JMD
http://dx.doi.org/10.14802/jmd.16011 / J Mov Disord 2016;9(3):160-165
pISSN 2005-940X / eISSN 2093-4939

ORIGINAL ARTICLE

Falls and Their Associated Risks in Parkinson's Disease Patients in Nigeria

Temitope Hannah Farombi, Mayowa O Owolabi, Adesola Ogunniyi

Deparment of Medicine, College of Medicine, University of Ibadan, University College Hospital, Ibadan, Nigeria

ABSTRACT

Objective Falls are a devastating consequence of Parkinson's disease (PD) and are due to motor imbalance. However, the frequency of falls and their risk factors among Nigerians with PD is not known despite the significant increase in PD cases in the country. To assess fall risk factors and frequency in Nigerian PD patients.

Methods Using an analytical design to compare falling versus non-falling patients, 81 PD patients were assessed for clinical factors, frequency of falls, and candidate risk factors for falls according to the Tinetti Balance and Gait, Unified Parkinson's Disease Rating Scale subsection 1, and Timed Up and Go Tests. Descriptive, bivariate, and multivariate analyses were performed at the 95% confidence level.

Results The mean age of participants was 65.6 ± 9.7 years. Falls were about three times ($p < 0.001$) more common in PD patients. Of the falling patients, 67.7% sustained injuries, 67.7% had recurrent falls and 44.9% admitted to having a fear of falling. The independent statistical predictors of fall were fear of falling [odds ratio (OR): 3.86], disease severity (OR: 1.09) and disease duration (OR: 1.01).

Conclusion The frequency of falls in PD patients was significantly higher when compared with the healthy adult population, and the modifiable predictor was fear of falling with a potential to significantly reduce falls when strategically addressed.

Key Words Parkinson's disease; risk factors; falls; Sub-Saharan Africa; Nigeria.

Falls are known to be frequent in patients with Parkinson's disease (PD) with a prevalence of approximately 13% weekly and 70% annually.[1] The risk increases exponentially with increasing age and disease severity.[2] Although fall incidents are said to be increasing among older adults living in senior communities, PD patients fell more when compared with healthy adults of the same age.[3]

Studies have reported fall rates in PD patients who clearly exceed those of community-dwelling healthy elderly persons.[4,5] Falls are associated with considerable morbidity ranging from minor bruises to major injuries, including fractures.[6] Also noteworthy is the rapid progression of disease and poor overall survival among patients who have fallen.[7] Increased mortality and morbidity occur as a result of lethal falls, reduced fitness, increased risk of cardiovascular disease, osteoporosis and social isolation due to immobilization.[8] Incapacitating fear of renewed falls brought about by previous falls aggravates these problems. Ultimately, this leads to a significantly diminished quality of life, and the patient may end up in a nursing home.[8] Management of these patients in nursing homes is associated with substantial costs for society.[2]

Preventing falls in PD patients is therefore of great importance due to the reasons described above. However, studies on the associated risk of falls have been inconclusive with inconsistent outcomes, with some studies relating falls in PD to age,[9] duration of the disease,[10] disease severity,[11,12] autonomic dysfunction,[9] urinary incontinence,[13] increased time in the Get-Up-and-Go test,[13] greater postural sway,[14] poorer stability in response to

Received: February 29, 2016 **Revised:** April 8, 2016 **Accepted:** May 16, 2016
Corresponding author: Adesola Ogunniyi, MBChB, Department of Medicine, College of Medicine, University of Ibadan, University College Hospital, PMB 5116, Ibadan 200001, Nageria / **Tel:** +234 8060 276274 / **Fax:** +234 8038 094173 / **E-mail:** aogunniyi53@yahoo.com

pushes and pulls,[15] and variability of stride time.[12] Poor balance while standing,[16] dyskinesia, dementia, frontal impairment, gait freezing, orthostatic hypotension, and muscle weakness[17] have also been proposed as fall predictors.

Recurrent falls of two or more in the previous year was judged to be the best predictor of falls in PD patients according to a meta-analysis of longitudinal studies of falls in PD patients over a period of three, six, and twelve months.[5,6,9,18] The results emphasize the fact that PD patients are prone to recurrent falls, but do not help to identify PD patients at risk prior to the first fall. A recent longitudinal study involving participants with early-stage PD noted that only increased postural sway on standing was a risk for falling.[19] The duration of follow-up in these studies probably were insufficient to determine the role of aging or disease progression for predicting appearance of falls.

