ACRM
AMERICAN CONGRESS OF REHABILITATION MEDICINE

Archives of Physical Medicine and Rehabilitation

journal homepage: www.archives-pmr.org

Archives of Physical Medicine and Rehabilitation 2016;97:152-6

BRIEF REPORT

Use of a Short-Form Balance Confidence Scale to Predict Future Recurrent Falls in People With Parkinson Disease

Michael H. Cole, PhD,[a] Jodi Rippey, BSc,[a] Geraldine A. Naughton, PhD,[b] Peter A. Silburn, PhD, FRACP[c]

From the [a]School of Exercise Science, Australian Catholic University, Banyo, Queensland; [b]School of Exercise Science, Australian Catholic University, Fitzroy, Victoria; and [c]Asia-Pacific Center for Neuromodulation, Center for Clinical Research, The University of Queensland, Brisbane, Queensland, Australia.

Abstract

Objectives: To assess whether the 16-item Activities-specific Balance Confidence scale (ABC-16) and short-form 6-item Activities-specific Balance Confidence scale (ABC-6) could predict future recurrent falls in people with Parkinson disease (PD) and to validate the robustness of their predictive capacities.

Design: Twelve-month prospective cohort study.

Setting: General community.

Participants: People with idiopathic PD (N=79).

Interventions: Clinical tests were conducted to assess symptom severity, balance confidence, and medical history. Over the subsequent 12 months, participants recorded any falls on daily fall calendars, which they returned monthly by reply paid post.

Main Outcome Measures: Logistic regression and receiver operating characteristic analyses estimated the sensitivities and specificities of the ABC-16 and ABC-6 for predicting future recurrent falls in this cohort, and "leave-one-out" validation was used to assess their robustness.

Results: Of the 79 patients who completed follow-up, 28 (35.4%) fell more than once during the 12-month period. Both the ABC-16 and ABC-6 were significant predictors of future recurrent falls, and moderate sensitivities (ABC-16: 75.0%; ABC-6: 71.4%) and specificities (ABC-16: 76.5%; ABC-6: 74.5%) were reported for each tool for a cutoff score of 77.5 and 65.8, respectively.

Conclusions: The results have significant implications and demonstrate that the ABC-16 and ABC-6 independently identify patients with PD at risk of future recurrent falls.

Archives of Physical Medicine and Rehabilitation 2016;97:152-6

Parkinson disease (PD) is characterized by complex symptoms that impair physical function and increase the risk of recurrent falls.[1] Nearly 65% of people with PD report falling at least once each year, whereas up to 50% experience recurrent falls.[2-4] The increased prevalence of falls is compounded by impaired postural responses[5] that increase the risk of fall-related injuries, injury-related deaths, and hospitalization.[6] Although fall-related injuries often receive considerable attention, the psychological consequences of falling are equally disabling and cannot be overlooked.[7] Specifically, frequent falls contribute to reduced balance confidence and increased fear of future falls, which restricts one's physical activities and ultimately reduces independence and quality of life.

The 16-item Activities-specific Balance Confidence scale (ABC-16) has been widely used to assess balance confidence in people with PD, but the need to accurately and rapidly assess patient risk in clinical practice often requires more time-efficient tools. Despite being shorter, the 6-item Activities-specific Balance Confidence scale (ABC-6) has properties similar to those of the ABC-16 and, therefore, may be useful in assessing balance confidence in people with PD.[8] Although the Chinese translated Activities-specific Balance Confidence scale (ABC-C)

Supported by an Australian National Health and Medical Research Council Early Career Researcher Fellowship (project no. GNT1016481) and research funding provided by the Australian Catholic University (project no. 2013000570). The funding bodies did not contribute to data collection or data analysis and played no part in the decision to prepare and publish this manuscript.

Disclosures: none.

