

Running Head: Screening for falls risk in Parkinson's

Title: Use of a short-form balance confidence scale to predict future recurrent fallers
in Parkinson's disease

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ABSTRACT

Objective: This prospective study evaluated whether the Activities-specific Balance Confidence (ABC-16) scale and short-form ABC-6 could predict future recurrent falls in Parkinson's disease (PD) and evaluated the robustness of their predictive capacities.

Design: 12-month prospective cohort study

Setting: General community

Participants: 313 PD patients were contacted via neurology clinics and pre-existing databases and invited to participate. Of those contacted, 188 did not respond, 22 were not interested and 4 were deceased. Following screening, a further 18 were excluded; 13 had deep brain stimulation surgery; 3 used walking aids; and 2 had poor cognition. The remaining 81 completed all assessments, but two withdrew before completing the follow-up.

Exposures: Clinical tests were completed to establish symptom severity, balance confidence and medical history. Over the subsequent 12 months, participants recorded any falls on daily falls calendars, which they returned monthly via reply-paid post.

Main Outcomes: 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' validations were used to assess their robustness.

Results: Of the 79 who completed the follow-up, 28 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 cut-off scores 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 Parkinson's disease at risk of future recurrent falls.

Keywords: Parkinson Disease; Fear; Accidental Falls; Risk Assessment

HIGHLIGHTS

- The ABC-16 and ABC-6 independently predict future falls in Parkinson's patients
- Cut-offs of 77.5 (ABC-16) and 65.8 (ABC-6) provided the best predictive values
- Assessing fear of falling in the clinic would help identify 'high risk' patients

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Parkinson's disease (PD) is characterised by complex symptoms that impair physical function and increase the risk of recurrent falls¹. Nearly 65% of people with PD report falling at least once each year, while up to 50% experience recurrent falls²⁻⁴. The increased prevalence of falls is compounded by impaired postural responses⁵ that increase the risk of falls-related injuries, injury-related deaths and hospitalisation⁶. While fall-related injuries often receive considerable attention, the psychological consequences of falling are equally disabling and cannot be overlooked⁷. Specifically, frequent falls contribute to reduced balance confidence and an 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-adopted 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 ABC (ABC-6) has similar properties to the ABC-16 and, therefore, may be useful for assessing balance confidence in PD⁸. While the Chinese translation of the ABC-16 (ABC-C) has been shown to independently predict future recurrent fallers in people with PD⁷, it is unclear whether the ABC-16 and ABC-6 are suitable for screening falls risk in PD patients. 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 validated the robustness of their predictive capacities.

METHODS

Study Population

Seventy-nine people with idiopathic PD based on the UK Brain Bank Criteria⁹ were recruited from neurology clinics and pre-existing patient databases between August 2011 and June

2013. Participants were excluded if they had; i) recent surgery; ii) a recurrent history of musculoskeletal injury; iii) an inability to walk without assistance; iv) significant visual or cognitive impairments; or v) received deep brain stimulation. In accordance with the Declaration of Helsinki, participants provided written informed consent and the protocol was approved by the Australian Catholic University Ethics Committee (Approval #Q2011 04).

Clinical Assessment

Participants completed questionnaires and clinical assessments to establish their medical history, symptom severity and balance confidence. Specifically, symptom severity was assessed using the Freezing of Gait questionnaire, Unified PD Rating Scale (UPDRS), Hoehn & Yahr stage score and Schwab and England Activities of Daily Living scale. The UPDRS is a universally-accepted clinical test comprising four sub-scales that assess; i) changes in mentation, behaviour or mood; ii) difficulties with activities of daily living; iii) impairments in motor function; and iv) therapeutic complications. The Hoehn and Yahr stage score assesses the stage of PD based on the severity and distribution of symptoms, with higher scores reflecting a more advanced disease state. Postural instability and gait difficulties (PIGD) were quantified by summing the scores for items 13 to 15 and 27 to 30 from the UPDRS and the ABC-16 and ABC-6 evaluated balance confidence. Patients were assessed within 1 to 2 hours of taking their anti-parkinsonian medication (Table 1).

Insert Table 1 about here.

