

Research Paper: Comparing Falls Efficacy Scale-International and Berg Balance Scale in Predicting Recurrent Risk of Fall in Stroke Patients



Shahid Khan¹, Mohammad Reza Hadian^{2*}, Gholamreza Olyaei³, Seyed Asadullah Arslan⁴, Saeed Yekaninejad⁵, Abbas Tafakhori⁶

1. MSc., Department of Physiotherapy, School of Rehabilitation, International Campus, Tehran University of Medical Sciences, Tehran, Iran.
2. Professor; Brain and Spinal Cord Injury Research Center (BASIR), International Campus, Tehran University of Medical Sciences, Tehran, Iran.
3. Professor; Department of Physiotherapy, School of Rehabilitation, International Campus, Tehran University of Medical Sciences, Tehran, Iran.
4. PhD Student, Department of Physiotherapy, School of Rehabilitation, International Campus, Tehran University of Medical Sciences, Tehran, Iran.
5. Assistant Professor; Department of Biostatistics, School of Public Health, International Campus, Tehran University of Medical Sciences, Tehran, Iran.
6. Professor; Department of Neurology, Imam Khomeini Hospital, International Campus, Tehran University of Medical Sciences, Tehran, Iran.



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ABSTRACT

Introduction: Stroke patients often experience falls with potentially serious consequences. Associated factors with falling in stroke patients have already been identified. The present study was conducted to find a better assessment tool for measuring the risk of falling, Fear of Falling (FOF), and balance between Falls Efficacy Scale-International (FES-I) and Berg Balance Scale (BBS).

Materials and Methods: One hundred stroke patients were recruited from the physiotherapy clinics affiliated to Tehran University of Medical Sciences (TUMS) based on inclusive criteria to administer two predictive scales; FES-I and BBS. In 16-item FES-I, face to face interview provide information on FOF in daily life activities. BBS is used to measure the FOF during sitting, standing, and postural changes (reaching, balancing on one limb and transferring). Data were analyzed on the basis of age, post stroke duration, history of falling since disease onset and in the last 6 months as well as risk of falling.

Results: Based on FES-I scale, the majority (69.8%) of old patients (50-64 years) showed low risk of falls and according to BBS, the majority of the stroke patients older than 64 years had high concern for falling. Both genders showed low concern for falling on FES-I and BBS scales and the results were not significant. On BBS, the falling concern was more among those who had one falling during the last 6 months.

Conclusion: BBS is more relevant to predict the risk of falls among Iranian stroke patients and is also easy to administer at the stroke centers with minimum equipment.

* Corresponding Author:

Mohammad Reza Hadian, PhD

Address: Brain and Spinal Cord Injury Research Center (BASIR), International Campus, Tehran University of Medical Sciences, Tehran, Iran.

Tel: +98 (21) 77533939

E-mail: hadianrs@sina.tums.ac.ir

1. Introduction

Stroke patients often experience falls which have potentially serious consequences [1]. Fear of Fall (FOF) is considered as a “disturbing factor” resulting in the loss of confidence, low physical activity, and increase dependency. Patients may also experience symptoms like social isolation, environmental inflexibility, low functional mobility, and balance problems. FOF was reported from 12% to 92% among post-stroke patients and 12% to 65% in patients with and without a fall [2]. Falling enhances the fear of future falling and serious injuries such as hip fracture and head injury. Some associated factors with falling in stroke patients have already been identified but prediction of fall preventive factors are still unclear [3].

Balance is an important issue that requires proper evaluation for choosing suitable mobility aids and better treatment. Patients must be aware of the post-stroke condition as balance becomes unstable after stroke. It is also very essential to find a reliable method for clinicians to monitor these changes and adopt a suitable treatment program. The Berg Balance Scale (BBS) is a useful tool which is originally designed to quantitatively evaluate balance in older adults [4]. BBS is being used widely to assess stroke patients. One study on 655 physical therapists reported that BBS has been the most frequently used assessment tool from acute care to community-based care [5]. Another assessment tool for stroke patients being used in rehabilitation settings is the Fall Efficacy Scale International (FES-I), developed by Yardley et al. [6]. It is an excellent clinical tool for assessing concerns about falling in both easy and difficult social activities [7]. FES assesses the patients' confidence while they do 10 basic activities of daily living without falling [8]. However, this assessment did not measure FOF symptoms in social and highly physical activities [9].