0003-9993/15/$36 - see front matter © 2016 by the American Congress of Rehabilitation Medicine
http://dx.doi.org/10.1016/j.apmr.2015.07.027

Table 1 Demographic data, balance confidence, and disease-specific scores for the participants with PD and the recurrent faller and nonrecurrent faller subgroups

Characteristic	All Patients (N=79)	Recurrent Faller (n=28)	Nonrecurrent Faller (n=51)	Test	*P*
Demographic characteristics					
Age (y)	68.1±0.9	69.5±1.6	67.3±1.1	1	.250
Sex: male	51 (64.6)	20 (71.4)	31 (60.8)	2	.344
Height (cm)	168.2±1.0	167.2±1.7	168.8±1.2	1	.451
Mass (kg)	74.3±1.8	70.3±2.9	76.5±2.2	1	.097
Body mass index (kg/m^2)	26.1±0.5	25.1±0.9	26.7±0.7	1	.134
Fall history and balance confidence					
ABC-16	77.5±1.9	67.9±3.1	82.8±2.1	3	<.001
ABC-6	67.2±2.6	55.4±4.0	73.7±3.0	3	<.001
Previous falls (12mo)	3.3±1.4	8.5±3.8	0.5±0.1	3	<.001
Neurological examination					
Disease duration (y)	6.1±0.5	8.4±1.0	4.8±0.5	3	.006
Levodopa (mg/d)	655.7±47.5	876.7±83.3	534.4±50.7	3	.001
Dopamine agonists	30 (38.0)	12 (42.9)	18 (35.3)	2	.508
Catechol-*O*-methyl transferase inhibitors	28 (35.4)	13 (46.4)	15 (29.4)	2	.130
Monoamine oxidase inhibitors	12 (15.2)	4 (14.3)	8 (15.7)	2	.868
Benzodiazepine	4 (5.1)	4 (14.3)	0 (0.0)	2	.006
No antiparkinsonian medication	5 (6.3)	0 (0.0)	5 (9.8)	2	.087
UPDRS I	3.2±0.2	3.4±0.4	3.0±0.2	3	.341
UPDRS II	11.3±0.6	14.0±1.1	9.8±0.6	3	.003
UPDRS III	20.2±1.0	25.1±1.5	17.6±1.2	1	<.001
UPDRS IV	3.9±0.3	5.0±0.7	3.4±0.3	3	.035
UPDRS total	34.7±1.5	42.5±2.5	30.4±1.6	1	<.001
PIGD score	4.7±0.4	6.3±0.7	3.7±0.3	3	.003
Freezing of Gait Questionnaire	5.8±0.6	9.1±1.0	4.0±0.5	3	<.001
Hoehn and Yahr stage scale	1.9±0.1	2.4±0.1	1.6±0.1	3	<.001
Schwab and England Activities of Daily Living Scale	80.9±1.1	74.6±1.8	84.3±1.1	3	<.001

NOTE. Values are mean ± SEM or as n (%).
Abbreviations: PIGD, postural instability and gait disability; Test 1, independent samples *t* test; Test 2, χ^2 test; Test 3, Mann-Whitney *U* test.

has been shown to independently predict future recurrent falls in people with PD,[7] it is unclear whether the ABC-16 and ABC-6 are suitable for screening fall risk in patients with PD. This prospective study aimed to assess whether the ABC-16 and ABC-6 were capable of predicting future recurrent falls in people with PD and to validate the robustness of their predictive capacities.

