

The BTrackS™ Balance Test is a Valid Predictor of Older Adult Falling

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Abstract

The BTrackS™ Balance Test (BBT) objectively measures postural sway, a known risk factor for falls in older adults. This paper provides validity evidence that the BBT fall risk categories (i.e. LOW, MOD, HIGH) relate to the likelihood of falling in older adults over a one-year period.

Introduction

One-third to one-half of older adults fall each year in the United States, equating to millions of individuals being affected (1). One in five falls results in a serious injury (e.g. broken bone, head trauma), which may ultimately lead to disability or death (2). Financially, the older adult falls “crisis” represents an estimated \$31,000,000,000 cost to the United States healthcare system (3).

Postural sway is defined as sustained oscillatory motion about a fixed postural position during upright standing (4). Previous research has shown that the amount of postural sway exhibited by an older adult predicts their likelihood of falling (5-16). Using a force plate device, postural sway can be measured with a high degree of accuracy and precision based on changes over time in a variable called center of pressure (COP).

Despite the scientific evidence supporting force plate fall risk assessments, this approach remains limited in use. This is most likely due to the high cost (~\$5,000-\$20,000) and poor portability associated with typical force plates. Despite this, the first low cost and easily portable force plate device was released in 2014 for fall risk assessment. This device, called the Balance Tracking System (BTrackS), costs ~\$1600 including software, and weighs less than 15lbs with no need for external AC power.

The aim of this paper is to share results demonstrating the efficacy of BTrackS for fall prediction. Specifically, a large sample of older adults were given the BTrackS Balance Test (BBT), and then followed for one year to determine their likelihood of falling based on BBT fall risk categorization. It was expected that a higher percentage of individuals in the HIGH vs. MOD vs. LOW risk category would experience a fall, thus, validating the ability of BTrackS™ to predict future falls in older adults.

Methods

Data were collected from a sample of 107 generally healthy adults aged 70 years and older (mean age = 74.9 years). Overall, there were more women (74%) than men (26%) tested. Participants were recruited from the local community through various advertising methods and were paid for their participation. All participants gave written informed consent prior to the study.

Postural sway was assessed first using the BTrackS™ Balance Plate and BTrackS™ Assess Balance software (Figure 1). The BTrackS™ Balance Plate, is an FDA registered, portable force plate used to determine COP with near perfect accuracy/precision (17). The BTrackS™ Assess Balance software guides test administrators through all aspects of postural sway assessment including 1) Profile Creation, 2) Data Collection and 3) Outputting various results and reports.



Figure 1. The BTrackS™ Balance Plate and BTrackS™ Assess Balance software



Figure 2. Depiction of the BBT setup. Participants stood with eyes closed, hands on hips and two feet on the BTrackS™ Balance Plate, while BTrackS™ Assess Balance software guided the test administrator through measurement of COP path length over four trials.

Postural sway assessments were based on the BBT protocol. Each BBT followed a standardized script consisting of four, 20s trials with minimal inter-trial delays (<10s). Each trial began and ended with an auditory tone, and required the participant to stand as still as possible on the BTrackS™ Balance Plate with eyes closed, hands on hips, and feet shoulder width apart (Figure 2). The first BBT trial was for familiarization and was discarded prior to analysis. The remaining three trials were used to determine the BBT result.

The BBT result (i.e. postural sway) for each test was calculated by the BTrackS™ Assess Balance software, equivalent to the average total COP path length in centimeters (cm) from the three, non-familiarization trials. This result was then translated into a fall risk category based on the following BBT result ranges:

Sex	BBT Fall Risk Category		
	LOW	MOD	HIGH
Males	(0-32)	(33-40)	(41+)
Females	(0-30)	(31-38)	(39+)

These categories were determined using normative data from over 17,000 BBT results. Specifically, the average postural sway of typical men and women 20-39 years old was initially calculated. Fall risk was then categorized as being LOW when BBT was within 1 standard deviation above typical adults, MOD when within 1-2 standard deviations above typical adults and HIGH when >2 standard deviations above typical adults.

Following BBT testing, participants were tracked for any falls experienced over a one-year period via monthly reports. Reports were obtained using an online survey format or conversation over the phone.

