maintain balance in different positions, as well as postural changes and movements. The scoring is based on the individual's ability to perform each task independently and/or meet certain time or distance requirements. Each item is scored on a five-point ordinal scale ranging from 0 (unable to perform) to 4 (normal performance). The total score range is 0 to 56 and higher scores denote a better balance. The BBS was recently validated for PD patients<sup>16</sup>. Its scores showed significant correlations with indicators of motor functioning, stage of the disease and daily living capacity in PD patients, supporting the criterion-related validity of the BBS<sup>16</sup>. The Brazilian version of the BBS was used in this study<sup>22</sup>.

The 6MWT was used to determine the walking capacity by measuring the maximum distance that an individual is

able to walk within six minutes<sup>23</sup>. Participants were instructed to walk as far they could and were provided with standardized encouragements every minute on the minute, such as: “You are doing well”, or “You have 5 minutes to go”. The heart rate was recorded by using a heart rate monitor.

The PDQ-39 can be described as a health profile, providing a more comprehensive picture of the wide range of issues that affect the QoL in a PD situation. It is a questionnaire comprising 39 items covering eight discrete dimensions: mobility (10 items), activities of daily living (6 items), emotional well-being (6 items), stigma (4 items), social support (3 items), cognition (4 items), communication (3 items) and bodily discomfort (3 items). The scores from each dimension are computed into a scale ranging from 0 (best, i.e. no problem whatsoever) to 100 (worst, i.e. maximum level of impairment)<sup>24,25</sup>.

The statistic analysis was performed using SPSS v15.0 software and statistical significance was set at  $p < 0.05$ . For the comparison of continuous variables, Student’s *t*-test or the Mann–Whitney U-test were used in normally or non-normally distributed data, respectively. Comparisons of categorical data were performed by using the  $\chi^2$  test. Correlation analyses between scales were calculated using Pearson’s correlation coefficient or Spearman’s rank correlation coefficient in normally or non-normally distributed data, respectively.

## RESULTS

Initially 49 patients with PD were invited to participate in this study, however demographic and clinic data were collected from 36 patients. The studied sample predominantly comprised patients with a typical onset PD, that is, from 50 years of age onward. Gender proportion was evenly distributed (18 men and 18 women). Twenty-nine (80.5%) patients were taking *L-dopa*. The severity of the disease according to the UPDRS was moderate in most cases. The patient distribution in the HY scale generally showed involvement mild-to-moderate. Likewise, percentile ratings on the SE were high and suggested relatively functional independence of the patients (Table 1).

The scores obtained in the BBS and the distance walked in the 6MWT were negatively correlated with the duration of the disease ( $r_s = -0.573$ ,  $p < 0.001$ ;  $r_s = -0.390$ ,  $p < 0.019$ ), with total UPDRS score ( $r_s = -0.783$ ,  $p < 0.001$ ;  $r_s = -0.577$ ,  $p < 0.001$ ), the stage of the disease ( $r_s = -0.776$ ,  $p < 0.001$ ;  $r_s = -0.611$ ,  $p < 0.001$ ), and the level of functional independence ( $r_s = 0.767$ ,  $p < 0.001$ ;  $r_s = 0.563$ ,  $p < 0.001$ ), respectively.

Our results suggested that younger patients and those with an earlier onset of PD had a worse QoL. This correlation occurred because of the worst perception of the emotional well-being dimension. The PDQ-39 scores correlated with the severity of PD as assessed through PD specific

instruments, including the UPDRS (total score and all of its subscales), HY and SE. Patients with severe balance dysfunctions assessed by the BBS and who scored lower distances in the 6MWT had worse QoL (Table 2). Upon evaluating the correlation between clinical data and PDQ-39 dimensions specifically, there was a correlation with mobility, activities of daily living, emotional well-being, cognition, communication and bodily discomfort dimensions. For the remaining two dimensions, i.e., stigma and social support, no correlation was found (Table 3).

