Research Report

Balance Confidence and Fear of Falling Avoidance Behavior Are Most Predictive of Falling in Older Adults: Prospective Analysis

Merrill R. Landers, Sarrie Oscar, Jessica Sasaoka, Kyle Vaughn

Background. Evidence suggests that there are several fall predictors in the elderly population, including previous fall history and balance impairment. To date, however, the role of psychological factors has not yet been thoroughly vetted in conjunction with physical factors as predictors of future falls.

Objective. The purpose of this study was to determine which measures, physical and psychological, are most predictive of falling in older adults.

Design. This was a prospective cohort study.

Methods. Sixty-four participants (mean age=72.2 years, SD=7.2; 40 women, 24 men) with and without pathology (25 healthy, 17 with Parkinson disease, 11 with cerebrovascular accident, 6 with diabetes, and 5 with a cardiovascular diagnosis) participated. Participants reported fall history and completed physical-based measures (ie, Berg Balance Scale, Dynamic Gait Index, self-selected gait speed, Timed "Up & Go" Test, Sensory Organization Test) and psychological-based measures (ie, Fear of Falling Avoidance Behavior Questionnaire, Falls Efficacy Scale, Activities-specific Balance Confidence Scale). Contact was made 1 year later to determine falls during the subsequent year (8 participants lost at follow-up).

Results. Using multiple regression, fall history, pathology, and all measures were entered as predictor candidates. Three variables were included in the final model, explaining 49.2% of the variance: Activities-specific Balance Confidence Scale (38.7% of the variance), Fear of Falling Avoidance Behavior Questionnaire (5.6% additional variance), and Timed "Up & Go" Test (4.9% additional variance).

Limitations. Falls were based on participant recall rather than a diary.

Conclusions. Balance confidence was the best predictor of falling, followed by fear of falling avoidance behavior, and the Timed "Up & Go" Test. Fall history, presence of pathology, and physical tests did not predict falling. These findings suggest that participants may have had a better sense of their fall risk than with a test that provides a snapshot of their balance.

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Falls are a serious problem facing older adults in the community. Approximately one-third of individuals aged 65 years or older will experience a fall within a year's time,[1–4] with roughly half of these individuals experiencing multiple falls.[2] Fall-related injuries occur in 20% to 60% of fall events[1,3,5,6] and can range from minor injuries such as bruises to major injuries, including fractures and severe head injuries.[2,4,7,8] The effects of these injuries can lead to chronic pain, decreased mobility, loss of independence, and death in the elderly population.[4,7,9,10] High medical costs also can burden patients and their families, with a mean cost of hospitalization after a fall-related injury being $17,483 (US dollars) and a stay of 7.6 days in the hospital.[11]

In older adults, falling can be the result of a number of physical insufficiencies, impairments, or debilitating diseases.[12–16] The most frequently reported reason for falling is "accidental," which has been linked to older individuals' inability to safely and functionally navigate around an environment and avoid a fall after an unexpected slip or obstructed step.[12] Gait and balance disorders have been cited as the second most frequent reason for falling.[12] Independent factors related to gait and balance that increase fall risk in older adults include difficulty or inability to perform a tandem walk,[13] slower than average gait speed,[13] and narrow stance width.[14] High amplitudes of balance deviation in a medial-lateral direction also have been shown to predict prevalence of multiple falls in individuals with associated risk factors.[14] Other physical factors that have been linked to an increase in fall risk include reduced visual acuity,[13] urinary incontinence,[15] and vitamin D deficiency.[16] Furthermore, specific personal history factors have been found to accurately predict fall prevalence, including previous fall history[14,15] and knee osteoarthritis.[16] Moreover, physically debilitating conditions that have been linked to an increase in fall risk include stroke, Parkinson disease (PD), cerebellar disorders, and orthostatic hypotension.[16]

In addition to physical components, there are psychological factors related to balance impairment and falling, including balance confidence and fear of falling (FOF), that lead to subsequent avoidance behaviors. Individuals who have experienced falls have significantly lower balance confidence than those who are nonfallers and are more affected by FOF.[17] The occurrence of FOF in the elderly population can be as high as 29% to 92%, and this anxiety becomes more prevalent in those individuals who have already experienced at least one fall.[18] The rate of avoidance of activity due to FOF is approximately 15% to 55%,[18] and this behavior can lead to functional decline,[19] restriction of social participation,[18] increased risk of falling,[20] and institutionalization.[19] Additionally, the combination of fall frequency and FOF has been shown to have substantial adverse effects on the physical and mental component scores of the Health-Related Quality of Life Scale.[21] Ribeiro and Santos[22] demonstrated that an individual's level of perceived control can affect his or her balance performance. Individuals with FOF displayed lower perceived control over falling, decreased balance, and lower falls self-efficacy, whereas those with no FOF and a greater perceived control over falling displayed a greater balance performance.[22] Thus, balance confidence and FOF are 2 essential psychological factors to consider when developing fall intervention strategies for the elderly population in order to enhance their ability to remain active at home and within the community, as well as avoid additional health care due to injurious falls.

