

# A Comparison of the Falls Efficacy Scale-International with Berg Balance Scale to Evaluate the Risk of Falls in Post Stroke Patients

## Abstract

Falling is the leading medical complication in patients with all stages of stroke. The present study was carried out to predict the risk of falling in patients with stroke for evaluating the agreement between the FES-I and BBS balance measures and to establish the strongest scale for measuring the risk of falls in clinical practice. Total 50 stroke patients were collected whose age were  $\geq 40$  years and post stroke period was  $\geq 6$  months. Kappa measure of agreement and Intraclass Correlation Coefficient (ICC) were estimated for determining the agreement between the FES-I and BBS tools. Logistic Regression (LR) was done for the falling history over the last six months with age on the BBS. The Symmetric Measures of Kappa for determining the agreement between FES-I and BBS was -0.466. Sixteen subjects (32%) had low agreement on status of falling. The ICC was -0.769 (-77%). Considerable relation was found on BBS without significant value. The Kappa and ICC measures declared that, there was lower to moderate agreement between FES-I and BBS to predict the risk of falls. Patients with stroke had a reasonable BBS score to predict the risk of falls as compared to FES-I.

**Keywords:** Falls Efficacy Scale-International (FES-I); Berg Balance Scale (BBS); Stroke; Risk of falls

## Research Article

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## Introduction

Falling is the most common medical complication in patients who had the stroke [1-3]. Fifty or fifty nine (50 or 59%) percent experienced at least one fall during the last 6 months among  $>50$  years patients with stroke [4,5]. Whatever the causes, impaired balance is important because it reduces confidence and increases the risk of falls at all stages of post stroke (Weerdesteyn et al., 2008, Intercollegiate Stroke Working Party, 2012) [6,7]. Balance and gait deficits were the two important risk factors for fall [6]. Balance was closely related to the risk of falling in patients who had stroke during the recovery period to maintaining stage [8]. The difficulty of control balance needs systematic clinical assessment for effective treatment [9]. Due to association between balance and falls-related self-efficacy with falls history, it should be addressed in chronic patients who had the stroke. Falls experienced individuals have fear of falling and low self-related self-efficacy, falls risk assessment and intervention should be included for their constructs [10]. Therefore, it is important to evaluate the risk of falls [1].

## Methods

Fifty patients with stroke was collected from "School of Rehabilitation", Tehran University of Medical Sciences (TUMS), Tehran, Islamic Republic of Iran with the approval of ethical

committee of TUMS. Age  $\geq 40$  years, incidence of first-ever stroke, post stroke duration  $\geq 6$  months and patients able to walk 8 m without assistance were included in the study. Diagnosis was confirmed by the Physiotherapist. Patients with major musculoskeletal problems (e.g. amputation or recent joint replacement surgery) or other neurological disorders in addition to stroke, only TIA (Transient Ischemic Attack) as well as uncooperative or unable to comply with instructions were excluded. Informed consent was obtained prior to data collection. Calculated sample size was 50 for estimating the Intraclass Correlation Coefficient (ICC) between FES-I and BBS with a desired confidence interval. The convenience sampling technique was used to select the fifty patients. Randomization method was followed to select the order/sequence of FES-I and BBS for measuring the risk of falls in patients who had the stroke and it was calculated by Biostatistician to avoid the trend (information) bias. Data were collected through the following tools, i.e., FES-I, face to-face structured interview [11] and the second one through BBS. In 16-item FES-I, a cut-point to differentiate between the low and high risk of falling are 16-22 and 23-64 out of 64 respectively [12]. A cutoff score of 45 on the BBS was established on the basis of clinical experience and then it was analyzed to determine the risk of falls with a score of less than 45 [13,14]. The FES-I was used to collect the information about the level of concern for the status of falls for