Despite the increase in the PD population in sub-Saharan Africa and by extension Nigeria, there are limited studies that have examined the frequency of falls, risk factors, screening tests, and interventions for PD-related falls. We therefore studied the frequency and risk factors associated with falling in PD patients in Ibadan, Nigeria.

MATERIALS & METHODS

This was an observational study using a case control method. Ethical approval was obtained from The Ethics Committee of the University of Ibadan/University College Hospital Review Board (UI/EC/13/0153). The patients were recruited from the neurology outpatient clinic at the University College Hospital (Tertiary Public Health Institution), Adeoyo State Hospital (Secondary Public Health Facility) and Oluyoro Catholic Hospital (Secondary private Health Facility), Ibadan. All consenting patients with the diagnosis of PD that could stand and walk with or without a history of falls and fulfilled the inclusion criteria were recruited into the study. The diagnosis of PD was made using the United Kingdom Parkinson's Disease Society (UKPDS) criteria. We excluded patients who did not give consent, those with atypical parkinsonian syndrome and those who were totally bed ridden.

Clinical assessments

A detailed questionnaire (interviewer administered) was used to collect socio-demographic variables (age, sex, occupation, and marital status) and relevant clinical information (date of first PD diagnosis, medication history, fall history in the last one, six, and 12 months, history of associated injury during falls and circumstances surrounding falls, static and dynamic balance, cadence and stability, and past history of hypertension and/or diabetes). PD was diagnosed independently by two trained neurologists using the UKPDS brain bank criteria.[20] A fall was defined as an event that resulted in a person coming to rest inadvertently on the ground or floor.[21] A patient was subjectively asked about fear of falling if the fall events and circumstances surrounding the fall were recorded. Cognition was assessed by using the community screening interview for dementia (CSI 'D').[22] PD severity was assessed using Unified Parkinson's Disease Rating Scale (UPDRS) criteria.[23] Cadence and stability was assessed using Timed Up and Go Test. Autonomic function was assessed using standard bedside tests (heart rate and blood pressure in response to standing). Postural hypotension was assessed using a difference of > 20 mm Hg in systolic blood pressure or > 10 mm Hg in diastolic blood pressure between standing and supine positions, respectively. Static and dynamic balance was assessed using the Tinetti Balance and Gait scale.

The Tinetti Balance and Gait test scale has a 71% sensitivity and 79% specificity to predict falls in both the elderly and PD patients.[9,24] The balance scale contains nine items with a total summation of 16 points while the gait scale contains eight items with a total summation of 12 points for a total of both 28 points for both scales. A score < 18 implies high risk, while scores between 19 and 23 imply moderate risk, and a score > 24 implies low fall risk.[25] Hypertension was diagnosed using sphygmomanometer measurements of blood pressure > 140/90 mm Hg measured at two different times or a history of antihypertensive therapy. Diabetes mellitus was diagnosed based on either a fasting plasma glucose of > 126 mg/dL or random plasma glucose of > 200 mg/dL measured on two different occasions at least 24 h apart. The Geriatric Depression Scale was used to assess depression.[26]

JMD
J Mov Disord 2016;9(3):160-165

Statistical analysis

Eighty-one consented respondents who had completed the questionnaire were analyzed. Normally distributed continuous variables were assessed using independent samples *t*-test, where data were not normally distributed, non-parametric methods were used. The Mann-Whitney U test for variables that were not normally distributed and Kruskal-Wallis test were used to compare ranked variables. Categorical variables were tabulated and statistically assessed for association using the χ^2 test or Fisher's exact test (where the expected counts were < five per cell) to compare falling with non-falling patients. Logistic regression was performed to evaluate the fall predictors. All variables that showed association with falls in univariate analysis were included in the regression model.

RESULTS

The mean age of the recruited participants was 65.8 ± 9.0 years, and the male to female ratio was 2:1. The median disease duration was 36 months [interquartile range (IQR): 20–60 months]. Seventy-seven (95.1%) were on medications, with 76 (93.8%) on carbidopa-levodopa, 57 (70.4%) on trihexyphenidyl and 6 (7.4%) on other anti-PD medications. Median occurrence of fall in our respondents was 30 months (IQR: 7–60 months) after diagnosis. Thirty-four (42%) respondents had history of falls in the last 12 months with 11 (32.3%) having single falls and 23 (67.7%) recurrent falls.