Although considerable research has been conducted regarding the correlation between physical and psychological risk factors and falling, few studies have used a prospective design to determine which of these variables is most predictive of future falling. Prospective studies that have been published report inconsistent results in regard to which constructs are most prognostic of falls. Muir et al[23] concluded that the Berg Balance Scale (BBS) score can predict an increased risk of any fall, multiple falls, and injurious falls as an individual's overall score decreases. Additionally, Shumway-Cook et al reported that the Timed "Up & Go" Test (TUGT) can be utilized as an indicator for falls[24] and in a second study found that the BBS score, the Dynamic Gait Index (DGI) score, the Balance Self-Perceptions Test score, and history of imbalance were all predictors of falling in the elderly population.[25] Therefore, this prospective study was aimed to determine which elements, including falling history, presence of pathology, and physical and psychological constructs, are most predictive of falling in older adults. In this exploratory prospective trial, we hypothesized that a combination of physical and psychological constructs would be most predictive of a future fall event.

Method

Study Design

A prospective research design was used to determine the physical and psychological factors (Tab. 1) that were most predictive of the number of falls incurred over 1 year (dependent variable). During the initial assessment at the University of Nevada, Las Vegas Gait and Balance Laboratory, participants completed a record of fall history within the previous year. A fall was defined to participants as an unexpected fall to the ground or another lower level during upright standing or a transitional movement during a daily task, other than as a result of an external force or medical condition.[26] Physical and psychological measures also were completed at this time. Participants were contacted by phone 1 year after the

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- eFigure 1: Receiver Operating Characteristic Curve for Frequent Faller Status 1 Year After Assessment for Each of the Following Predictor Variables: FFABQ, FES, and TUGT
- eFigure 2: Receiver Operating Characteristic Curve for Frequent Faller Status 1 Year After Assessment for Each of the Following Predictor Variables: Fall History, ABC, BBS, DGI, SSGS, and SOT
- eTable: Multiple Regression Model Summary for Prediction of Falls in the Next Year

Table 1.
Description of the Physical-Based and Psychological-Based Measures Used in This Study[a]

Measure	Standardized Scale	Construct	Test Details	Evidence for Reliability	Evidence for Validity
Physical-based measures	BBS	Clinician-rated assessment of balance and functional mobility	Number of tasks: 14 Scores: 0 (greatest fall risk)–56 (least fall risk)	ICC=.97[42]	Shown to have a high specificity (96%) for predicting nonfallers and a low sensitivity (53%) in predicting falls in an elderly population[42]
	SOT	Computerized dynamic posturography places individual in 6 different sensory conditions challenging visual, somatosensory, and vestibular systems	Number of conditions: 6 Scores: sway during 6 conditions determines composite score from 0 to 100 based on age- and height-adjusted norms	ICC=.66[43]	A composite score of <38 is associated with individuals who have reported a previous fall[44]
	DGI	Clinician-rated assessment of ability to modify gait under various conditions	Number of tasks: 8 Scores: 0 (greatest fall risk)–24 (least fall risk)	ICC=.96–1.00[45]	Correlated with BBS, timed walking test, TUGT, and ABC in chronic stroke (range=.68–.83)[46] and prediction of fall risk
	SSGS	Timed comfortable walking pace over 10 m	Average of 3 trials	ICC=.90–.96[29]	Slow gait speed associated with FOF[47]
	TUGT[30]	Timed test of functional mobility	Number of components: 5 (stand up from chair, walk 3 m, turn around, return to chair, sit down) Score: >30 s to complete indicated dependence in mobility	ICC=.99 for community-dwelling elderly people with a variety of medical conditions[30]	Shown to predict fall risk with a sensitivity of 56% and specificity of 60% in elderly adults[48]
Psychological-based measures	FES[49]	Self-administered assessment of self-efficacy in completing ADLs without falling	Number of items: 10 Scores: 10 ("very confident")–100 ("not confident")	*r*=.71[49]	Correlated with age, balance score, gait scores, mobility scores, and falls in the previous year[49]
	ABC[32]	Self-administered assessment of confidence with balance during various ADLs	Number of items: 16 Scores: 0% ("not confident")–100% ("very confident")	*r*=.92[32]	Correlated with age, balance score, gait scores, mobility scores, and falls in the previous year[50]
	FFABQ[28]	Self-reported assessment that quantifies an individual's avoidance of specific activities due to FOF	Number of items: 14 Scores: 0–56, higher scores indicating a greater level of activity limitations and participation restrictions	*r*=.812[28]	Validated for different populations, including healthy older adults and older adults with PD and CVA[28]