a range of activities of daily living. Scores range was minimum 16 points (high risk of falling) to maximum 64 points (vice versa). Each item was scored on a four-point scale: 1= not at all concerned, 2= somewhat concerned, 3=fairly concerned and 4=very concerned. A summary score was calculated by adding the score of each item, giving a scale ranging from 16 to 64 for the 16-item FES-I [11,15,16]. BBS was used for measuring the physical balance regarding risk of falling on the following categories such as sitting, standing, and postural change (reaching, balancing on one limb and transferring) to evaluate in 14 areas with using a five-point scale (0–4) to rate each item, with each area having a low score of 0 point and a high score of 4 points, for a possible total of 56 points with a higher score implying better balance control [4,17-19]. Patients were asked about age, post stroke duration, falling histories over the last six months or falling histories since the stroke onset. At first, data were analyzed for distribution of age, post stroke duration in months, falling histories “during the last six months” and “since the stroke onset”, risk of falls on FES-I and BBS measures. Then FES-I and BBS scores were compared with different groups of age, post stroke duration, falling histories during the last six months, falling histories since the stroke onset. Odds Ratio (OR) was calculated for the falling histories, during the last six months and since the stroke onset for the BBS. The Kappa measure of agreement, symmetric measures of Kappa and Intraclass Correlation Coefficient (ICC) were estimated for evaluating the agreements between the FES-I and BBS measures to predict the risk of falls. At last, the multiple logistic regression (LR) model analysis was also done for adjusting the falling histories with the age groups on BBS.

## Result

In FES-I, 33.3% subjects had no falling experience, but they were at risk during the last six months, whereas it was 28.6% those who had at least one time falling experience and FES-I was not significant for number of falls during the last six months (p 0.746). The BBS had a significant relation with the falling history during the last six months (p 0.029). Those who had never experienced a fall, they were at low risk of falling (only 30.6%), while, those who had at least one falling they were more prone to falling (64.3%) (Figure 1).

In FES-I, 34.5% and 28.6% had no fall and at least once fall since the stroke onset while it were 34.5% and 47.6% for BBS. The FES-I and BBS both had no significant relationship with the falling history since the onset of stroke. The p-value was 0.349 for stroke since it occurred, whereas it was 0.029 for last six months on the BBS, while on FES-I it was 0.658 since the stroke onset and 0.746 for the last six months (Figure 2).

An OR of 4.1 with 95% CI was noted for the falling history during the last six months and OR 1.727 with 95% CI for since the stroke onset on the BBS scale (Table 1).

Symmetric Measures of Kappa 0.466 with p-value 0.001 to determine the agreement between FES-I and BBS. One subject had agreement between FES-I and BBS scores for measuring risk of fall and 15 subjects had agreement between FES-I and BBS for measuring low risk of fall. While, there were no agreements between FES-I and BBS for 19 subjects for measuring high risk

and for 15 subjects for measuring low risk of falling. 32% (16 subjects) had low agreement about the status of falling (Table 2 & 3).

The result of the ICC was -0.769 (-77%) with 95% CI and p-value was not significant. Scoring systems of two scales (FES-I and BBS) were opposite. Agreement was moderate (Table 4 & 5).

Multiple logistic regression model analysis was done for adjusting the falling history with the age groups. Falling history was statistically significant as well as age groups were also near significant. The relationship about the falling histories over the last six months with adjusting the age groups was considerable but it was not statistically significant. The OR for the history of falls over the last six months was 2.859 with 95% CI with p-value 0.138. Those patients who had at least one time falling history over the last six months had 2.859 times more risk of falls as compared to those who had no fall. The OR for the age group of 50-64 years was 2.876 with 95% CI with p-value 0.236. The patients with stroke with the age group of 50-64 years were around three times higher risk of falls as compared to the <50 years of age group. The OR for the age group >64 years was 5.263 with 95% CI with p-value 0.100. The patients with stroke with the age group >64 years were around five times higher risk of falls as compared to <50 years of age group. For FES-I, logistic regression model was not analyzed for the age group with the falling histories although the age groups were statistically significant. Because there were negative trends towards the age related high risk of falling (Table 6).

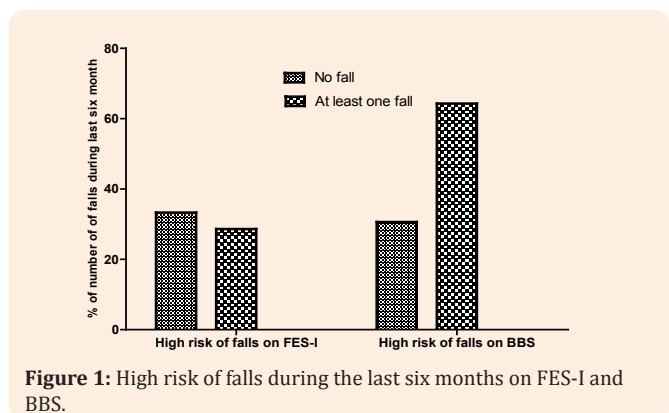


Figure 1: High risk of falls during the last six months on FES-I and BBS.