There were no statistically significant differences in age and gender between the falling and non-falling patients. Falling patients reported having longer disease durations with a median duration of 60 months as opposed to 24 months among non-falling patients ($p < 0.001$). More of the falling patients (22; 64.7%) had a fear of falling when compared to non-falling patients (9; 25.7%). The mean CSI 'D' score of the falling patients was significantly lower than the non-falling patients ($p = 0.034$). These results are summarized in Table 1 and Figure 1.

Patients with previous falls, when compared to non-falling patients, had worse PD severity as measured using UPDRS ($p < 0.001$) (Table 2). Static and dynamic balance was also worse in falling than in non-falling patients. There was no difference in cadence and stability (measured using the Timed Up and Go Test) between the falling and non-falling patients ($p = 0.117$) (Table 2).

Multivariate logistic regression was modeled with fall occurrence being the primary outcome. Variables that showed statistical significance during univariate analysis were inputted into the model. Total UPDRS and Tinetti score (not their sub-scores) were used in the model. When all predictor variables were considered together, they significantly predicted fall occurrence ($\chi^2 = 34.4$, $p = 0.000$, $R^2 = 0.336$). The results showed that PD severity [odds ratio (OR): 1.09, 95% confidence interval (CI): 1.02–1.16], disease duration measured in months (OR: 1.01, 95% CI: 1.00–1.03), and fear of falling (OR: 3.86, 95% CI: 1.17–12.7) were significant fall predictors in this study (Table 3).

Table 1. Characteristics of study participants

Variables	Fallers (*n* = 34)	Non-fallers (*n* = 47)	*p*-value
Age (mean, SD) in years	65.8 (9.0)	65.4 (10.2)	0.856
Sex (*n*, %)			0.596
Male	25 (73.5)	32 (68.1)	
Female	9 (26.5)	15 (31.9)	
Disease duration in months (median, IQR)	60 (30–120)	24 (11.5–36)	< 0.001*
Anti-parkinsonian medications (*n*, %)	32 (94.1)	44 (93.6)	0.926
Orthostatic hypotension (*n*, %)	18 (52.9)	13 (27.7)	0.021*
Fear of falls (*n*, %)	22 (64.7)	9 (25.7)	0.002*
CSI 'D' score (mean, SD)	37.9 (4.7)	40.3 (4.8)	0.034*
Systolic blood pressure (mean, SD)	124.6 (18.3)	129.5 (24.1)	0.331
Diastolic blood pressure (mean, SD)	80.2 (10.6)	84.4 (16.0)	0.192

*statistically significant. CSI 'D': community screening interview for dementia, IQR: interquartile range.

DISCUSSION

Fall frequency

To the best of our knowledge, this is the first documentation of falls among PD patients in sub-Saharan Africa. The frequency of falls was 42% com-

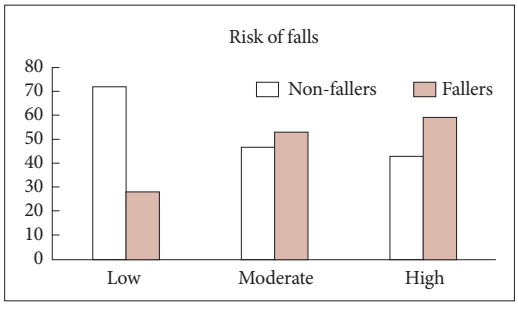

Figure 1. Risk of fall among fallers and non-fallers using Tinneti scale.

pared to 14.8% of age-matched healthy adults, and the median disease duration in the PD patients was 36 months. Most of the PD patients (71.6%) were on two or more anti-PD drugs. Factors responsible for falls in PD patients are multiple and most likely include similar factors associated with falls in healthy elderly patients.

The frequency of falls in our study was similar to those described in previous studies in PD patients.[5,9] In a study to assess the risk of falls in 160 PD patients, Contreras and Grandas[9] documented a 38.8% prevalence, a figure slightly lower than the finding in this study. However, a meta-analysis of six fall studies in PD patients reported fall frequencies ranging between 38% and 50%.[5] The frequency in our study lies within this range, and variations in study methodology and clinical characteristics could account for the varied frequencies.

It is difficult to speculate on cultural factors playing a very significant role in falls in PD patients because the frequency was similar to what was obtained in other environments. Factors such as special flooring (marble, tiles, and polished surfaces) that could predispose a patient to fall are absent in most traditional Nigerian homes but did not seem to have any significant effects on falling frequencies when compared to other types of homes. Additionally, there were no increases in the incidence of neuropathy, visual impairment, or medications that predispose PD patients to fall. Further studies exploring these factors should be performed.