**Table 1.** Demographic and clinical features of patients with Parkinson’s disease (PD).

Variables	PD (n=36)	
	Mean±SD	Range
Age (years)	65.5±7.9	51–84
Duration of disease (years)	7.3±4.6	1–15
Age of PD onset (years)	58.1±9.5	40–75
UPDRS	44.97±25.88	10–115
UPDRS I	3.0±2.39	0–10
UPDRS II	12.8±7.63	1–31
UPDRS III	29.16±18.35	4–75
HY	2.22±0.76	1–4
SE	80.27±11.58	50–100
BBS	49.52±7.09	29–56
6MWT (m)	396.3±109.9	155.0–570.0
PDQ-39	21.32±17.28	1.92–65.13

SD: standard deviation; UPDRS: Unified Parkinson’s Disease Rating Scale; HY: Hoehn and Yahr Staging Scale; SE: Schwab and England Activities of Daily Living Scale; BBS: Berg Balance Scale; 6MWT: Six-minute Walk Test; PDQ-39: Parkinson’s Disease Quality of Life Questionnaire.

**Table 2.** Coefficient of correlation of Spearman ( $r_s$ ) and p-value between clinical features, clinical tests and PDQ-39.

Variables	PDQ-39	
	$r_s$	p
Age	-0.341	0.042
Age of PD onset	-0.353	0.035
Disease duration	0.224	0.190
UPDRS	0.701	<0.001
UPDRS I	0.658	<0.001
UPDRS II	0.746	<0.001
UPDRS III	0.578	<0.001
HY	0.490	0.002
SE	-0.728	<0.001
BBS	-0.577	<0.001
6MWT	-0.372	0.025

PD: Parkinson’s disease; UPDRS: Unified Parkinson’s Disease Rating Scale; HY: Hoehn and Yahr Staging Scale; SE: Schwab and England Activities of Daily Living Scale; BBS: Berg Balance Scale; 6MWT: Six-minute Walk Test; PDQ-39: Parkinson’s Disease Quality of Life Questionnaire.

**Table 3.** Bivariate correlations (Coefficient of correlation of Spearman) among the different variables and dimensions of PDQ-39.

	Mobility	Activities of daily living	Emotional well-being	Stigma	Social support	Cognition	Communication	Bodily discomfort
Age	-0.182 0.288	-0.195 0.254	-0.468 0.004	-0.276 0.104	-0.224 0.188	-0.150 0.381	-0.203 0.236	-0.024 0.889
Age of PD onset	-0.306 0.070	-0.228 0.182	-0.363 0.030	-0.141 0.413	-0.159 0.355	-0.196 0.252	-0.168 0.327	-0.010 0.953
Disease duration	0.372 0.025	0.186 0.277	0.046 0.788	-0.160 0.350	-0.041 0.811	0.101 0.558	0.040 0.818	0.042 0.810
UPDR	0.684 <0.001	0.684 <0.001	0.402 0.015	0.019 0.911	0.094 0.586	0.474 0.004	0.514 0.001	0.152 0.378
UPDRS I	0.475 0.003	0.477 0.003	0.609 <0.001	0.138 0.421	0.141 0.411	0.550 0.001	0.289 0.088	0.313 0.063
UPDRS II	0.684 <0.001	0.693 <0.001	0.441 0.007	0.071 0.680	0.248 0.145	0.424 0.010	0.433 0.008	0.403 0.015
UPDRS III	0.590 <0.001	0.601 <0.001	0.292 0.084	0.011 0.950	-0.031 0.857	0.420 0.011	0.512 0.001	-0.017 0.922
HY	0.546 0.001	0.315 0.061	0.287 0.090	-0.191 0.264	-0.035 0.839	0.409 0.013	0.356 0.033	0.237 0.163
SE	-0.727 <0.001	-0.646 <0.001	-0.477 0.003	-0.011 0.951	-0.070 0.686	-0.537 0.001	-0.448 0.006	-0.288 0.088
BBS	-0.734 <0.001	-0.439 0.007	-0.296 0.080	0.022 0.898	0.062 0.720	-0.412 0.013	-0.308 0.068	-0.218 0.202
6MWT	-0.506 0.002	-0.272 0.108	-0.209 0.222	0.066 0.702	0.031 0.858	-0.199 0.244	-0.207 0.225	-0.148 0.390

PD: Parkinson's disease; UPDRS: Unified Parkinson's Disease Rating Scale; HY: Hoehn and Yahr Staging Scale; SE: Schwab and England Activities of Daily Living Scale; BBS: Berg Balance Scale; 6MWT: Six-minute Walk Test; PDQ-39: Parkinson's Disease Quality of Life Questionnaire.