Methods

Study population

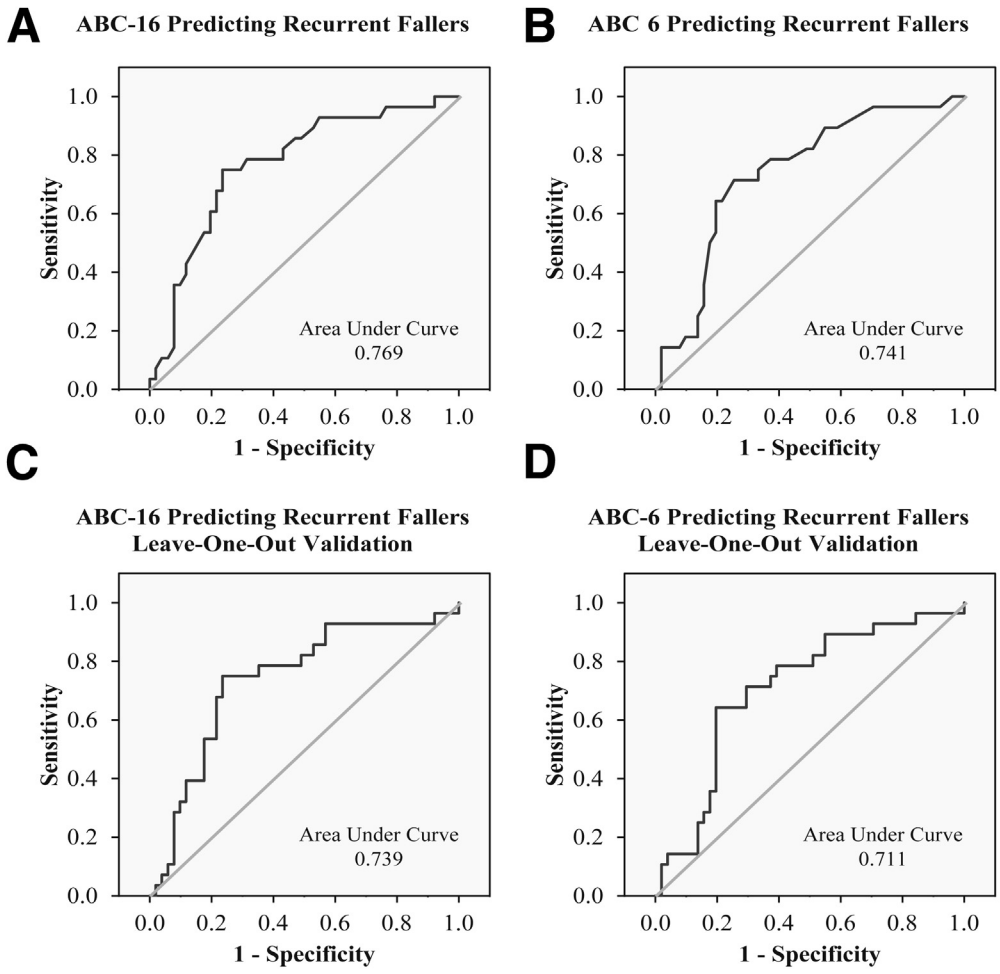
Seventy-nine people with idiopathic PD based on the UK Brain Bank Criteria[9] were recruited from neurology clinics and preexisting patient databases between August 2011 and June 2013. Participants were excluded if they had (1) recent surgery; (2) a recurrent history of musculoskeletal injury; (3) an inability to walk without assistance; (4) significant visual or cognitive impairments; or (5) received deep brain stimulation. Participants gave written informed consent in accordance with the Declaration of Helsinki, and the protocol was approved by the Australian Catholic University's Human Research Ethics Committee (approval no. Q2011 04).

List of abbreviations:

ABC-6 6-item Activities-specific Balance Confidence scale
ABC-16 16-item Activities-specific Balance Confidence scale
ABC-C Chinese translated Activities-specific Balance Confidence scale
PD Parkinson disease
ROC receiver operating characteristic
UPDRS Unified Parkinson's Disease Rating Scale

Clinical assessment

Participants completed questionnaires and clinical assessments to assess their medical history, symptom severity, and balance confidence. Specifically, symptom severity was assessed using the Freezing of Gait Questionnaire, Unified Parkinson's Disease Rating Scale (UPDRS), Hoehn and Yahr stage scale, and Schwab and England Activities of Daily Living Scale. The UPDRS is a universally accepted clinical test comprising 4 subscales that assess (1) changes in mentation, behavior, or mood; (2) difficulties with activities of daily living; (3) impairments in motor function; and (4) therapeutic complications. The Hoehn and Yahr stage scale assesses the stage of PD on the basis of the severity and