[a] BBS=Berg Balance Scale, ICC=intraclass correlation coefficient, SOT=Sensory Organization Test, DGI=Dynamic Gait Index, SSGS=self-selected gait speed, TUGT=Timed "Up & Go" Test, FES=Falls Efficacy Scale, ABC=Activities-specific Balance Confidence Scale, FFABQ=Fear of Falling Avoidance Behavior Questionnaire, N/A=not available, FOF=fear of falling, ADL=activities of daily living, PD=Parkinson disease, CVA=cerebrovascular accident.

Table 2.
Fall Categories and Respective Health Conditions for Initial 64 Participants[a]

Fall Category	Measurement Point	Number (%) of Participants	Healthy	Parkinson Disease	Cerebrovascular Accident	Diabetes	Cardiovascular Diagnosis
Faller	Baseline	25 (39.1%)	8	7	8	1	1
	1 y	18 (32.1%)	5	8	2	2	1
Frequent faller	Baseline	12 (18.8%)	3	3	5	0	1
	1 y	9 (16.1%)	2	5	1	1	0
Recent faller	Baseline	11 (17.2%)	2	3	5	0	1
	1 y	N/A	N/A	N/A	N/A	N/A	N/A
Injured faller	Baseline	11 (17.2%)	5	3	2	0	1
	1 y	7 (12.5%)	3	2	2	0	0

[a] N/A=not available.

initial assessment and asked to recall the number of falls and any resulting injuries over the course of the year. A systematic review on fall monitoring in older adults has shown that a 12-month recall has high specificity (91%–95%) and sensitivity (80%–89%); additionally, 12-month recall has been shown in a few studies to be equally or more reliable than recall over a 3-month or 6-month time frame.[27] The definition of a fall was reiterated at this time.

Participants

The minimum a priori sample size estimate, calculated using PASS 10.0 software (NCSS LLC, Kaysville, Utah), for the proposed multiple regression was 54 participants and was based on the following: anticipated effect size ($f^2=R^2/1-R^2$), where $R^2=.26$ (estimated based on unpublished data), $f^2=0.35$, power=0.80, number of predictors=9, and probability level=.05. Ultimately, 64 participants (mean age=72.2 years, SD=7.2; 40 women, 24 men) with and without pathology (25 healthy, 17 with PD, 11 with cerebrovascular accident, 6 with diabetes, and 5 with a cardiovascular diagnosis) participated in this trial from July 2009 to December 2012. Eight participants were lost at the 1-year follow-up (unable to make contact: n=7 cases; death: n=1). These 8 dropouts were not statistically different ($P>.353$, all analyzed with chi-square testing, except for age, which was analyzed using a *t* test) from the participants who were not lost at follow-up (mean age=70.9 years, SD=6.6; 6 female, 2 men; 3 with a fall history, 2 healthy, 3 with PD, 1 with cerebrovascular accident, 1 with diabetes, 1 with a cardiovascular diagnosis).

Participants were recruited as a convenience sample through snowball sampling at community-based private physical therapy balance clinics, local senior centers, and various support groups (eg, PD support group, stroke support group) in the Las Vegas metropolitan area. Posted print media were used at the clinics, and research assistants handed out print media at support groups. Interested participants were asked to contact the primary investigator, who obtained verbal consent to participate in the study prior to obtaining formal consent at the Gait and Balance Laboratory. Recruitment specifically targeted a population of individuals with a wide range of balance capabilities, especially those who were at higher risk for falls (eg, PD, cerebrovascular accidents, diabetes). This strategy also would logically improve the generalizability of the results. Participants were included if they were community-dwelling and older than 60 years of age. Exclusion criteria included the following: unable to read or speak English, nonadherence, cognitive impairment (Mini-Mental State Examination score <21), or comorbidities (eg, recent surgeries, nonstable medical conditions, painful osteoarthritis with weight bearing, orthostatic hypotension, vestibulopathy) that prevented participation in balance testing.

