



# Further Validity of the Short Version of the Activities-Specific Balance Confidence Scale in Patients with Multiple Sclerosis

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## Abstract

**Objective:** There is scarce data on the utility of the short version of the Activities-specific Balance Confidence Scale in persons with multiple sclerosis (pwMS). Thus, this study aimed to expand the validity of the ABC-6 scale and compare it with the original version of the 16-item ABC scale (ABC-16) in pwMS.

**Materials and Methods:** In total, 156 patients were included (median age: 35 years, 73.1% female and 26.9% male) in this study. The ABC-16 and ABC-6, timed up-and-go test (TUG), TUG-cognitive, six-minute walk test, timed 25-foot walk, MS walking scale, single-leg stance test, modified fatigue impact scale (MFIS), brief international cognitive assessment for multiple sclerosis, Beck depression inventory-II (BDI-II), and epworth sleepiness scale (ESS) were assessed. Validity was assessed in terms of criterion, convergent, discriminant, and known-group validity.

**Results:** The correlation coefficient between the ABC-6 and ABC-16 was 0.974 ( $p < 0.001$ ). The ABC-16 and ABC-6 were strongly correlated with measures of the expanded disability status scale, all walking and balance tests, and physical and psychosocial subscores of MFIS ( $r_s = -0.520$  to  $-0.811$ ,  $p < 0.05$ ). Moderate correlations were found with a cognitive subscore of fatigue, cognitive processing speed, visuospatial memory, and BDI-II ( $r_s = -0.321$  to  $-0.446$ ,  $p < 0.05$ ). Low correlations were found in verbal memory and ESS scores ( $r_s = -0.160$  to  $-0.246$ ,  $p < 0.05$ ). PwMS with a moderate-severe disability had significantly lower ABC-6 scores than that of patients with mild disability ( $p < 0.001$ ).

**Conclusion:** The ABC-6 demonstrated high validity for measuring balance confidence in pwMS. Our findings strengthen the clinical utility of the ABC-6 in pwMS.

**Keywords:** Multiple sclerosis, balance confidence, balance impairment, validity

## Introduction

Multiple sclerosis (MS) is a neurodegenerative disease characterized by reduced motor and cognitive functions and fall risk (1,2). A total of 56% of patients with MS (pwMS) fall in the previous three months, and 37% of those are recurrent (3). Balance confidence is deemed as a psychological aspect of balance-demanding activities and falls (4). Furthermore, a lower level of balance confidence is demonstrated as related to lower physical activity and participation (5,6).

The 16-item Activities-specific Balance Confidence (ABC-16) scale has been a widely used patient-reported outcome measure for pwMS and other populations to assess balance

confidence (7). In addition, the ABC-16 was shown to be the best determinant of falls in pwMS and older adults (8-10). Hence, its use to evaluate or predict falls is recommended. However, proper fulfillment of the original scale requires approximately 5-20 min. Therefore, a six-item version of the ABC-16 scale, named the ABC-6, was created to save time and allow a rapid quantitative assessment in busy clinical settings (11). However, limited data is available about the validity of the ABC-6 in pwMS. Therefore, further research is warranted to confirm its utilization in this population.

Wood et al. (12) reported moderate convergent validity and good internal consistency of the ABC-6 in pwMS. They also

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revealed that both the ABC-6 and ABC-16 had good sensitivity and specificity in distinguishing between pwMS with high fall risk and controls, whereas were less accurate at differentiating low and high fall risk of pwMS. Nevertheless, only physiologic profile assessment and fall history were investigated in their study. Results are promising for the use of ABC-6, but these findings should be confirmed considering the multifactorial nature of balance confidence. Therefore, the present study aimed to expand the validity of the ABC-6 in pwMS, investigating its correlations with walking, balance, fatigue, cognition, and psychosocial measures. A better understanding of related factors of balance confidence can guide rehabilitation strategies and ultimately help reduce activity limitation and encourage task performance.

## Materials and Methods

### Participants and Procedure

Data collected from the initial assessments of the longitudinal study registered to ClinicalTrials.gov (NCT03878836) were analyzed for this study. The study protocol was approved by the Ethics Board of Dokuz Eylul University (approval number: 2016/27-08). Data were extracted from a patient registry electronic system (iMed, Version 6.1; Merck Serono SA, Geneva, Switzerland).

The study included data from 156 pwMS. Eligible participants were selected according to the following inclusion criteria: a definite diagnosis of MS, Expanded Disability Status Scale (EDSS) below 7, and aged 18-65 years. Exclusion criteria included relapse within 30 days, neurological disease diagnosis other than MS, and severe cognitive impairment hindering assessment understanding. Written informed consent was taken from all participants.