A simple, convenient, and better method is much needed to evaluate quickly stroke patients at busy rehabilitation clinics. In this regard, a comparative study was needed to determine a better assessment tool to accurately measure the risk of falling, fear of falling, and balance by estimating the agreement between two above mentioned scales; FES-I and BBS.

2. Materials and Methods

This study setting was physiotherapy clinics affiliated to Tehran University of Medical Sciences. After the Eth-

ics Committee approval, 100 stroke patients diagnosed by neurologists, aged ≥ 40 years, with their first stroke in the last 6 months, and ability to walk for a distance of 8 meters without help (orthotics and assistive devices were allowed) were recruited. The relevant data were collected after obtaining their consent form. Patients with musculoskeletal disorders, recent surgery, other neurological disorders (Alzheimer disease, Transient Ischemic Attack), reluctance to cooperate, less than 6 months past their stroke duration, or unable to walk 8 m were excluded from the study. Questions regarding demographic data with the history of stroke, FOF, and number of falls during last six months were asked. The Intra-class Correlation Coefficient (ICC) with 95% Confidence Interval (CI) was used to estimate relation between FES-I and BBS.

In the second phase, the sequence of FES-I and BBS measurements in stroke patients was determined by randomization method recommended by an expert in biostatistics. Two predictive scales, i.e. FES-I and BBS were used in this study. FES-I, developed by Yardley et al. is an excellent clinical tool for assessing concerns about falling in easy, difficult, and social activities [6]. In 16-item FES-I, face to face interviews provide information on FOF on different activities of daily life. A low cut point was considered from 16 to 22 and a high cut point was between 23 and 64 out of 64 [7]. Four-point scale was used to score each item (Each item in the questionnaire has four scores 1=not at all concerned, 2=somewhat concerned, 3=fairly concerned and 4=very concerned. A total of scores was calculated by adding the scores of each item, giving a scale ranging from 16 to 64 for the 16-item FES-I [6]. Reliability, validity, and responsiveness of the Persian FES-I in stroke patients had already been examined and demonstrated an adequate and acceptable assessment of FOF in these patients [10].

The Persian version of BBS [11] has acceptable levels of intra and inter-rater reliability. Armed with a moderate internal consistency and high validity, it is used to measure the FOF during sitting, standing, and postural changes (reaching, balancing on one limb and transferring). Fourteen areas were evaluated by using a 5-point rating scale (0-4), with 0 point indicating inability or need for maximal assistance to complete a task with safety concerns up to 4 points indicating independent and safe ability to perform a task. The highest total score would be 56 points with a higher score implying better balance control [4, 5, 12].

Data were analyzed on the basis of age, post stroke duration, history of falling since disease onset and in the last 6 months as well as risk of falling by using SPSS version

21. A value of $P=0.05$ was considered significant in all comparisons. Both scales were compared on the basis of above mentioned parameters. Odds Ratio (OR) was calculated to know association and agreements between FES-I and BBS to predict the risk of falls by estimating the Kappa and Intra-class Correlation Coefficient (ICC). Multiple logistic regression models were also performed by adjusting the falling histories with the age groups on BBS.

3. Results

Demographic data showed that both genders (Male=48, Female=52) almost equally participated and their mean(SD) age was 54.74(9.78) years. Results were presented on the basis of cut off scoring. On BBS, risk of fall was determined with a score less than 45 [13, 14] while on FES-I, a cut-point has been defined by a comprehensive longitudinal validation study, to differentiate between low and high risk of falling which was 16-22 and 23-64 out of 64, respectively [7].