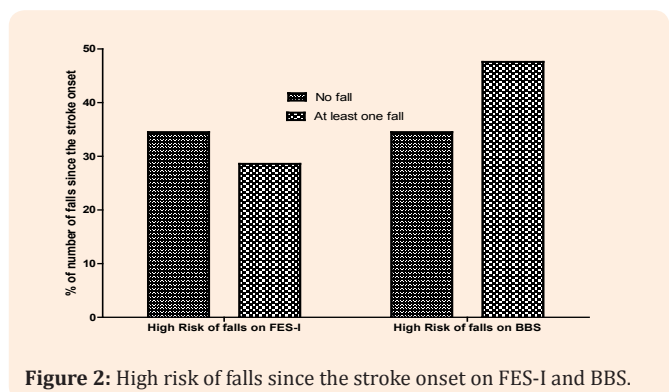


Figure 2: High risk of falls since the stroke onset on FES-I and BBS.

**Table 1:** Risk Estimation for the falling history “during the last six months” and “since the stroke onset”.

		OR value	95% Confidence Interval	
			Lower	Upper
<b>Risk Estimate for the falling history during the last six months</b>	<b>Odds Ratio for the falling history during the last six months (no fall / at least one falling)</b>	<b>4.091</b>	<b>1.111</b>	<b>15.057</b>
	For cohort BBS recode=45 to 56=Low risk/fear of falling	1.944	0.932	4.057
	For cohort BBS recode=0 to 44=High concern about falling	0.475	0.254	0.891
<b>Risk Estimate for the falling history since the stroke onset</b>	<b>Odds Ratio for the falling history since the stroke onset (no fall / at least one falling)</b>	<b>1.727</b>	<b>0.548</b>	<b>5.448</b>
	For cohort BBS recode=45 to 56=Low risk/fear of falling	1.251	0.769	2.033
	For cohort BBS recode=0 to 44=High concern about falling	0.724	0.369	1.419

**Table 2:** FES-I\* BBS Cross tabulation for Kappa agreement.

		Risk of falls on BBS tool		p-value
		0 to 44=High risk of falling	45 to 56=Low risk/fear of falling	
<b>Risk of falls on FES-I tool</b>	23 to 64=High risk of falling	1 (6.2%)	15 (93.8%)	0.001
	16 to 22=Low risk/fear of falling	19 (55.9%)	15 (44.1%)	

**Table 3:** Symmetric Measures.

	Value	Asymp. Std. Error	Approx. T	p-value
<b>Measure of Agreement</b>	<b>-0.466</b>	0.1	-3.342	0.001

**Table 4:** Reliability Statistics.

Cronbach's Alpha	N of Items
-6.663	2

**Table 5:** Intraclass Correlation Coefficient (ICC).

	Intraclass Correlation	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	p value
Single Measures	-0.769	-0.862	-0.626	0.131	49	49	>0.90
Average Measures	-6.663	-12.503	-3.348	0.131	49	49	>0.90

**Table 6:** Multiple logistic regression (LR) models for BBS.

	p-value	OR	95% CI	
			Lower level	Upper level
Falling history	0.138	2.859	0.713	11.462
Age group <50 years (Referent)	0.258			
Age group 50-64 years	0.236	2.876	0.502	16.49
Age group >64	0.1	5.263	0.729	38.01

### Discussion

The risk of falls was 32.0% on FES-I and 40% on BBS among all of the patients with stroke during the last six months as well as since the stroke onset. In the previous studies, the post-stroke duration, age and affected side were not significant for BBS scores in patients with chronic stroke [20,21]. There was no group differences for age, BBS scores or the side of paresis between those who did not fall and those who fell once, or between, who fell more than once and those who had not fallen over the past six months [4]. These findings were in line with the result of the present study that the side of paresis was not important to predict the risk of falls as the side of paresis was not evaluated in this study, although it might be different due to dominance of extremity, or especially patients with right hemisphere stroke as reported by a recent study [22]. The patients with ambulatory ability with left hemiplegia/hemiparesis were more vulnerable to falls after a stroke [21]. In one study reported by Belgen et al. [10] in patients with chronic stroke, lower risk of falling was measured by FES-S (FES- Swedish version) and those who had falling were 2.4 times more likely to be afraid of falling. Although, there were no differences found in demographic, impairment, or functional measures between those who fell and those who did not (Belgen et al., 2006, Lim et al., 2012) [10,21]. In the present study, 34.5% stroke subjects who had no falling experience both on FES-I and BBS scales as well as 28.6% on FES-I and 47.6% on the BBS tools among those who had at least one time falling experience since the stroke onset had a high risk of falling. During the development and initial validation of FES-I among ≥60 years elder population, 46.6% had no falling in the past year, 53.4% had at least one or more than one fall [11]. The 28.6% risk of falling since the stroke onset on FES-I in the present study was focusing the improvement of the rehabilitation outcomes in Tehran, Iran as compared to previous and recent studies [2,10,11,21].