### Outcome Measures

Basic demographics, including age and sex, were recorded. The clinical information of participants was obtained from the current records. Neurological disability level was measured using the EDSS (13).

### Balance Confidence

The primary outcomes were the ABC-16 and ABC-6. The ABC-16 scale includes 16 items related to daily life activities. All items are ranked from 0 (no confidence) to 100 (complete confidence), and the score of the questionnaire is calculated by dividing the total score obtained from 16 activities by 16 (6,7,14). The ABC-6 constitutes the six most challenging tasks (questions 5, 6, 13, 14, 15, and 16) of the ABC-16 and approximately takes 5 min. Therefore, the score of ABC-6 is calculated by dividing the sum of the six items by six (11).

### Walking

The Six-Minute Walk Test (6MWT) was implemented to assess the walking capacity. Participants were instructed to walk safely

at their fastest speed in 6 min, according to a study by Motl et al. (15) The total distance covered during the 6 min was recorded in meters.

Timed-25 Foot Walking (T25FW) was carried out in a 7.62-meter long corridor; participants were asked to walk as fast and safely as possible to measure the walking speed. The average of two trials was recorded as the test score (16).

Timed Up-and-Go (TUG) test is a widely used instrument that assesses dynamic stability, mobility, turning, and rising out of a chair (17). The dual-task assessment was performed using the TUG test as a motor task and by adding a cognitive task, which is a serial 3 subtraction task. Serial subtraction tasks have been previously used to quantify dual-task cost in pwMS (18,19).

The severity of perceived walking difficulties was assessed using the 12-item MS Walking Scale (MSWS-12). Higher scores indicate an increased impact of MS on walking (20).

### Balance

The static standing balance was assessed using the Single-Leg Stance Test. Participants were asked to stand on their dominant feet with eyes open for 60 s. The test ended when participants achieved 60 s or their feet touched the ground or their opposite extremity (21).

### Fatigue

The Modified Fatigue Impact Scale (MFIS) is a patient-rated instrument that obtains information about the effects of fatigue and consists of 21 items. It involves physical, psychosocial, and cognitive subscales. Higher scores show more perceived fatigue (22,23).

### Cognition

Brief International Cognitive Assessment for MS (BICAMS) composing the oral version of symbol digit modalities test (SDMT), brief visuospatial memory test-revised, and california verbal learning test (CVLT-II) were used in our study. The Turkish version of BICAMS was found valid and suitable for pwMS (24).

### Depression

The severity of depressive symptoms was evaluated using the Beck Depression Inventory-II (BDI-II). Higher scores of BDI-II show enhanced depression symptom severity (25).

### Sleep

The Epworth Sleepiness Scale (ESS) was used to evaluate daytime sleepiness. Higher scores of ESS indicate increased daytime sleepiness. The reliability of the Turkish form of ESS was found high (26).

### Statistics Analysis

Data analysis was conducted using the IBM SPSS Statistics for Windows (Version 25.0. Armonk, NY: IBM Corp.). Data distribution was checked using the Kolmogorov-Smirnov test

and investigation of the histogram and plots. Nonparametric tests were used as the ABC-6 and ABC-16 did not show normal distribution. Spearman rank-order correlation was calculated to identify associations between the ABC-6 scale, ABC-16 scale, and other measures. Correlation coefficients of 0.1-0.29 were interpreted as small, 0.3-0.49 as moderate, and 0.5-1.0 as strong correlations. The validity was assessed in terms of criterion, convergent, discriminant, and known-groups validity by testing predefined hypotheses. The correlation coefficient between the ABC-16 and ABC-6 was explored to assess the criterion validity, and a strong correlation was expected. For examining the convergent validity, the following predefined hypotheses were constructed:

1. A strong correlation was expected between the ABC-6 and ABC-16 as they assess the same construct.
2. A moderate to strong correlation was expected between the ABC-6 and walking and balance tests, fatigue, cognitive processing speed, and visuospatial memory as they measure the nonsimilar construct, but these factors may influence balance confidence based on previous research.

A low correlation was foreseen between the ABC-6 and sleepiness and verbal memory for examining the discriminant validity as they do not measure balance-related constructs. Known-groups validity assesses whether an instrument can distinguish between known groups of patients. In this study, the ABC-6 and ABC-16 scores were compared using the Mann-Whitney U test between the disability groups. Groups were described according to the EDSS score as mild disability group (EDSS  $\leq$ 3.5) and moderate-severe (EDSS  $>$ 3.5) (27). Significance was set at  $p < 0.05$ .