Fall histories provided by participants were used to determine each participant's classification as a faller, frequent faller, recent faller, or injured faller (Tab. 2). A "faller" was defined as an individual who had at least one unexplained fall in the previous year. A "frequent faller" was defined as an individual experiencing 2 or more of these incidents in the previous year.[28] A "recent faller" was defined as an individual who had this incident within the previous month.[28] An "injured faller" was defined as an individual who sustained an injury requiring medical assistance in the previous year.[28] Participants may have been placed in more than one category, as classifications were not mutually exclusive. Twenty-five participants were classified as fallers. Of these participants, 12 were classified as frequent fallers, 11 as recent fallers, and 11 as injured fallers.

Physical-Based Measures

Balance was measured using the BBS and the Sensory Organization Test (SOT) (Tab. 1). The BBS was developed as a clinical measure of functional balance in older individuals and includes transfers, standing, and mobility tasks.[23,26] The SOT, which is performed using computerized dynamic posturography, measures postural sway and challenges balance stability in 6 different sensory conditions to differentiate fallers from nonfallers based on balance impairment.[19]

Functional gait and transitional mobility were assessed using the DGI, self-selected gait speed (SSGS), and TUGT (Tab. 1). The DGI is used to test an individual's mobility and gait in varying conditions.[25] The SSGS is a practical test where participants walk at their self-selected pace or at their normal pace to replicate their usual ambulation in the community.[29] The TUGT is a timed balance test used to measure functional mobility in older adults in which participants stand up from a chair, walk 3 m, turn around, walk back, and sit down and is used as in indicator for fall risk in community-dwelling older adults.[24,30]

Psychological-Based Measures

The Falls Efficacy Scale (FES) measures confidence in performing a range of daily activities without falling.[31] The Activities-specific Balance Confidence Scale (ABC) is a commonly used 16-item scale that assesses confidence while performing daily activities.[32] In comparison with the FES, the ABC contains a wider continuum of activity difficulty, including activities outside the home and more specific descriptions of the activities.[32] Low scores have been associated with balance impairment and falls. The Fear of Falling Avoidance Behavior Questionnaire (FFABQ) is a self-report assessment that quantifies an individual's avoidance of specific activities due to FOF.[28] See Table 1 for more details on these measures.

Data Analysis

All data were analyzed using IBM SPSS version 22.0 (IBM Corp, Armonk, New York). The level of significance for all of the analyses was set as α=.05. All participants lost to follow-up were excluded from the analyses. Of those remaining, there were no cases of missing data.

To compare the overall diagnostic ability of the measures, receiver operating characteristic (ROC) curves were constructed by plotting the true positive rate (sensitivity) against the false positive rate (1 − specificity) for each scale level of the predictor variables for 2 dichotomous outcomes (faller status at 1 year and frequent faller status at 1 year). Using the ROC, area under the curve (AUC) values were calculated for each predictor variable.

Multiple linear regression was used to compare the relative effectiveness of these predictors against each other. The following were entered into the analyses as predictor candidates for the number of falls within the next year: fall history, presence of pathology (yes or no), physical-based measures (BBS, DGI, SSGS, and TUGT), and psychological-based measures (ABC, FES, FFABQ). The stepwise method (entry factors: $P\leq.05$; removal factors: $P\geq.10$) was used to select the best predictor variable, followed by the next predictor variable that had the largest semi-partial correlation. This method was chosen because this study was exploratory and was for the purpose of determining which variables, in order, were the most important for predicting future falls. Dependent variable outliers, defined as those with standardized residual values above 3.3 or below −3.3, were screened for removal from the analyses. Subsequently, no outliers were identified. Normality, collinearity diagnostics, and bivariate correlations also were conducted. There were no major deviations from normality. Due to multicollinearity, the FES was removed from the regression.

Results

After 1 year, 18 of the 56 participants who were contacted reported at least one fall, with an overall mean fall average of 2.94 falls per year (SD=2.65, range=1–10). Of the 18 participants who fell in the following year, 9 fell 2 or more times and were classified as frequent fallers (Tab. 2). There were negligible to moderate correlations between the number of falls in the year before testing and the number of falls in the next year after testing (Pearson r=.387, P=.003), faller classification before and after testing (phi=−0.125, P=.350), and frequent faller classification before and after testing (phi=−0.273, P=.041). Chi-square analysis suggested there were no differences in the proportion of fallers at baseline and 1 year later (χ^2_1=0.874, P=.350) and frequent fallers at baseline and 1 year later using Yates continuity correction (χ^2_1=2.516, P=.113).