However for BBS, high risk of fall was from 0 to 44 while low risk was considered from 45 to 56, as mentioned in Table 1. In FES-I scale, majority (69.8%) of 50-64 years old patients showed low risk of falls and the results were also significant. In BBS, majority of the stroke patients older than 64 years had high concern for

falling. Both genders showed low concern for falling according to FES-I and BBS scales and the results were not significant. During the last 6 months, those without the falling history or at least one falling history showed less concern for falling according to FES-I while according to BBS, the falling concern was more among those who had one falling history during the last 6 months.

Since stroke, the falling concern was less among most of those patients who had no fall based on FES-I and BBS while patients with at least one fall showed more concern according to BBS. With respect to the falling history, during the last six months an OR of 1.346 in FES-I and 0.241 in BBS were noted. Odds ratio for falling history since stroke was 1.338 in FES-I and 0.465 in BBS (Table 2). Multiple logistic regressions were done by adjusting the falling history with the age groups. Falling history and age groups were statistically significant as shown in Table 3.

4. Discussion

Falls are the most recurrent problem in stroke patients and in stroke rehabilitation; it is essential to consider a variety of its associated factors, such as fear of falling, balance impairment, and cognitive dysfunction [12]. This could be observed in the present study where ma-

Table 1. Association of different variables with FES-I and BBS scores

Risk of Fall	Risk of Fall Based on FES-I			P	Risk of Fall on Based BBS		P
	High Concern (23 to 64)	Low Concern (16 to 22)	High Concern (0-44)		Low Concern (45-56)		
Age group (year)	<50	12(57.1%)	9(42.9%)	0.01	3(14.3%)	18(85.7%)	0.02
	50-64	16(32.2%)	37(69.8%)		21(39.6%)	32(60.4%)	
	>64	2(7.70%)	24(92.30)		17(65.4%)	9(34.6%)	
Gender	Male	17(36.2%)	30(63.8%)	0.205	18(38.3%)	29(61.7%)	0.605
	Female	13(24.5%)	40(75.5%)		23(43.4%)	30(56.6%)	
Post stroke duration (month)	<12	6(20.0%)	24(80.0%)	0.003	13(43.3%)	17(56.7%)	0.050
	12-24	18(51.4%)	17(48.6%)		9(25.7%)	26(74.3%)	
	>24	6(17.1%)	29(82.9%)		19(54.3%)	16(45.7%)	
Last 6 months falling history	No Fall	22(31.9%)	47(68.1%)	0.540	21(30.4%)	48(69.6%)	0.001
	At least fall once	8(25.8%)	23(74.2%)		20(64.5%)	11(35.5%)	
Falling history since stroke	No fall	18(32.7%)	37(67.3%)	0.511	18(32.7%)	37(67.3%)	0.063
	At least one fall	12(26.7%)	33(73.3%)		23(51.1%)	22(48.9%)	

Table 2. Risk estimation for falling history

Risk Estimation for Falling History	Scales	Odds Ratio (OR)	95% Confidence Interval	
			Lower	Higher
Last 6 months falling history	FES-I	1.346	0.520	3.482
	BBS	0.241	0.098	0.590
Falling history since stroke	FES-I	1.338	0.562	3.188
	BBS	0.465	0.207	1.048

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majority of the stroke patients according to FES-I and BBS had high risk of falling. One recent study had also reported that patients with stroke compared to normal people, were significantly more likely to experience recurrent falls and fear of falling [1]. The paresis side might be different due to dominance of extremity, or especially in patients with right hemisphere stroke. However, this matter has not been discussed in the present study. Previous studies had also not reported any group differences for age, BBS scores, or paresis side between no fall and at least one fall cases [12, 15].

The present study showed lower to moderate agreement between two scales; however, BBS was considered as a stronger predictor in measuring the falling risk. In one previous study, comparison of the faller and non-faller groups revealed significant differences in their age as investigators in many studies of falls in community-dwelling older adults cited impaired balance [16] which was similar to this study and well predicted by BBS as the risk of fall increased with the increase in age.