## Results

Demographic and clinical characteristics of 156 participants with pwMS are summarized in Table 1. The clinical course of most patients was relapsing-remitting MS (92.3%).

The median score of the ABC-16 and ABC-6 were 83.12 and 73.33, respectively. Table 2 displays the correlation coefficient between ABC-6, ABC-16, and other outcome measures. All the predetermined hypotheses for the validity assessment were confirmed. The correlation coefficient between ABC-6 and ABC-16 was 0.974 ( $p < 0.001$ ). The ABC-6 and ABC-16 were strongly correlated with measures of the EDSS, walking and balance tests, and physical and psychosocial subscores of fatigue. The strongest correlation between ABC-16, ABC-6, and other outcome measures was found among perceived walking difficulties assessed using the MSWS-12 ( $r_s = -0.811$ ,  $r_s = -0.768$ ,  $p < 0.001$ ; respectively). Moderate correlations were found with the cognitive subscore of fatigue, SDMT, BVMT-R, and depression. Low correlations were found in CVLT-II and ESS scores. Correlations coefficients between the ABC-6 and ABC-16 and other measures were similar.

**Table 1. Demographic and clinical characteristics of participants**

	Total (n=156)
<b>Age (years)</b>	35 (28.0-44.0)
<b>Gender, n (%)</b>	
<b>Female</b>	114 (73.1%)
<b>Male</b>	42 (26.9%)
<b>EDSS (0-10)</b>	1.5 (0-2.0)
<b>Disease duration (years)</b>	2 (2.0-11.37)
<b>Clinical course of MS, n (%)</b>	
<b>Relapsing-remitting</b>	144 (92.3%)
<b>Secondary-progressive</b>	9 (5.8%)
<b>Primary-progressive</b>	3 (1.9%)

EDSS: Expanded disability status scale, MS: Multiple sclerosis

Table 3 shows that patients with higher EDSS reported lower scores in the ABC-6 and ABC-16 scales, and differences were significant for both scales.

## Discussion

The primary finding of our study revealed that the ABC-6 test is strongly correlated with measures of neurological disability level, walking and balance tests, and fatigue in PwMS. Furthermore, an almost perfect correlation was found between them. These findings provide insights into the clinical utility of the ABC-6 in pwMS by showing good validity, including criterion, convergent, discriminant, and known-groups validity.

The median ABC-16 score (83.12) was lower than that of the ABC-6 score. This result indicates that ABC-6 contains more challenging activities compared with ABC-16 for pwMS. The median EDSS score was 1.5 in our sample; however, the balance confidence level assessed using ABC-6 (73.33) was not high. This finding supports that selected activities (item 5: reach on tiptoes, item 6: standing on a chair to reach, item 13: being bumped into by people while walking through a mall, item 14: stepping off an escalator with rail, item 15: stepping off an escalator without holding onto the railing, and item 16: walking on an icy sidewalk) are challenging for pwMS.

Balance confidence refers to balance-related self-efficacy, which increases the possibility of the activity being accomplished regardless of physical (7,28). The increasing amount of evidence indicates that balance confidence as measured using the ABC-16 is a predictor of falls in pwMS (8-10). The ABC-16 has the highest explanatory value, whereas performance-based tests could not adequately explain falls in those without clinical disability (10). Few studies were reported; however, ABC-6 also has good sensitivity in distinguishing fallers or participants with high risk fall in Parkinson's disease (71.4%) and pwMS (95%), and values are similar to the ABC-16 (12,29).