## DISCUSSION

PD is widely known as a chronic disease that significantly affects the QoL<sup>9-13</sup>. The QoL in PD patients includes the individual's symptoms and physical functioning, as well as psychosocial variables<sup>26</sup>. Although many studies demonstrated that the motor symptoms contribute to the worsening of the perception of QoL in individuals with PD, these investigations predominantly correlated the items of the UPDRS with the dimensions from the PDQ-39<sup>10-13</sup>. Therefore, the aim of our study was to specifically assess the balance and the walking capacity of PD patients through instruments usually used in clinical practice of the Physiotherapy and to correlate the findings with the QoL perception of these individuals.

Our results showed that the patients who obtained lower scores in the BBS, i.e., those who had greater changes in balance, had a worse perception of QoL. This association occurred mainly at the expense of the patients' perception of their mobility and activities of daily living dimensions. It is also common knowledge that the main symptoms of PD (rigidity, bradykinesia and tremors) may hamper the daily living activities right from the outset of the disease. In the course of its progression, changes in posture may arise, leading to postural instability, gait disturbance and a predisposition to falls<sup>5-7</sup>. As the ability to keep balance deteriorates, PD patients are susceptible to falls, which in turn commonly causes them to develop a fear of falling<sup>7</sup>. This anxiety may be protective if it interferes only with hazardous activities or if it increases the level of alertness during the performance of all other daily

living tasks, but it can be maladaptive when it compels patients to limit their mobility, independence or social participation, leading to further deconditioning, functional decline and decline of QoL<sup>6,7,10</sup>.

Few studies reported walking capacity during the 6MWT in people with PD<sup>8,27,28</sup>. Our results demonstrated that those patients who were able to walk shorter distances also had a worse perception of their QoL. This association occurred at the expense of the patients' perception of their mobility. The simplicity of the 6MWT has led to its use in the assessment of patients with functional disability caused by neurologic disorders<sup>17,18,29</sup>. The mean walking distance obtained from our sample is on a par with the results put forward by Garber and Friedman<sup>28</sup>. These authors reported a mean of 395 m in PD patients with mild to moderate impairment<sup>28</sup>. This distance is only 42% of their predicted distance based on normative values for age, sex, height and weight. Canning et al.<sup>8</sup> reported that the major impairment limiting the walking capacity is hypokinesia, which results in deconditioning, limitation and gradual physical disabilities<sup>8</sup>. The results of the present study demonstrate that reducing the walking capacity generates a negative impact as regards how the patients perceive their mobility according to the PDQ-39.

These findings are indicative that the motor limitations, especially those related to a deficit in the balance and to the reduction in the walking capacity, influence negatively the perception of dimensions as mobility and daily living activities, thus determining a worse overall QoL perception of individuals with PD. We believe that dealing with



these aspects during the process of rehabilitation through a specifically-designed approach may enhance the way by which these patients perceive their QoL. Moreover, it was observed that the younger patients and with earlier onset of PD reported a worse QoL perception. As showed by Schrag et al.<sup>10</sup>, we suggest that these patients may have experienced situations such as job loss and marital problems, and greater perceived stigmatization more often than older-onset PD patients<sup>10</sup>.

Our study also made it clear that higher scores in all subscales of UPDRS and total UPDRS, advanced stages of disease assessed by HY stages and worst level of functional independence evidenced by the SE negatively affected the perception of QoL in PD patients. This association was sustained mainly by the worst perception of the mobility, activities of daily living, emotional well-being, cognition, communication and bodily discomfort dimensions of the PDQ-39.