Receiver operating characteristic curves and accompanying AUCs for the dichotomous outcome of faller (yes or no) at 1 year after assessment were statistically significant for all of the predictor variables except SOT and fall history (Tab. 3, Figs. 1 and 2). The most predictive, listed from highest to lowest AUC, were the following (Tab. 3): FFABQ, DGI, ABC, FES, SSGS, TUGT, and BBS. The ROC curves and AUCs for frequent faller (yes or no) at 1 year after assessment were statistically significant for all predictor variables except SOT and fall history. The most predictive were the following, in order of highest to lowest (Tab. 3; eFigs. 1 and 2, available at ptjournal.apta.org): ABC, FES, FFABQ, DGI, BBS, SSGS, and TUGT.

The final multiple regression model with all 3 predictors produced an R^2=.492 (adjusted R^2=.462, $F_{3,51}$=16.439, P<.001). The 3 variables included in the final model entered in the following order (Tab. 4): ABC (38.7% of the variance, 37.5% adjusted), FFABQ (5.6% additional variance, 4.7% adjusted), and TUGT (4.9% additional variance, 4.0% adjusted). Together, these variables explained 49.2% (46.2% adjusted) of the variance for falls in the subsequent year (eTable, available at ptjournal.apta.org; Fig. 1). When the ABC was removed from the model, the FFABQ (33.2% of the variance, 32.0% adjusted) was the only variable remaining (Fig. 2) (R^2=.332, adjusted R^2=.320, $F_{1,53}$=26.380, P<.001, B=0.098, standard error=0.019, beta=0.576, zero-order r=.576). History of falling, presence of pathology, and the remaining physical balance tests (ie, BBS, DGI, SSGS, SOT, TUGT) were not included in the final model.

Discussion

Although most of the variables in our study offered reasonable predictive value as independent predictors of future falls using AUC of ROC curves, when compared against each other using multiple regression, our results suggest that psychological factors may offer more value as predictors of future falls. Specifically, balance confidence (ABC) and fear of falling avoidance behavior (FFABQ) were the best at predicting future falls, independently and when compared against other variables. Although each of the physical and psychological measures may have individually predicted future falls, when compared against each other, there was undoubtedly some overlap and shared correlation due to the similarities

Table 3.
Areas Under the Curve (AUC) for Each of the Predictor Variables for Faller and Frequent Faller Status at 1 Year[a]

Dichotomous Outcome	Predictor Variables	AUC (Rank Ordered)	Standard Error	Asymptotic Significance	Asymptotic 95% Confidence Interval	
					Lower Bound	Upper Bound
Faller at 1 y after assessment	FFABQ	0.763	0.073	0.002	0.619	0.906
	DGI	0.727	0.073	0.007	0.583	0.870
	ABC	0.715	0.073	0.010	0.571	0.859
	FES	0.702	0.073	0.016	0.559	0.845
	SSGS	0.701	0.069	0.016	0.565	0.837
	TUGT	0.683	0.073	0.029	0.541	0.826
	BBS	0.683	0.077	0.028	0.532	0.833
	SOT	0.637	0.084	0.099	0.472	0.803
	Fall history	0.566	0.083	0.430	0.403	0.729
Frequent faller at 1 y after assessment	ABC	0.897	0.055	0.000	0.790	1.000
	FES	0.847	0.060	0.001	0.730	0.963
	FFABQ	0.824	0.066	0.002	0.695	0.952
	DGI	0.770	0.061	0.011	0.651	0.888
	BBS	0.767	0.062	0.012	0.646	0.888
	SSGS	0.749	0.068	0.019	0.616	0.882
	TUGT	0.729	0.079	0.031	0.574	0.885
	Fall history	0.652	0.100	0.150	0.456	0.849
	SOT	0.583	0.109	0.435	0.369	0.796

[a] FFABQ=Fear of Falling Avoidance Behavior Questionnaire, DGI=Dynamic Gait Index, ABC=Activities-specific Balance Confidence Scale, FES=Falls Efficacy Scale, SSGS=self-selected gait speed, TUGT=Timed "Up & Go" Test, BBS=Berg Balance Scale, SOT=Sensory Organization Test.