Table 2. Disease characteristics associated with falls

Test items	Fallers (*n* = 34)	Non-fallers (*n* = 47)	*p*-value
UPDRS (mean, SD)			
Mentation	3.3 (2.5)	1.8 (1.4)	< 0.001*
Daily life	15.1 (5.4)	8.7 (5.1)	< 0.001*
Motor	23.1 (9.0)	15.8 (6.6)	< 0.001*
Total UPDRS	41.5 (14.6)	26.3 (11.3)	< 0.001*
Tinetti Test (mean, SD)			
Gait	8.7 (3.5)	10.2 (2.8)	0.034*
Balance	10.1 (4.7)	13.1 (3.4)	0.001*
Total Tinetti score	18.8 (7.8)	23.3 (5.7)	0.004*
Timed Up and Go Test (mean, SD)	32.6 (38.2)	21.0 (20.1)	0.117
Geriatric Depression Scale (mean, SD)	7.3 (2.1)	6.5 (1.5)	0.050

*statistically significant. UPDRS: Unified Parkinson's Disease Rating Scale.

Table 3. Independent predictors of falls in PD patients

	Adjusted OR	95% CI	*p*-value
Duration of disease	1.01	1.00–1.03	0.033*
Fear of falling	3.86	1.17–12.7	0.026*
UPDRS	1.09	1.02–1.16	0.006*
Tinetti	1.01	0.91–1.12	0.889

Model characteristics: $\chi^2 = 34.4$, $p = 0.000$, $R^2 = 0.336$. *statistically significant. PD: Parkinson's disease, OR: odds ratio, CI: confidence interval, UPDRS: Unified Parkinson's Disease Rating Scale.

Factors associated with falls

In this study, disease severity was associated with falls. Falling patients had significantly worse disease and longer durations when compared to non-falling patients. These findings are similar to findings by Bloem et al.[18] and Wood et al.,[1] who also reported higher UPDRS motor scores in falling versus non-falling patients; therefore, this is not a predictor of falls. Postural instability was prominent in the falling patients more than the non-falling patients due to poor preparatory adjustments, abnormal postural balance, and delayed reaction time.[27] This increases the propensity for falls and leads to impaired gait-dependent activities.

A study by Contreras and Grandas[9] reported predictability of Tinetti balance test to predict falls with 71% sensitivity and 79% specificity. He confirmed the Tinetti test tool as an independent fall predictor after using a multivariate logistic regression model.[9] This is consistent with studies of gait and balance abnormalities that were carried out in other environments where gait abnormality was considered the most consistent predictor of falls.[19] However, in this study the Tinetti Balance and Gait Tool did not independently predict the risk of falls.

The frequency of falls has also been reported to have a direct correlation with age, disease severity, medication, cognitive dysfunction, orthostatic hypotension, and visual impairment.[9,28] Our study could not demonstrate age as an independent risk factor for falls. A previous study of falls both in PD patients and healthy adults had shown an association between adults > 65 years and increased falls of 30 to 40%.[29] This was most likely because most of the PD patients in that study were younger compared to other studies conducted in different environments.[9,28] Advancing age (> 70 years) has been associated with increased risk of falls due to advanced PD progression.[9] Furthermore, older age is associated with frailty and reduced muscle mass and strength. In this study, a relatively higher proportion of young onset PD patients were evaluated. This is different from previous epidemiological studies of PD in Nigeria where relatively low proportions

of young onset PD patients were evaluated.[30] However, Femi et al.[31] reported an increasing older age of PD onset in the Northwestern Nigeria. These differences might be due to an inappropriate record of birth dates due to low level of literacy, shorter average life expectancy of those living in the underdeveloped and developing countries, poverty and/or poor access to health care services. Furthermore, different genetic makeups and environmental exposures of the study participants might be responsible for the observed differences.[30]

A previous fall has been shown to be a significant risk factor for more falls.[5] Pickering et al.[5] reported in a meta-analysis that > 2 falls was the best predictor of more falls in PD. This might be the result of lower recovery performances in forward falls and lower muscle strength in PD patients who fall.[32] In this study, 67.7% of our PD patients had recurrent falls, out of which 44% had a fear of falling. The reported frequency of recurrent falls was higher than what was obtained by Landers et al. (51%)[16] and Dibble and Lange (55%).[23] However, the findings in this study are similar to a prospective study of falls by Cole et al. (68%).[33] These differences may be due to differences in methodology and characteristics of disease severity.