12-Month Prospective Follow-up

Following clinical evaluation, participants recorded any falls experienced over the subsequent year on daily falls calendars that they returned monthly via reply-paid post. To minimise

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 demographics, symptom severity and balance confidence. Where the assumptions of parametric statistics were violated, the non-parametric Mann-Whitney *U* test was used. The chi-square (χ^2) 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 PD, the sensitivities and specificities of these assessments were evaluated using logistic regression and receiver operating characteristic (ROC) analyses. The best cut-off score for each 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, a ‘leave-one-out’ validation was included. Significance was set at $p < 0.05$ and all statistical procedures were conducted using SPSS 21 and the R statistics package.

RESULTS

Of the 313 patients contacted, 188 did not respond, 22 were not interested and 4 were deceased. A further 18 were excluded following screening; 13 had deep brain stimulation surgery; 3 used a walking aid; and 2 had poor cognition. The remaining 81 completed all assessments, but two did not complete the follow-up. Based on prospective falls, participants were divided into two groups that included; i) 28 participants (35%) who reported more than

one fall during the 12-month period (recurrent fallers); and ii) 51 participants (65%) who experienced one or fewer falls during this period (non-recurrent fallers). Compared with non-recurrent fallers, recurrent fallers had significantly longer disease duration, took larger amounts of levodopa and experienced greater difficulties with daily activities, physical function and mobility (Table 1). Furthermore, recurrent fallers typically presented with symptoms of more advanced PD, had less balance confidence and experienced more previous falls and therapeutic complications (e.g. dyskinesia) according to the UPDRS IV.

The logistic regression analyses indicated that the ABC-16 (OR: 0.95; 95% CI: 0.92-0.98) and ABC-6 (OR: 0.96; 95% CI: 0.94-0.99) were both significant predictors of recurrent falls in PD. Furthermore, ROC analyses indicated that a cut-off score of 77.5 provided the best sensitivity (75.0%) and specificity (76.5%) for predicting future falls with the ABC-16 (Figure 1A), while 65.8 provided the best sensitivity (71.4%) and specificity (74.5%) for the ABC-6 (Figure 1B). Validation of the models marginally reduced the area under the curve for the ABC-16 (Figure 1C) and ABC-6 (Figure 1D) and the specificity of the ABC-6 (70.6%).

Insert Figure 1 about here.

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 cut-off scores for the ABC-16 (77.5/100) and ABC-6 (65.8/100) produced moderate to high sensitivities and specificities and the validation suggested that both models were robust. However, it is important to note that these cut-offs were chosen based on the best combinations of sensitivity and specificity, hence, different cut-off scores should be considered if minimizing the likelihood of

misclassifying ‘high-risk’ patients is important. For example, a cut-off of 85.9 on the ABC-16 yielded a sensitivity and specificity of 85.7% and 52.9%, while a score of 77.5 on the ABC-6 increased sensitivity to 82.1%, but reduced specificity to 51.0%.

Interestingly, our cut-offs were higher than previous research concerning the ABC-C⁷, 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 two factors; i) the ABC-C modified 4 questions on the ABC-16 that were considered irrelevant for Chinese people¹⁰; and ii) all recurrent fallers assessed with the ABC-C had previously fallen⁷ (compared with 71% in the current study). This higher percentage of previous fallers would likely exacerbate fear of future falls for these individuals (i.e. lower balance confidence). 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.

It is important to consider that the transferability of these findings may be limited as only 25% of the invited patients agreed to participate. While it was not possible to compare symptom severity or balance confidence between the included patients and those who declined or did not respond, comparison of the groups for age ($p=0.765$), gender distribution ($p=0.586$) and proximity to the testing location ($p=0.512$) 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 cut-off scores may not be suitable for all PD populations.

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 can also independently predict future recurrent falls in this population.

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FIGURE CAPTION

Figure 1: Receiver operating characteristic (ROC) plots for the; A) 16-item Activities-specific Balance Confidence scale (ABC-16); B) 6-item Activities-specific Balance Confidence scale (ABC-6); C) the leave-one-out validation of the ABC-16; and D) the leave-one-out validation of the ABC-6.

TABLE CAPTIONS

Table 1: Demographic data, balance confidence and disease-specific scores for the participants with Parkinson's disease and the recurrent faller and non-recurrent faller sub-groups. Data represent the mean (and standard error of the mean (SEM)) values or absolute numbers and percentages.