**Table 2. Correlation coefficients between ABC-6, ABC-16, and other outcome measures**

	Median (interquartile range)	Correlation coefficient with ABC-16	Correlation coefficient with ABC-6
<b>Criterion validity</b>			
ABC-16 (0-100)	83.12 (58.43-95.56)	-	0.974
ABC-6 (0-100)	73.33 (45.83-95.0)	0.974	-
<b>Convergent validity</b>			
EDSS (0-10)	1.5 (0-2.0)	-0.668	-0.635
6MWT (m)	465 (380-520)	0.606	0.607
T25FW (s)	4.75 (4.34-5.65)	-0.614	-0.632
TUG (s)	6.78 (6.15-8.41)	-0.630	-0.635
TUG-cognitive (s)	7.69 (6.64-10.55)	-0.520	-0.533
MSWS-12 (0-54)	17.0 (12.0-29.0)	-0.811	-0.768
SLST (0-60 s)	21.87 (5.3-60)	0.572	0.573
MFIS-total (0-84)	27.0 (10.0-48.0)	-0.604	-0.582
MFIS-physical (0-36)	13.0 (4.0-21.0)	-0.679	-0.663
MFIS-cognitive (0-40)	13.0 (4.0-22.0)	-0.446	-0.421
MFIS-psychosocial (0-8)	3.0 (0-5.0)	-0.543	-0.524
SDMT	49.0 (41.0-56.0)	0.321	0.335
BVMT-R	28.0 (22.0-31.0)	0.334	0.329
BDI-II (0-63)	9.0 (5.0-15.0)	-0.423	0.384
<b>Discriminant validity</b>			
CVLT-II	53.0 (42.0-61.0)	0.224	0.246
ESS (0-24)	4.0 (2.0-7.0)	-0.178	-0.160

p<0.05 for all correlation coefficients

ABC-16: 16-item activities-specific balance confidence, ABC-6: 6-item activities-specific balance confidence, EDSS: Expanded disability status scale, 6MWT: Six-minute walk test, T25FW: Timed 25-foot walk, TUG: Timed up-and-go, MSWS-12: Multiple sclerosis walking scale, SLST: Single-leg stance test, MFIS: Modified fatigue impact scale, SDMT: Symbol digit modalities Test; BVMT-R: Brief Visuospatial memory test-revised, BDI-II: Beck depression Inventory, CVLT-II: California verbal learning test, ESS: Epworth sleepiness scale

**Table 3. Comparison of ABC-6 and ABC-16 scores between pwMS with different disability levels (known-groups validity)**

	Mild disability group (n=133)	Moderate-severe disability group (n=23)	p
ABC-6	83.33 (53.33-95.0)	30.0 (10.0-45.83)	<0.001
ABC-16	88.13 (70.0-97.5)	49.38 (24.06-58.44)	<0.001

ABC-16: 16-item activities-specific balance confidence, ABC-6: 6-item activities-specific balance confidence

Wood et al. (12) revealed good reliability and moderate convergent validity of the ABC-6 in pwMS. The ABC-6 was negatively correlated with physiologic profile assessment and fall history. However, this study overlooked other factors thought to be associated with balance confidence. Our previous research showed that psychosocial factors are also related to balance confidence in a large sample of pwMS (30). Depression, fatigue, and cognitive processing speed assessed using SDMT were determinants of the ABC-16. The ABC-6 was also correlated with these measurements in this present study. Our results suggest that the ABC-6 can reflect the relationship with these factors.

In accordance with previous studies on the ABC-16, the ABC-6 was also correlated with physical measurements, including T25FW, 6MWT, TUG, TUG-cognitive, MSWS-12, and balance assessment (6,31). The fact that the correlation values with physical tests are so close to the ABC-16 suggests that items included in the ABC-6 successfully reflect balance confidence. Therefore, the ABC-6 can also be used to save time in clinics or research.

**Study Limitations**

Most of the pwMS had mild disabilities, which could restrict the generalizability of findings. Notwithstanding this limitation, this study involves some strength, such as relatively large sample size and considerations of other dimensions that are yet to

be investigated in validity studies involving the ABC-6 scale in pwMS.

## Conclusion

The ABC-6 showed good criterion, convergent, discriminant, and known-groups validity in pwMS. Our study expands the evidence promoting the utility of the ABC-6 scale to assess balance confidence in pwMS. The ABC-16 and ABC-6 were associated with disability level, physical functions, cognition, fatigue, depression, and sleepiness in pwMS and showed similar correlations with these measures. Thus, the ABC-6 can be used in research and clinical settings as it allows rapid and accurate assessment of balance confidence.

## Ethics

**Ethics Committee Approval:** The Non-invasive Research Ethics Board of Dokuz Eylul University approved the study protocol (protocol number: 2959-GOA and approval number: 2016/27-08).

**Informed Consent:** Written informed consent was taken from all participants.

## Authorship Contributions

Surgical and Medical Practices: C.B., S.O., Concept: Z.A., T.K., C.B., O.E., S.O., Design: Z.A., P.Y., C.B., O.E., S.O., Data Collection or Processing: : Z.A., P.Y., Analysis or Interpretation: Z.A., T.K., Literature Search: Z.A., P.Y., C.B., O.E., S.O., Writing: Z.A., T.K., C.B., O.E., S.O.

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