Both genders had shown almost similar incidence rate for stroke and this was also mentioned by other research studies [17]. Previous researchers indicated that 40% to 59% of the study participants had experienced single fall-

ing in the last 6 months [12, 18, 19]. However in the present study, just 31% of subjects had experienced falling for at least once and the majority of them (74.2%) had low risk of fall based on FES-I with 23 score while based on BBS, the majority (64.50%) had high risk of fall.

Risk of fall decreased with the increase in the post stroke duration. According to a research, risk of fall (13%) was high after the stroke but it would reduce to 4% after one year [20]. Their research had taken the patients with recurrent stroke but the present research included the first stroke patients, however, in both categories the risk of fall decreased with the increase in post duration period. According to BBS, those with one falling history since the onset of their first stroke had higher fear of falling. Based on multiple Logistic Regression (LR) models for BBS (Table 3) the older stroke patients (50-64 years) compared to those less than 50 years, had 3.46 times higher risk of falling and this risk increases to 7.18 times for patients older than 64 years.

BBS showed that high intra-rater (0.97) and inter-rater (0.98) relative reliability [14, 21] and its reliability, validity and psychometric properties are proven. This scale is easy to use within a short period without expensive equipment [5]. Patients with one falling incident in the

Table 3. Multiple Logistic Regressions (LR) model for BBS

	P	OR	95% CI	
			Low	High
Falling history in last 6 months	No Fall (Reference)			
	At least one fall	2.74	1.03	7.25
Age group	<50 (Reference)			
	50-64 Age group	3.46	0.89	13.46
	>64	7.18	1.55	33.30

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last 6 month were 2.74 times more at risk of falling as compared to those who had no fall in the last 6 months. Moreover, one previous study had also reported that the repeated risk of falling for patients with one previous fall was 2.2 (95% CI, 1.5 to 3.2), adjusted for the other risk factors [22].

The present study had also few limitations as some participants were tired at the time of the test procedure because we had recruited the patients at the physiotherapy clinics where the patients were willing to participate in the research after their regular treatment. Therefore, fatigue might have affected the results. BBS is more relevant to predict the risk of falls among Iranian stroke patients besides, it can be administered at the stroke centers with minimum equipment.

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Conflict of Interest

The authors declared no conflicts of interest.