Adkin et al.[34] demonstrated low balance confidence scores, which is an indicator for more falls, in PD patients compared to controls.[34] Patients who fall more frequently often have a self-induced restriction of activities due to fear of more falls, thus, leading to reduced muscle strength and increased risk of more falls, resulting in poor health-related quality of life. Studies have demonstrated increased incidence of trochanteric fractures in PD patients due to adduction of arms against the trunk when falling, while older adults without PD stretched out their arms in the direction of impending fall and, thus, sustained minor injuries such as abrasion.[35] Worthy of note in this study is the predictability of fear of falling as a strong modifiable risk factor with an adjusted OR of 3.86. Thus, clinical strategies to reduce fear of falling in PD patients will reduce the frequency of falls and their health-related and economic burden. In this study, it was observed that falling PD patients sustained other injuries such as fractures and lacerations; however, Bloem et al.[18] recorded no fractures in their study but reported a high proportion of soft tissue injuries (60%),[18] a figure slightly lower than the finding in our study. These injuries may be a result of the inter-segmental stiffness and postural inflexibility observed in PD patients.[33] Thus, an exercise program that enhances flexibility is needed for PD patients.

This study has several limitations. Being a retrospective study, there was the possibility of recall bias, and subjects with cognitive impairment may not have been accurate about fall frequency. It has been said that older people tend to forget occurrences of previous falls; however, this can be improved upon by getting a fall diary to be used in a prospective study. Secondly, this was a hospital-based study, and thus, the proportion of falling patients in our study may not represent community-dwelling PD patients who are at greater risk of falls. Although the results show that fear of falling could be an independent risk factor for falls in PD patients, additional prospective studies are required to confirm if this is a cause or consequence of falling or both. Meanwhile, our findings suggest that addressing the fear of falling may help to reduce falling events in PD patients.

In conclusion, our study confirmed an increased frequency of falls among PD patients, and this frequency was shown to be multifactorial. The predictive risk factors were disease severity and duration and fear of falling. Early detection of risk factors can prevent the untoward effects of falls in PD patients. This will facilitate tailored management to suit such patients and ultimately reduce the economic health-related burden of falls in these patients.

Conflicts of Interest

The authors have no financial conflicts of interest.

REFERENCES

1. 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.
2. Snijders AH, Nonnekes J, Bloem BR. Recent advances in the assessment and treatment of falls in Parkinson's disease. F1000 Med Rep 2010;2:76.
3. Mak MK, Pang MY. Parkinsonian single fallers versus recurrent fallers: different fall characteristics and clinical features. J Neurol 2010;257:1543-1551.
4. Ashburn A, Stack E, Pickering RM, Ward CD. A community-dwelling sample of people with Parkinson's disease: characteristics of fallers and non-fallers. Age Ageing 2001; 30:47-52.
5. Pickering RM, Grimbergen YA, Rigney U, Ashburn A, Mazibrada G, Wood B, et al. A meta-analysis of six pro-