Tables

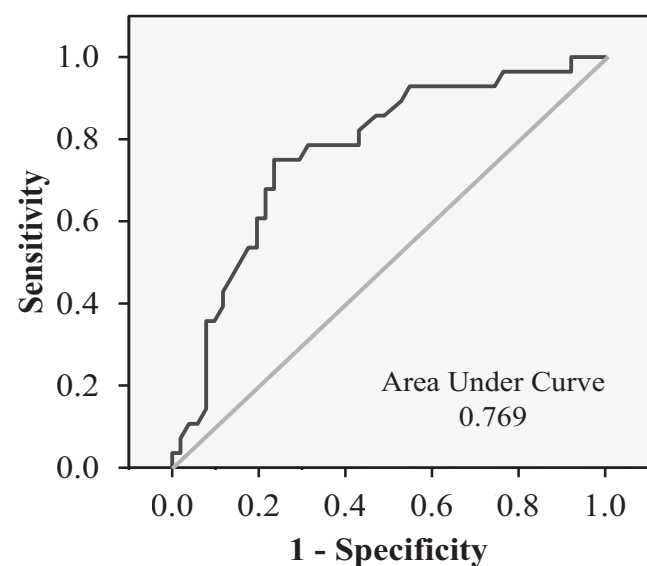
	All Patients (n = 79)	Recurrent Faller (n = 28)	Non Recurrent Faller (n = 51)		
	Mean (SEM) or N (%)	Mean (SEM) or N (%)	Mean (SEM) or N (%)	Test	p-value
Demographics					
Age (years)	68.1 (0.9)	69.5 (1.6)	67.3 (1.1)	1	0.250
Gender (male)	51 (64.6%)	20 (71.4%)	31 (60.8%)	2	0.344
Height (cm)	168.2 (1.0)	167.2 (1.7)	168.8 (1.2)	1	0.451
Mass (kg)	74.3 (1.8)	70.3 (2.9)	76.5 (2.2)	1	0.097
Body Mass Index (kg/m ²)	26.1 (0.5)	25.1 (0.9)	26.7 (0.7)	1	0.134
Falls History and Balance Confidence					
16-item ABC scale	77.5 (1.9)	67.9 (3.1)	82.8 (2.1)	3	<0.001
6-item ABC scale	67.2 (2.6)	55.4 (4.0)	73.7 (3.0)	3	<0.001
Previous Falls (12 months)	3.3 (1.4)	8.5 (3.8)	0.5 (0.1)	3	<0.001
Neurological Exam					
Disease Duration (years)	6.1 (0.5)	8.4 (1.0)	4.8 (0.5)	3	0.006
Levodopa (mg/day)	655.7 (47.5)	876.7 (83.3)	534.4 (50.7)	3	0.001
Dopamine Agonists	30 (38.0%)	12 (42.9%)	18 (35.3%)	2	0.508
Catechol-O-Methyl Transferase Inhibitors	28 (35.4%)	13 (46.4%)	15 (29.4%)	2	0.130
Monoamine Oxidase Inhibitors	12 (15.2%)	4 (14.3%)	8 (15.7%)	2	0.868
Benzodiazepine	4 (5.1%)	4 (14.3%)	0 (0.0%)	2	0.006
No Anti-Parkinsonian Medication	5 (6.3%)	0 (0.0%)	5 (9.8%)	2	0.087
UPDRS I	3.2 (0.2)	3.4 (0.4)	3.0 (0.2)	3	0.341
UPDRS II	11.3 (0.6)	14.0 (1.1)	9.8 (0.6)	3	0.003
UPDRS III	20.2 (1.0)	25.1 (1.5)	17.6 (1.2)	1	<0.001
UPDRS IV	3.9 (0.3)	5.0 (0.7)	3.4 (0.3)	3	0.035
UPDRS Total	34.7 (1.5)	42.5 (2.5)	30.4 (1.6)	1	<0.001
PIGD Score	4.7 (0.4)	6.3 (0.7)	3.7 (0.3)	3	0.003
Freezing of Gait	5.8 (0.6)	9.1 (1.0)	4.0 (0.5)	3	<0.001
Hoehn & Yahr Stage Score	1.9 (0.1)	2.4 (0.1)	1.6 (0.1)	3	<0.001
Schwab & England ADL Scale	80.9 (1.1)	74.6 (1.8)	84.3 (1.1)	3	<0.001