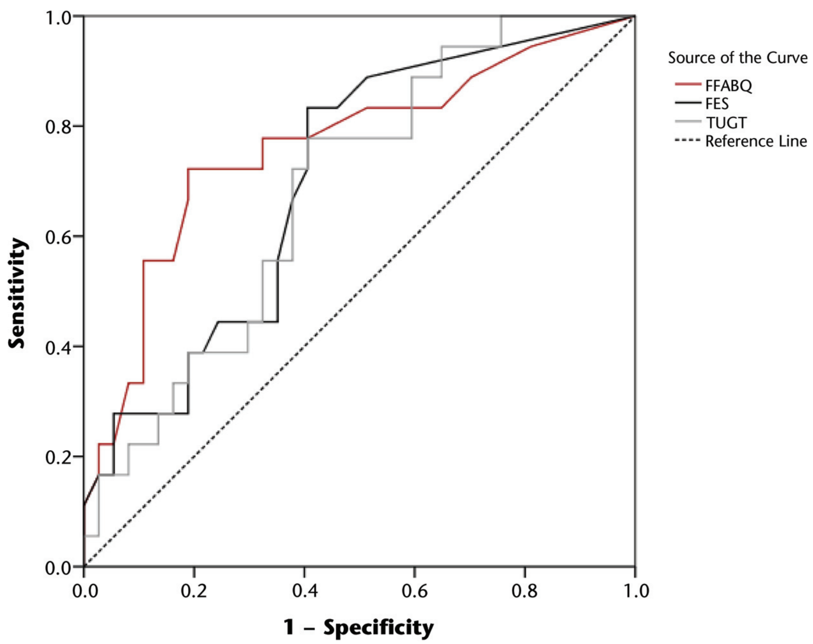

Figure 1.
Receiver operating characteristic curve for fall history 1 year after assessment for each of the following predictor variables: Fear of Falling Avoidance Behavior Questionnaire (FFABQ), Falls Efficacy Scale (FES), and Timed "Up & Go" Test (TUGT).

in the constructs of the measures. In the regression model we used, those shared correlations were controlled, and only those variables that made the best unique contribution were included in the model. Only 3 measures emerged in the final model, which suggests that those 3 variables best explained the variance of future falls. Although the variables not included in the final model may have individually predicted future falls, they did not offer any more predictive value over and above the final 3 variables.

As history of falls, presence of pathology, and physical balance tests were less predictive of falls, assessing patients with psychological measures would be advantageous to health care professionals. These results indicate that the beliefs people possess about their capabilities, rather than their actual physical performance, may be most important in identifying those who are at risk for falling. Namely, patients may have a better

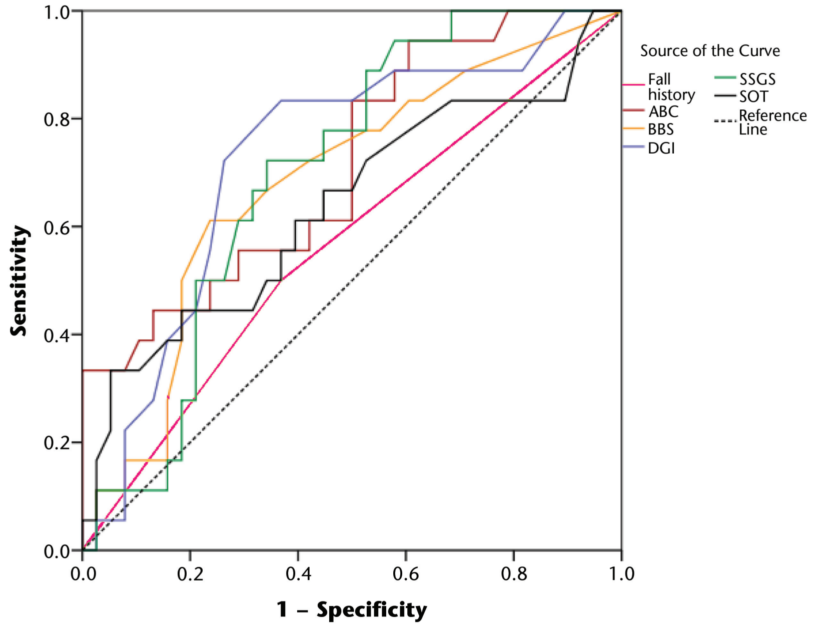

Figure 2.
Receiver operating characteristic curve for fall history status 1 year after assessment for each of the following predictor variables: fall history (number of falls in the year before assessment), Activities-specific Balance Confidence Scale (ABC), Berg Balance Scale (BBS), Dynamic Gait Index (DGI), self-selected gait speed (SSGS), and Sensory Organization Test (SOT).

understanding of their capabilities than what physical tests demonstrate.