Cut-off scores and corresponding sensitivities and specificities for the ABC-16 and ABC-6

ABC-16

Cut-off Score	Sensitivity	Specificity
65.9	42.8	88.2
77.5	75.0	76.5
85.9	85.7	52.9

ABC-6

Cut-off Score	Sensitivity	Specificity
52.5	50.0	82.4
65.8	71.4	74.5
77.5	82.1	51.0

Fig 1 ROC curves for the (A) ABC-16; (B) ABC-6; (C) leave-one-out validation of the ABC-16; and (D) leave-one-out validation of the ABC-6.

distribution of symptoms, with higher scores reflecting a more advanced disease state. Postural instability and gait difficulties were quantified by summing the scores for items 13 to 15 and 27 to 30 of the UPDRS, and the ABC-16 and ABC-6 were used to assess balance confidence. Patients were assessed within 1 to 2 hours of taking their antiparkinsonian medication (table 1).

Twelve-month prospective follow-up

After clinical evaluation, participants recorded any falls experienced over the subsequent year on daily fall calendars that they returned monthly by reply paid post. To minimize attrition, participants were posted a reminder if one of the calendars was not returned. A *fall* was defined as an unintentional coming to the ground or some lower level not as a result of a major intrinsic event or overwhelming hazard.[6]

Statistical analysis

Independent samples *t* tests were used to assess differences between groups for continuous measures of demographic characteristics, symptom severity, and balance confidence. Where the assumptions of parametric statistics were violated, the nonparametric Mann-Whitney *U* test was used. The chi-square test was used to evaluate associations between the categorical variables.

To determine whether the ABC-16 and ABC-6 could predict future recurrent falls in people with PD, the sensitivities and specificities of these assessments were evaluated using logistic regression and receiver operating characteristic (ROC) analyses. The best cutoff score on each scale was considered to be optimal in providing the highest sensitivity and specificity pairing on the ROC curves. To assess the efficacy of the ABC-16 and ABC-6 to predict

future falls in other samples, "leave-one-out" validation was used. Significance was set at $P<.05$, and all statistical procedures were conducted using SPSS 21[a] and the R statistics package.[b]

Results

Of the 313 patients contacted, 188 did not respond, 22 were not interested, and 4 were deceased. A further 18 were excluded after screening: 13 had deep brain stimulation surgery, 3 used a walking aid, and 2 had poor cognition. The remaining 81 completed all assessments, but 2 did not complete follow-up. On the basis of prospective falls, participants were divided into 2 groups: (1) 28 participants (35%) who reported ≥2 falls during the 12-month period (recurrent fallers); and (2) 51 participants (65%) who experienced ≤1 falls during this period (nonrecurrent fallers). Compared with nonrecurrent fallers, recurrent fallers had significantly longer disease duration, took larger amounts of levodopa, and experienced greater difficulties with daily activities, physical function, and mobility (see table 1). Furthermore, recurrent fallers typically presented with symptoms of more advanced PD, had lower balance confidence, and experienced more previous falls and therapeutic complications (eg, dyskinesia) according to part IV of the UPDRS.

Logistic regression analyses revealed that the ABC-16 (odds ratio, .95; 95% confidence interval, .92−.98) and ABC-6 (odds ratio, .96; 95% confidence interval, .94−.99) were both significant predictors of recurrent falls in people with PD. Furthermore, ROC analyses indicated that a cutoff score of 77.5 provided the best sensitivity (75.0%) and specificity (76.5%) for predicting future falls with the ABC-16 (fig 1A) whereas a cut-off score of 65.8 provided the best sensitivity (71.4%) and specificity (74.5%) with the ABC-6 (fig 1B). Validation of these models marginally reduced the area under the curve for the ABC-16 (fig 1C) and ABC-6 (fig 1D), as well as the specificity of the ABC-6 (70.6%).