These results corroborate the findings of other researchers that indicate the close association between motor symptoms measured by the UPDRS, HY and SE, and a poor QoL in individuals with PD<sup>8-12</sup>. Lyons et al.<sup>30</sup> found that postural instability, gait abnormalities and bradykinesia assessed by means of questions from the motor section of the UPDRS have the greatest impact on the QoL. Franchignoni et al.<sup>7</sup> also demonstrated severe disturbances of balance and mobility in PD individuals measured by specific tests and they correlated them with the UPDRS. They also showed a good correlation of the PDQ-39 with these tests, such as the BBS, and especially with

the fear of falling<sup>7</sup>. A study conducted by Lana et al. in the same tertiary center where our investigation was carried out showed that dimensions such as mobility and daily living activities are those which mainly account for a worsened perception of the QoL in patients with PD<sup>13</sup>. These authors hold that improvements in these dimensions might enhance the perception of QoL in PD patients<sup>13</sup>. Gómez-Esteban et al. showed correlations between the gait dysfunctions measured by the questions from the motor section of the UPDRS and the PDQ-39<sup>11</sup>. This association occurred at the expense of the patients' perception of their mobility and activities of daily living dimensions<sup>11</sup>.

This study has some limitations, such as its relatively modest sample size. This was mainly made up of PD patients with a mild to moderate degree of impairment. Just a few patients were rated 3 and 4 in HY stages. Although we did not have a control group in order to compare the results of depressive symptoms and motor performance with the QoL, our data were in line with previous reports in the literature.

In conclusion, we showed that physical disabilities, as balance and gait disturbances, are factors that significantly worsen the QoL perception of patients with PD. These disabilities should be treated during physical therapy rehabilitation to improve the mobility and performance of ADL, thus, indirectly providing a better QoL for this population. Moreover, the PDQ-39 could be an important tool in the rehabilitation process, especially when it comes down to taking decisions, and it can potentially improve the QoL of patients with PD.

## References

- Lau LM, Breteler MM. Epidemiology of Parkinson's disease. *Lancet Neurol* 2006;5:525-535.
- Samii A, Nutt JG, Ransom BR. Parkinson's disease. *Lancet* 2004;363:1783-1793.
- Bloem BR, van Vugt JP, Beckley DJ. Postural instability and falls in Parkinson's disease. *Adv Neurol* 2001;87:209-223.
- Morris ME, Huxham FE, McGinley J, Iansek R. Gait disorders and gait rehabilitation in Parkinson's disease. *Adv Neurol* 2001;87:347-361.
- Wood BH, Bilclough JA, Bowron A, Walker RW. Incidence and prediction of falls in Parkinson's disease: a prospective multidisciplinary study. *J Neurol Neurosurg Psychiatry* 2002;72:721-725.
- Murphy SL, Williams CS, Gill TM. Characteristics associated with fear of falling and activity restriction in community-living older persons. *J Am Geriatr Soc* 2002;50:516-520.
- Franchignoni F, Martignoni E, Ferriero G, Pasetti C. Balance and fear of falling in Parkinson's disease. *Parkinsonism Relat Disord* 2005;11:427-433.
- Canning CG, Ada L, Johnson JJ, McWhirter S. Walking capacity in mild to moderate Parkinson's disease. *Arch Phys Med Rehabil* 2006;87:371-375.
- Global Parkinson's Disease Survey Steering Committee. Factors impacting on quality of life in Parkinson's disease: results from an international survey. *Mov Disord* 2002;17:60-67.
- Schrag A, Jahanshahi M, Quinn N. What contributes to quality of life in patients with Parkinson's disease. *J Neurol Neurosurg Psychiatry* 2000;69:308-312.
- Gómez-Esteban JC, Zarranz JJ, Lezcano E, et al. Influence of motor symptoms upon the quality of life of patients with Parkinson's disease. *Eur Neurol* 2007;57:161-165.
- Schestatsky P, Zanatto VC, Margis R, et al. Quality of life in a Brazilian sample of patients with Parkinson's disease and their caregivers. *Rev Bras Psiquiatr* 2006;28:209-211.
- Lana RC, Álvares LMRS, Nasciutti-Prudente C, Goulart FRP, Teixeira-Salmela LF, Cardoso FE. Percepção da qualidade de vida de indivíduos com doença de Parkinson através do PDQ-39. *Rev Bras Fisioter* 2007;11:397-402.
- Damiano AM, Snyder C, Strausser B, Willian MK. A review of health-related quality-of-life concepts and measures for Parkinson's disease. *Qual Life Res* 1999;8:235-243.
- Steffen T, Seney M. Test-retest reliability and minimal detectable change on balance and ambulation tests, the 36-Item short-form health survey, and the unified Parkinson disease rating scale in people with parkinsonism. *Phys Ther* 2008;88:733-746.
- Scalzo PL, Nova IC, Perracini MR, et al. Validation of the Brazilian version of the Berg balance scale for patients with Parkinson's disease. *Arq Neuropsiquiatr* 2009;67:831-835.
- Poh P, Duncan P, Perera S, et al. Influence of stroke-related impairments on performance in the 6-minute walk test. *J Rehabil Res Dev* 2002;39:439-444.
- Eng J, Chu K, Dawson A, Kim C, Hepburn KE. Functional walk tests in individuals with stroke: relation to perceived exertion and myocardial exertion. *Stroke* 2002;33:756-761.