This study utilized multiple psychological measures to determine their relationship to falling. Little research has gone into concluding which psychological constructs may predict future falls for elderly adults with and without pathology. One study conducted by Lajoie and Gallagher[17] showed that the ABC is a significant predictor of falls. Our results confirm their findings that psychological constructs play a large role in predicting fall risk. An explanation for the importance of psychological factors in predicting future falls may lie within the realm of social cognitive theory. As explained by Bandura,[33] self-efficacy, or the beliefs people hold about their capability to control their life and function, is a very influential component in determining their decision making, the effort that they put into a task, their stress when presented with a challenge, and their thought processes, whether self-aiding or self-destructive. This idea of self-efficacy is related to balance confidence, which, as we determined, may be the most predictive factor for future falls. When people possess decreased balance confidence and decreased self-efficacy, they are more likely to alter their behavior to avoid activities and situations that may cause falls because they may believe that if they do not, falls will be unavoidable. Filiatrault et al[34] discussed the importance of addressing FOF in physical therapy and occupational therapy. Fear of falling can lead to self-imposed restriction of activities and participation in typical daily routines, which may cause a decline in physical capacity and an increased risk of falling.[34] In light of our findings, future research should focus on developing intervention strategies to prevent future falls that are resultant of underlying psychological factors such as balance self-efficacy and FOF. From a clinical perspective, addressing balance self-efficacy and FOF should be an important interventional target.

It is interesting to note that after removing the ABC from the regression and reanalyzing the data, the only variable entering into the model was the FFABQ. Avoidance behavior due to FOF, which is a separate construct but related to FOF, shares considerable prediction with balance confidence (ABC). In the first model with the ABC, the FFABQ explained only 5.6% (4.7% adjusted) of the variance of future falls, but when the ABC was removed, it explained 33.2% (32.0% adjusted) of the variance. Thus, although the ABC and the FFABQ share variance in fall prediction, the FFABQ offers a unique, albeit smaller, contribution to fall prediction when the 2 measures are used together. This finding suggests that although these psychological measures are indeed related constructs, avoidance behavior due to FOF is a subtly different construct from balance confidence. Furthermore, the TUGT was included in the model with the ABC, yet when the ABC was removed, it did not remain as a significant predictor, leaving

Table 4.
Multiple Regression Table for Predicting Falls Within the Next Year[a]

Model	B	Standard Error	Beta	t	P	Zero-Order r
ABC	−0.061	0.011	−0.622	−5.785	.000	−.622
ABC	−0.042	0.013	−0.429	−3.215	.002	−.622
FFABQ	0.052	0.023	0.305	2.287	.026	.576
ABC	−0.050	0.013	−0.510	−3.808	.000	−.622
FFABQ	0.061	0.022	0.355	2.715	.009	.576
TUGT	−0.064	0.029	−0.250	−2.207	.032	.121

[a] ABC=Activities-specific Balance Confidence Scale, FFABQ=Fear of Falling Avoidance Behavior Questionnaire, TUGT=Timed "Up & Go" Test.

the FFABQ as the lone significant predictor. Presumably, removing the ABC may have uncovered latent FFABQ and TUGT correlations, which, ultimately, more strongly favored the FFABQ and caused the TUGT to be dropped. Although both the FFABQ and the TUGT were individually predictive of future falls, the FFABQ explained more variance, and the TUGT simply did not have a unique and significant contribution over and above the FFABQ once the ABC was removed. Considering the 2 regression models together, the strongest predictor of falls was the ABC followed by the FFABQ.

Another noteworthy finding of this study is that physical factors were not as strong predictors of a future fall as psychological measures. A review of previous literature showed inconsistent evidence in regard to which physical measurements are most predictive of falls. Shumway-Cook et al[25] reported that the BBS and a self-reported history of imbalance can be used in a predictive model to determine fall risk in community-dwelling older adults. In another study, Shumway-Cook et al[24] found that the TUGT also could be a sensitive and specific measure used to identify individuals prone to falls. Lajoie and Gallagher[17] and Muir et al[23] concluded that the BBS was a significant predictor of future falls. In contrast, in a 1-year prospective design, Boulgarides et al[35] determined that the Modified Clinical Tests of Sensory Interaction for Balance, 100% Limits of Stability Test, BBS, TUGT, and DGI were not predictive of fall risk in a community-dwelling older population. Our results indicate that the only physical measure predictive of falls in the regression model was the TUGT. Despite the fact that the TUGT was not as predictive as the SSGS, BBS, and DGI using the AUC of the ROC curves, it was the only physical measure that explained a unique portion of the variance that was over and above the ABC and FFABQ. Interestingly, the DGI was the best physical measure at predicting falls using the AUC of the ROC curves. However, its relationship to falling was presumably shared with the ABC, FFABQ, and TUGT; thus, it did not offer any additional predictive value.