Discussion

This is the first study to establish that the ABC-16 and ABC-6 can independently predict future recurrent falls in people with PD. The optimal cutoff scores on the ABC-16 (77.5 of 100) and ABC-6 (65.8 of 100) produced moderate to high sensitivities and specificities, and the validation suggested that both models were robust. However, these cutoff scores were chosen on the basis of the best combinations of sensitivity and specificity; hence, different cutoff scores should be considered if minimizing the likelihood of misclassifying "high-risk" patients is important. For example, a cutoff score of 85.9 on the ABC-16 yielded a sensitivity and specificity of 85.7% and 52.9%, whereas a cut-off score of 77.5 on the ABC-6 increased sensitivity to 82.1% but reduced specificity to 51.0%.

Interestingly, our cutoff scores were higher than those found in a previous research[7] on the ABC-C, which demonstrated that a score of 68.4 predicted future recurrent fallers with a sensitivity and specificity of 87% and 68%. This discrepancy is likely related to 2 factors: (1) the ABC-C modified 4 questions on the ABC-16 that were considered irrelevant to Chinese people[10]; and (2) all recurrent fallers assessed with the ABC-C had previously fallen[7] (compared with 71% in the present study). This higher percentage of previous fallers would likely exacerbate fear of future falls (ie, lower balance confidence) for these individuals. Given this point, our results may be limited to the English versions of the ABC-16 and ABC-6 and to people with PD living independently in the community.

Study limitations

It is important to consider that the transferability of these findings may be limited because only 25% of the invited patients agreed to participate. Although it was not possible to compare symptom severity or balance confidence between the included patients and those who declined or did not respond, a comparison of the groups for age ($P=.765$), sex distribution ($P=.586$), and proximity of the testing location ($P=.512$) showed no significant differences. Despite these results suggesting that the sample was somewhat representative of the wider PD community in this geographical region, it is possible that the reported cutoff scores may not be suitable for all populations with PD.

Conclusions

Nonetheless, these results are clinically significant and demonstrate that the ABC-16 and short-form ABC-6 are suited to not only assessing balance confidence in people with PD but also independently predicting future recurrent falls in this population.

Suppliers

a. IBM Corp.
b. The R Foundation.

Keywords

Accidental falls; Fear; Parkinson disease; Rehabilitation; Risk assessment

Corresponding author

Michael H. Cole, PhD, School of Exercise Science, Australian Catholic University, P.O. Box 456, Virginia, QLD 4014, Australia.
E-mail address: michael.cole@acu.edu.au.

References

1. Bloem BR, Grimbergen YA, Cramer M, Willemsen M, Zwinderman AH. Prospective assessment of falls in Parkinson's disease. J Neurol 2001;248:950-8.
2. Cole MH, Silburn PA, Wood JM, Kerr GK. Falls in Parkinson's disease: evidence for altered stepping strategies on compliant surfaces. Parkinsonism Relat Disord 2011;17:610-6.
3. 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;25:2369-78.

4. 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;72:721-5.
5. Grimbergen YA, Munneke M, Bloem BR. Falls in Parkinson's disease. Curr Opin Neurol 2004;17:405-15.
6. Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. N Engl J Med 1988;319:1701-7.
7. Mak MK, Pang MY. Fear of falling is independently associated with recurrent falls in patients with Parkinson's disease: a 1-year prospective study. J Neurol 2009;256:1689-95.
8. Peretz C, Herman T, Hausdorff JM, Giladi N. Assessing fear of falling: can a short version of the Activities-specific Balance Confidence scale be useful? Mov Disord 2006;21:2101-5.
9. Hughes AJ, Daniel SE, Kilford L, Lees AJ. Accuracy of clinical diagnosis of idiopathic Parkinson's disease: a clinico-pathological study of 100 cases. J Neurol Neurosurg Psychiatry 1992;55:181-4.
10. Mak MK, Lau AL, Law FS, Cheung CC, Wong IS. Validation of the Chinese translated Activities-specific Balance Confidence scale. Arch Phys Med Rehabil 2007;88:496-503.