spective studies of falling in Parkinson's disease. Mov Disord 2007;22:1892-1900.
6. Gray P, Hildebrand K. Fall risk factors in Parkinson's disease. J Neurosci Nurs 2000;32:222-228.
7. Rudzińska M, Bukowczan S, Stożek J, Zajdel K, Mirek E, Chwała W, et al. Causes and consequences of falls in Parkinson disease patients in a prospective study. Neurol Neurochir Pol 2013;47:423-430.
8. Grimbergen YA, Schrag A, Mazibrada G, Borm GF, Bloem BR. Impact of falls and fear of falling on health-related quality of life in patients with Parkinson's disease. J Parkinsons Dis 2013;3:409-413.
9. Contreras A, Grandas F. Risk of falls in Parkinson's disease: a cross-sectional study of 160 patients. Parkinsons Dis 2012; 2012:362572.
10. Koller WC, Glatt S, Vetere-Overfield B, Hassanein R. Falls and Parkinson's disease. Clin Neuropharmacol 1989;12:98-105.
11. Ashburn A, Stack E, Pickering RM, Ward CD. Predicting fallers in a community-based sample of people with Parkinson's disease. Gerontology 2001;47:277-281.
12. Schaafsma JD, Giladi N, Balash Y, Bartels AL, Gurevich T, Hausdorff JM. Gait dynamics in Parkinson's disease: relationship to Parkinsonian features, falls and response to levodopa. J Neurol Sci 2003;212:47-53.
13. Balash Y, Peretz C, Leibovich G, Herman T, Hausdorff JM, Giladi N. Falls in outpatients with Parkinson's disease: frequency, impact and identifying factors. J Neurol 2005;252: 1310-1315.
14. Matinolli M, Korpelainen JT, Korpelainen R, Sotaniemi KA, Virranniemi M, Myllylä VV. Postural sway and falls in Parkinson's disease: a regression approach. Mov Disord 2007;22:1927-1935.
15. Foreman KB, Addison O, Kim HS, Dibble LE. Testing balance and fall risk in persons with Parkinson disease, an argument for ecologically valid testing. Parkinsonism Relat Disord 2011;17:166-171.
16. Landers MR, Backlund A, Davenport J, Fortune J, Schuerman S, Altenburger P. Postural instability in idiopathic Parkinson's disease: discriminating fallers from nonfallers based on standardized clinical measures. J Neurol Phys Ther 2008;32:56-61.
17. Robinson K, Dennison A, Roalf D, Noorigian J, Cianci H, Bunting-Perry L, et al. Falling risk factors in Parkinson's disease. NeuroRehabilitation 2005;20:169-182.
18. Bloem BR, Grimbergen YA, Cramer M, Willemsen M, Zwinderman AH. Prospective assessment of falls in Parkinson's disease. J Neurol 2001;248:950-958.
19. Kerr GK, Worringham CJ, Cole MH, Lacherez PF, Wood JM, Silburn PA. Predictors of future falls in Parkinson disease. Neurology 2010;75:116-124.
20. Jankovic J. Parkinson's disease: clinical features and diagnosis. J Neurol Neurosurg Psychiatry 2008;79:368-376.
21. World Health Organization. Falls (WHO Fact Sheet No. 344). Geneva: World Health Organization, 2012. [cited 2015 Jul 23]. Available from: http://www.who.int/mediacentre/factsheets/fs344/en.
22. Akinyemi RO, Okubadejo NN, Akinyemi JO, Owolabi MO, Owolabi LF, Ogunniyi A. Cognitive dysfunction in Nigerians with Parkinson's disease. Mov Disord 2008;23: 1378-1383.
23. Dibble LE, Lange M. Predicting falls in individuals with Parkinson disease: a reconsideration of clinical balance measures. J Neurol Phys Ther 2006;30:60-67.
24. Tinetti ME, Baker DI, McAvay G, Claus EB, Garrett P, Gottschalk M, et al. A multifactorial intervention to reduce the risk of falling among elderly people living in the community. N Engl J Med 1994;331:821-827.
25. Tinetti ME. Performance-oriented assessment of mobility problems in elderly patients. J Am Geriatr Soc 1986;34: 119-126.
26. Verghese J, Holtzer R, Lipton RB, Wang C. Quantitative gait markers and incident fall risk in older adults. J Gerontol A Biol Sci Med Sci 2009;64:896-901.
27. Horak FB, Dimitrova D, Nutt JG. Direction-specific postural instability in subjects with Parkinson's disease. Exp Neurol 2005;193:504-521.
28. Allcock LM, Rowan EN, Steen IN, Wesnes K, Kenny RA, Burn DJ. Impaired attention predicts falling in Parkinson's disease. Parkinsonism Relat Disord 2009;15:110-115.
29. Ganz DA, Bao Y, Shekelle PG, Rubenstein LZ. Will my patient fall? JAMA 2007;297:77-86.
30. Okubadejo NU, Bower JH, Rocca WA, Maraganore DM. Parkinson's disease in Africa: a systematic review of epidemiologic and genetic studies. Mov Disord 2006;21:2150-2156.
31. Femi OL, Ibrahim A, Aliyu S. Clinical profile of parkinsonian disorders in the tropics: experience at Kano, northwestern Nigeria. J Neurosci Rural Pract 2012;3:237-241.
32. Moreno Catalá M, Woitalla D, Arampatzis A. Recovery performance and factors that classify young fallers and non-fallers in Parkinson's disease. Hum Mov Sci 2015;41: 136-146.
33. Cole MH, Silburn PA, Wood JM, Worringham CJ, Kerr GK. Falls in Parkinson's disease: kinematic evidence for impaired head and trunk control. Mov Disord 2010;25: 2369-2378.
34. Adkin AL, Frank JS, Jog MS. Fear of falling and postural control in Parkinson's disease. Mov Disord 2003;18:496-502.
35. Williams DR, Watt HC, Lees AJ. Predictors of falls and fractures in bradykinetic rigid syndromes: a retrospective study. J Neurol Neurosurg Psychiatry 2006;77:468-473.