Results

Based on BBT results, there were 44 individuals in the LOW category, 24 in the MOD category and 39 in the HIGH category. The composition of these categories did not differ in age (t-test, $p > 0.05$) or sex (χ^2 , $p > 0.05$).

Across all categories, 40% (43/107) of older adults experienced a fall. Likelihood of falling was significantly (χ^2 , $p < 0.05$) less in the LOW category (29%) compared to those in the HIGH (51%) category. MOD category individuals had a fall rate of 42%. Calculated odds ratios indicated that those in the HIGH category were ~2.5 times more likely to fall those in the LOW category. Individuals in the MOD category were 1.7 times more likely to fall than those individuals in the LOW category.

Discussion

Individuals in the LOW category according to the BBT had the smallest likelihood of falling (29%). This rate is lower than that of the total sample studied. In contrast, the fall risk of MOD and HIGH individuals was 1.7-2.5 times greater than that seen in the LOW category.

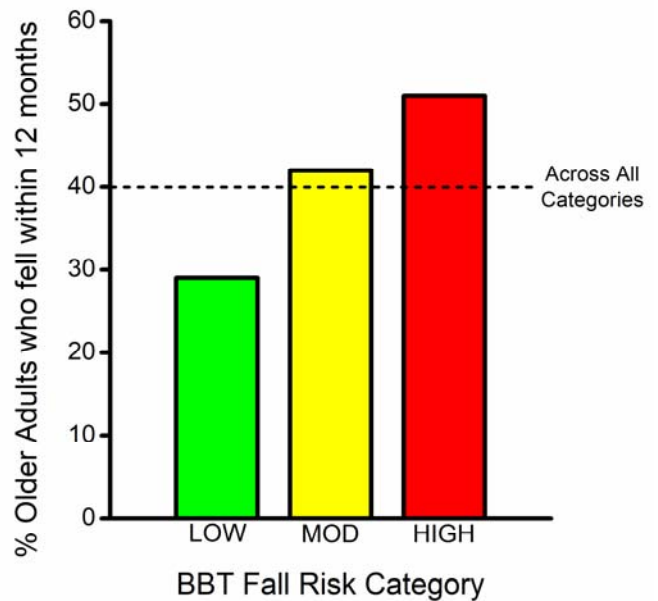


Figure 3. Likelihood of falling in the next year for older adults in each BBT Fall Risk category and across all categories (dotted line).

These results replicate many previous studies using more expensive and less portable force plates to demonstrate that postural sway is an objective risk factor of older adult falling (4-15). However, unlike most force plates, BTrackS is relatively low cost and truly portable. These factors can facilitate access and availability of postural sway testing and improve the evaluation of fall risk in older adults to help mitigate this growing public health issue.

References

1. Verma SK, et al. PLOS One. 2016;11:e0150939.
2. Alexander BH, et al. Am J Public Health. 1992;82:1020-1023.
3. Burns EB, et al. J Safety Res. 2016;58:99-103.
4. Hellebrandt FA, Braun GL. Am J Phys Anthropol. 1939;24:347-360.
5. Lichenstein MJ, et al. J Am Geriatr Soc. 1988;36:996-1002.
6. Maki BE, et al. J Gerontol A Biol Sci Med Sci. 1994;49:M72-M84.
7. Melzer I, et al. Age Ageing. 2004;33:602-607.
8. Melzer I, et al. Clin Biomech. 2010;25:984-988.
9. Swannenburg J, et al. Gait Posture. 2010;317-321.
10. Johansson J, et al. Age Ageing. 2017;46:964-970.
11. Park JW, et al. J Phys Ther Sci. 2014;26:381-384.
12. Thapa PB, et al. J Gerontol A Biol Sci Med Sci. 1996;51:M239-246.
13. Stel VS, et al. J Clin Epidemiol. 2003;56:659-668.
14. Pajala S, et al. J Gerontol A Biol Sci Med Sci. 2008;63:171-178.
15. Bigelow KE, Berme N. J Gerontol A Biol Sci Med Sci. 2011;66A:228-233.
16. Merlo A et al. Gait Posture. 2012;36:662-666.
17. O'Connor SM, et al. J Biomech. 2016;49:4142-4145.