19. Brucki SMD, Nitrini R, Caramelli P, Bertolucci PHF, Okamoto IH. [Suggestions for utilization of the mini-mental state examination in Brazil]. *Arq Neuropsiquiatr* 2007;61:777-781.
20. Fahn S, Elton R. Unified Parkinson's Disease Rating Scale. In: Fahn S, Marsden CD, Caine DB, Goldstein M (Eds). *Recent developments in Parkinson's disease*. Vol. 2. Florham Park: Macmillan Health Care information 1987; 153-63, 293-304.
21. Hoehn MM, Yahr MD. Parkinsonism: onset, progression and mortality. *Neurology* 1967;17:427-442.
22. Miyamoto ST, Lombardi LJ, Berg KO, Ramos LR, Natour J. Brazilian version of the Berg balance scale. *Braz J Med Biol Res* 2004;37:1411-1421.
23. ATS Committee on Proficiency Standards for Clinical Pulmonary Function Laboratories. ATS statement: guidelines for the six-minute walk test. *Am J Respir Crit Care Med* 2002;166:111-117.
24. Peto V, Jenkinson C, Fitzpatrick R. PDQ-39: a review of the development, validation and application of a Parkinson's disease quality of life questionnaire and its associated measures. *J Neurol* 1998;245(Suppl):S10-S14.
25. Carod-Artal FJ, Martinez-Martin P, Vargas AP. Independent validation of SCOPA-psychosocial and metric properties of the PDQ-39 Brazilian version. *Mov Disord* 2007;22:91-98.
26. Scalzo P, Kummer A, Cardoso F, Teixeira AL. Depressive symptoms and perception of quality of life in Parkinson's disease. *Arq Neuropsiquiatr* 2009;67:203-208.
27. Schenkman M, Cutson T, Kuchibhatla M, Chandler J, Pieper C. Reliability of impairment and physical performance measures for persons with Parkinson's disease. *Phys Ther* 1997;77:19-27.
28. Garber C, Friedman J. Effects of fatigue on physical activity and function in patients with Parkinson's disease. *Neurology* 2003;60:1119-1124.
29. Salbach N, Mayo N, Higgins J, Ahmed S, Finch L, Richards C. Responsiveness and predictability of gait speed and other disability measures in acute stroke. *Arch Phys Med Rehabil* 2001;82:1204-1212.
30. Lyons KE, Pahwa R, Troster AI, Koller WC. A comparison of Parkinson's disease symptoms and self-reported functioning and well being. *Parkinsonism Relat Disord* 1997;3:207-209.