The presence of the TUGT in the regression model could be due to the fact that this measure includes more dynamic and transitional movements that occur frequently during normal daily activities (ie, standing from a chair, walking, turning, and sitting down) compared with the other physical tests included in this study. For instance, the SOT tests standing static balance only, and the SSGS focuses only on normal gait speed on even surfaces. One weakness of previous research in this area has been the overwhelming focus on physical factors in determining fall risk; this emphasis may have made physical factors seem more essential in predicting falls than is actually the case, as our study showed that psychological components may carry more weight.

These results are clinically meaningful for health care providers who screen for fall risk. By utilizing the ABC, FFABQ, and TUGT, clinicians can identify the individuals who are most at risk for falling and provide restorative or preventive care. Using proper intervention strategies may lead to a reduction of falls and subsequent injuries in an older population and help to reduce overall medical costs and number of hospital visits. A focus of these intervention strategies should be increasing balance confidence and self-efficacy, which has been shown to be related to lower levels of FOF and better functional outcomes.[36] A systematic review focusing on fall prevention showed that interventions in this area have been effective in reducing both the risk of falling and the monthly rate of falling.[37] The most effective intervention for decreasing fall risk was a multifactorial fall risk assessment and management program.[37] The ABC, FFABQ, and TUGT could be included in this assessment protocol to help clinicians determine in which areas intervention is necessary. For instance, patients who display FOF and resulting avoidance behavior may require treatment to improve confidence and activity levels.

Collaboration with other health care providers, such as mental health professionals or social workers, also may be beneficial to maximize the improvement of patients with an increased fall risk. Zijlstra et al[38] completed a randomized controlled trial analyzing the effect of cognitive behavioral intervention in improving FOF and activity avoidance in community-dwelling older adults. Treatment focused on cognitive restructuring in order to view fall risk and FOF as controllable, setting goals for safely increasing activity, modifying the home to decrease risk of falls, and using physical exercise to improve balance and strength.[38] Behavioral change also was emphasized after the cognitive restructuring.[38] After completion of the intervention, participants receiving this multicomponent cognitive-behavioral therapy displayed decreased FOF and avoidance behavior at 2 months and at 8 months following intervention.[38] By incorporating both cognitive-behavioral therapy and physical therapy in the treatment of elderly people with FOF, clinicians can use an interdisciplinary approach to mitigate fall risk from multiple angles and improve quality of life.

There are limitations to this study. First, fall history was dependent on each participant's ability to recall falls in the previous year; therefore, this study may have been subject to recall bias. Although this method has been shown to have good specificity, we recommend that future designs for studies like this incorporate a more structured surveillance method with shorter weekly to monthly intervals.[27] Second, this study did not include additional related factors that may be predictive of falls, including depression,[39] effect of medications,[40] cognitive impairments,[3] and leg extension and grip strength.[41] Third, this study grouped together both healthy individuals and those with a variety of pathologies; therefore, our findings may not be appropriate for a specific pathological subset (eg, PD, cerebrovascular accident). Furthermore, the percentage of older adults with pathology in our participant population was higher than normal; therefore, our results may not be entirely representative of the total population aged 65 years or older.

In conclusion, this study provided meaningful data regarding which constructs are most clinically applicable to the prediction of falls in the elderly population.

Namely, psychological measures including the ABC and FFABQ are more predictive of fall risk in older adults than physical measures, history of falls, or presence of pathology. These findings reveal potential areas of future research that will help to develop a better understanding of risk factors for falling. Subsequent studies may consider examining other factors that contribute to fall occurrence, frequency, and resulting injuries. These data also may be used as a framework to help develop better fall prevention strategies for individuals who are at risk for falls, a field of research that continues to be relevant to an increasingly aging and vulnerable population.

Dr Landers provided concept/idea/research design, project management, participants, data analysis, and facilities/equipment. All authors provided writing. Ms Oscar, Ms Sasaoka, and Mr Vaughn provided consultation (including review of manuscript before submission).

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