ABC: Activities-specific Balance Confidence; **UPDRS:** Unified Parkinson's Disease Rating Scale; **PIGD:** Postural Instability and Gait Disability; **ADL:** Activities of Daily Living

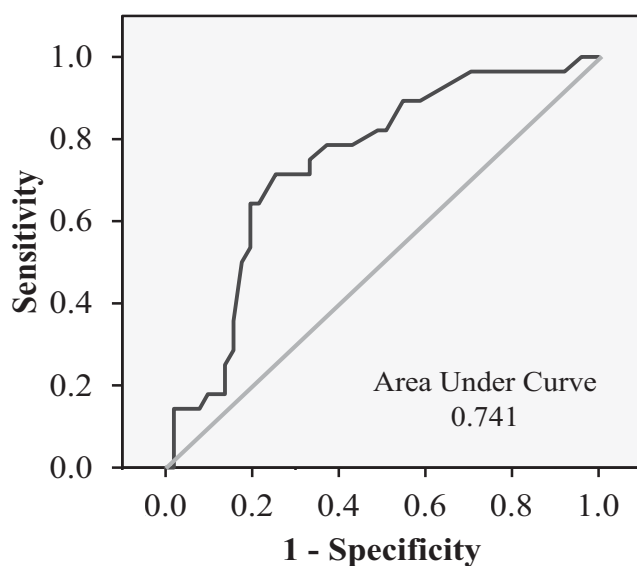
N.B. Test 1 = Independent samples t-test; Test 2 = χ^2 test; Test 3 = Mann-Whitney U test

Table 1.

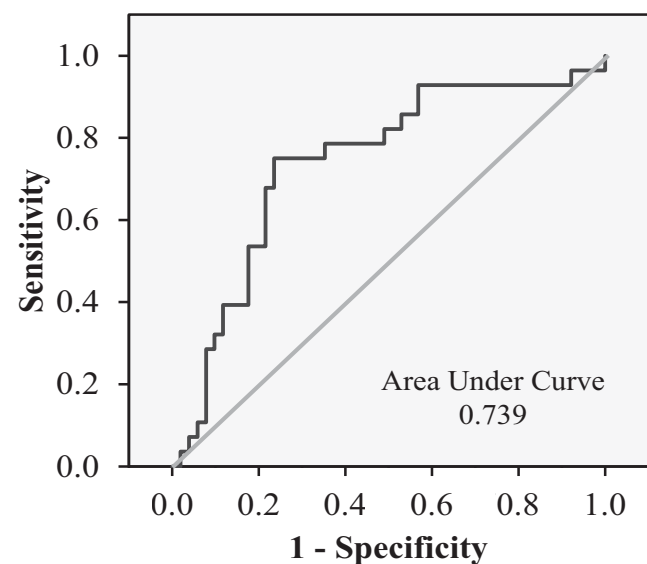
A)

ABC-16 Predicting Recurrent Fallers

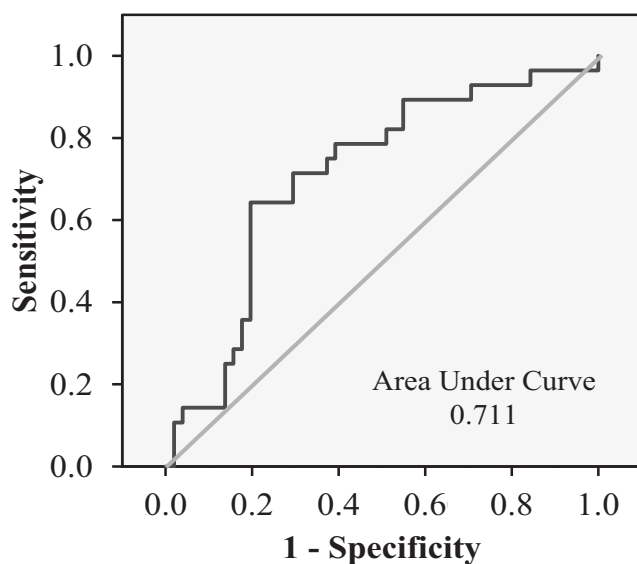
B)

ABC 6 Predicting Recurrent Fallers

C)

**ABC-16 Predicting Recurrent Fallers
Leave-One-Out Validation**

D)

**ABC-6 Predicting Recurrent Fallers
Leave-One-Out Validation****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