An OR of 4.1 with 95% CI and OR of 1.727 with 95% CI were found for the falling histories during the last six months and since the stroke onset. Patients with stroke who had experienced at least one fall during the last six months had almost 4 times more risk of falling compared to those who had never an experience of falling as well as it was near to 2 times more risk for since the stroke onset group. These were a strong relationship of BBS with the falling histories during the last six months for patients with stroke. This result was comparable with Li et al. [23] study. The

OR of 4.1 (for the last six months) and OR of 1.727 (for since the stroke onset) in this study were in accordance with the previous research [10]. Therefore, according to chronicity, patients who had stroke may be familiarized to overcome the risk of falls; consequently the risk of falls was less for “since the stroke onset” than “during the last six months”.

The Symmetric Measures of Kappa to determine the agreement between the FES-I and BBS scores was -0.466 and this moderate agreement was statistically significant. There was only 32% (16 subjects) having agreement about the status of falling, which was really a low agreement with statistically significant, although both the FES-I and BBS had strong fall risk predictability [4,10-12,17,24-26]. The reliability for the FES-I and BBS was found moderate without significant p-value (>0.90) with the ICC -0.769 (-77%) and this agreement was moderate. The negative results both for Kappa and ICC showed that, scoring systems of the two scales (FES-I and BBS) were opposite. The Kappa and ICC measures revealed that, there were a lower to moderate agreements between FES-I and BBS to predict the risk of falls. Therefore, further studies are needed to define an agreement between the FES-I and BBS about the status of falling.

OR for the history of falls over the last six months was 2.859 with 95% CI without significant p-value (0.138). Those patients had at least one time falling experience over the last six months had almost three times more risk of falls as compared to those who had no fall. The OR for the age group of 50-64 years was 2.876 with 95% CI without significant p-value (0.236). The patients with stroke with the age group of 50-64 years were about three times higher risk of falls as compared to <50 years of age group. The OR for the age group of >64 years was 5.263 with 95% CI and this strong relation was also not statistically significant (p-value of 0.100). The patients with stroke with the age group of >64 years were found more than five times higher risk of falls as compared to <50 years of age group.

According to the significant results for BBS about the falling histories during the last six months as well as more risk of falling among who had at least one time fall for both “during the last six months” and “since the stroke onset” groups (64.3, 47.6%, respectively) as compared to those who had no falling (30.6%, 34.5% respectively) had 4 folds (value 4.1) and near 2 folds (value 1.727). This strong outcome gave the reasonable support for BBS in this study to predict the risk of falls as compared to



FES-I. The BBS had been found to have substantial and consistent evidence of high intra-rater (0.97) and inter-rater (0.98) relative reliability [10,26]. The BBS had shown strong reliability, validity, psychometric properties, and it was useful and easy to administer without expensive equipment or prolonged assessment time as well as it was valuable in assessing clinical change in balance after stroke [17]. BBS indicated excellent predictive validity for discharge disposition, with the notable exception of falls/risk of fall [4,25].

## Conclusion

Patients with stroke had reasonable BBS scores to predict the risk of falls as compared to the FES-I. The FES-I was found less relevant for Iranian patients who had the stroke to predict the risk of falls strongly as compared to BBS among all the stroke survivors for the last six months in this study. The number of falls for both during the last six months and since the stroke onset on FES-I was a negative trend among who had no fall and who had at least one time falling experience while it was positive for the BBS. However, the agreements between FES-I and BBS measures were not only statistically but also clinically important. Therefore, due to the lower to moderate agreements between FES-I and BBS to predict the risk of falls, future study required for clinical application to generalize the results. Overall, the BBS can be easily administered, making it an attractive measure for clinicians; it involves minimal equipment (chair, stopwatch, ruler, step) and space and requires no specialized training. Although it is suggested for physiotherapists/clinicians/balance trainers to consider the use of other balance measures in conjunction with the BBS to address its floor and ceiling effects.

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