References

- [1] Goh HT, Nadarajah M, Hamzah NB, Varadan P, Tan MP. Falls and fear of falling after stroke: A case-control study. *PM&R*. 2016; 8(12):1173-80. doi: 10.1016/j.pmrj.2016.05.012
- [2] Schmid AA, Acuff M, Doster K, Gwaltney Duiser A, Whittaker A, Damush T, et al. Poststroke fear of falling in the hospital setting. *Topics in Stroke Rehabilitation*. 2009; 16(5):357-66. doi: 10.1310/tsr1605-357
- [3] Cho K, Yu J, Rhee H. Risk factors related to falling in stroke patients: A cross-sectional study. *Journal of Physical Therapy Science*. 2015; 27(6):1751-3. doi: 10.1589/jpts.27.1751
- [4] Berg KO, Wood Dauphinee SL, Williams JJ, Maki B. Measuring balance in the elderly: Validation of an instrument. *Canadian Journal of Public Health*. 1991; 83:S7-11. PMID: 1468055
- [5] Blum L, Korner Bitensky N. Usefulness of the Berg Balance Scale in stroke rehabilitation: A systematic review. *Physical Therapy*. 2008; 88(5):559.-66. doi: 0.2522/ptj.20070205
- [6] Yardley L, Beyer N, Hauer K, Kempen G, Piot Ziegler C, Todd C. Development and initial validation of the Falls Efficacy Scale-International (FES-I). *Age and Ageing*. 2005; 34(6):614-9. doi: 10.1093/ageing/afi196
- [7] Delbaere K, Close JC, Mikolaizak AS, Sachdev PS, Brodaty H, Lord SR. The falls efficacy scale international (FES-I): A comprehensive longitudinal validation study. *Age and Ageing*. 2010; 39(2):210-6. doi: 10.1093/ageing/afp225
- [8] Tinetti ME, Richman D, Powell L. Falls efficacy as a measure of fear of falling. *Journal of Gerontology*. 1990; 45(6):P239-43. doi: 10.1093/geronj/45.6.p239
- [9] Büla CJ, Martin E, Rochat S, Piot Ziegler C. Validation of an adapted falls efficacy scale in older rehabilitation patients. *Archives of Physical Medicine and Rehabilitation*. 2008; 89(2):291-6. doi: 10.1016/j.apmr.2007.08.152
- [10] Mosallanezhad Z, Salavati M, Hellström K, Reza Sotoudeh G, Nilsson Wikmar L, Frändin K. Cross-cultural adaptation, reliability and validity of the Persian version of the modified falls efficacy scale. *Disability and Rehabilitation*. 2011; 33(25-26):2446-53. doi: 10.3109/09638288.2011.574774
- [11] Salavati M, Negahban H, Mazaheri M, Soleimanifar M, Haddadi M, Sefiddashti L, et al. The Persian version of the Berg Balance Scale: Inter and intra-rater reliability and construct validity in elderly adults. *Disability and Rehabilitation*. 2012; 34(20):1695-8. doi: 10.3109/09638288.2012.660604
- [12] Harris JE, Eng JJ, Marigold DS, Tokuno CD, Louis CL. Relationship of balance and mobility to fall incidence in people with chronic stroke. *Physical Therapy*. 2005; 85(2):150-8. PMID: 15679466
- [13] Kornetti DL, Fritz SL, Chiu YP, Light KE, Velozo CA. Rating scale analysis of the Berg Balance Scale. *Archives of Physical Medicine and Rehabilitation*. 2004; 85(7):1128-35. doi: 10.1016/j.apmr.2003.11.019
- [14] Berg K, Wood Dauphine S, Williams J, Gayton D. Measuring balance in the elderly: Preliminary development of an instrument. *Physiotherapy Canada*. 1989; 41(6):304-11. doi: 10.3138/ptc.41.6.304
- [15] Rosario ER, Kaplan SE, Khonsari S, Patterson D. Predicting and assessing fall risk in an acute inpatient rehabilitation facility. *Rehabilitation Nursing*. 2014; 39(2):86-93. doi: 10.1002/rnj.114
- [16] Hyndman D, Ashburn A. People with stroke living in the community: Attention deficits, balance, ADL ability and falls. *Disability and Rehabilitation*. 2003; 25(15):817-22. doi: 10.1080/0963828031000122221
- [17] Ghandehari K, Izadi Z. The Khorasan Stroke Registry: Results of a five-year hospital-based study. *Cerebrovascular Diseases*. 2007; 23(2-3):132-9. doi: 10.1159/000097050
- [18] Belgen B, Beninato M, Sullivan PE, Narielwalla K. The association of balance capacity and falls self-efficacy with history of falling in community-dwelling people with chronic stroke. *Archives of Physical Medicine and Rehabilitation*. 2006; 87(4):554-61. doi: 10.1016/j.apmr.2005.12.027
- [19] Baetens T, De Kegel A, Calders P, Vanderstraeten G, Cambier D. Prediction of falling among stroke patients in rehabilitation. *Journal of Rehabilitation Medicine*. 2011; 43(10):876-83. doi: 10.2340/16501977-0873
- [20] Burn J, Dennis M, Bamford J, Sandercock P, Wade D, Warlow C. Long-term risk of recurrent stroke after a first-ever stroke. *Stroke*. 1994; 25(2):333-7. doi: 10.1161/01.str.25.2.333

- [21] Downs S, Marquez J, Chiarelli P. The Berg Balance Scale has high intra-and inter-rater reliability but absolute reliability varies across the scale: A systematic review. *Journal of Physiotherapy*. 2013; 59(2):93-9. doi: 10.1016/s1836-9553(13)70161-9
- [22] Tutuarima J, Van der Meulen J, De Haan R, Van Straten A, Limburg M. Risk factors for falls of hospitalized stroke patients. *Stroke*. 1997; 28(2):297-301. doi: 10.1161/01.str.28.2.297