International Journal of Health Sciences and Research
Vol.10; Issue: 5; May 2020
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

To Check Inter-Rater & Intra-Rater Reliability of Fullerton Advanced Balance (FAB) Scale in Stroke Patients

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ABSTRACT

Fullerton Advanced balance Scale is commonly used for elder patients to assess fall risks. This scale assesses both static and dynamic balance considering all the system required to maintain balance such as all three visual, vestibular and proprioception. Hence, it can come out as more effective measure to assess balance in chronic stroke patients. A cross-sectional study was done to check inter-rater and intra-rater reliability of Fullerton advanced Balance Scale – FAB Scale on 80 stroke individuals. FAB Scale score recorded on the first day by two raters for inter-rater reliability and by one of the testers after 7 days for intra-rater reliability. To check reliability Intraclass Correlation Coefficient (ICC) was used. The results demonstrated Intraclass Correlation Coefficient (ICC) with standard error of mean (SEM) of 0.99 & 0.02721 for inter-rater reliability and 0.99 & 0.4492 for inra-rater reliability. A Bland-Altman limit of agreement has also confirmed that inter-rater and intra- rater were within the limits of agreement in 95% of occasions. So it was concluded that FAB Scale shows high inter-rater and intra-rater reliability for stroke individuals.

Key words: Stroke, Fullerton Advanced balance Scale (FAB), Reliability.

INTRODUCTION

Stroke was defined by the World Health Organisation (WHO) more than 40 years ago as "rapidly developing clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than vascular origin." The Stroke Council of the American Heart Association/American Stroke Association has an updated definition of stroke for the 21st century. "Central nervous system infarction is defined as brain, spinal cord, or retinal cell death attributable to ischemia, based on neuropath logical, neuroimaging, and/or clinical evidence of permanent injury." [1]

Balance is the dynamic process by which body's position is maintained in equilibrium. [2] It is a complex motor control task involving the detection and integration of sensory information to assess the position and motion of the body in space and the execution of appropriate musculoskeletal response to control body position within the context of the environment and task. Thus, balance control requires the interaction of nervous system and contextual effects. Nervous system provides sensory processing for body orientation in space mainly provide by visual, vestibular and somatosensory. Sensorimotor integration is essential for linking sensation to motor response. Musculoskeletal contributions

include postural alignment, musculoskeletal flexibility such as joint ROM, muscle performance and sensation. Contextual effects that interact with the two systems are the environment whether it is closed or open. [3]

To have good balance all these systems need to work well together. Impairment in balance occurs when there is alteration is information processing in any of the three stages. A stroke can affects the brain area and information processing which leads to balance issues. Most individuals can compensate well if one of three systems is impaired, but if they are more severe, your system will be unable to work effectively and you will probably feel unsteady. [3,4]

Since balance impairment is one of the major disabilities following stroke, assessing balance is important. Also, it is required to set up an objective of treatment, to determine a treatment method and suggest progression or prognosis. In addition using objective balance measurement tool is important for evidence based practice in order to improve balance ability.

There are certain tests require the performance of a single task (tandem stance ,single leg stance), others require the performance of multiple tasks which includes Performance Oriented mobility Assessment (POMA), Fast Evaluation of Mobility & balance and fear (FEMBAF) ,Berg Balance scale (BBS), most widely used clinical test to assess balance . But Berg et al acknowledge that "the lack of an item that requires a postural response to an external stimulus or uneven support surface is a limitation of scale". So, Conducting focused fall risk screenings and physical performance assessments is an important method for identifying subtle changes in balance and mobility abilities.

Fullerton Advanced Balance Scale – FABS was developed in an effort to address the need to identify more subtle changes in the multiple dimensions of balance – motor, sensory, neuromuscular. In addition to evaluate multiple dimensions of balance in both static and
dynamic environments, the FAB scale includes test items that are specifically designed to challenge the balance abilities. [5]

FAB scale is commonly used in old age people to assess both static and dynamic balance by which we can predict risk of falls. There are many scales which can be used to assess balance in chronic stroke but this scale helps to identify more subtle changes in the multiple dimension of balance where other scales fails to do so. There is lack of literature found that assess balance considering sensory, musculoskeletal and motor systems in stroke. The purpose of this study is to develop a new balance Assessment tool that could be used to identify balance Problems in stroke individual and also evaluate more of the system(s) (e.g.: Sensory, musculoskeletal , neuromuscular)that might be contributing to balance.

METHODOLOGY

A total of 80 subjects were selected on the basis of inclusion criteria like first occurrence of stroke diagnosed by CT or MRI or diagnostic medical reports by a neuro physician, age between 35 to 65 years, duration after stroke between 3 months to 2 years, mini mental scale score of more than 24, Brunnstrom voluntary control (BRS) grade 4 or more, participant ambulatory before stroke and doesn't have any medical contraindication to walking. The patients having any other neurological disease or musculoskeletal disorders and any other sensory issues affecting balance were excluded. A detailed explanation regarding study and test procedure was given to each participant and as a formality toward their willingness to be a par Participants were tested on the scale in a single session and in a quiet, designated area by two therapists, but the scores were kept blinded from each other, on day 1 and on day 7 the same patient was tested again by one of the therapist. For intra-rater

reliability after 1 week same Fullerton Advanced Balance Scale was administrated on the same subject by the same researcher. Scoring of scale which is obtained from the first day will be used for comparison. For inter-rater reliability the same test administrated by the other researcher on the same time.

The scoring of inter-rater reliability was taken by both the testers together at the same time, but blinded, to avoid fatigue due to long duration required to administer the scale. If the scores are taken at different times, then it is difficult to decide that scores are result of true performance of the subject or has fatigue affected the level of performance of subject. In the present study, both the examiners have practiced enough before application of test and equipment and testing has been used same throughout for all the subjects.

DATA ANALYSIS

In this study, total 80 subjects of stroke were included. Subjects were assessed using the Fullerton Advanced Balance (FAB) Scale and main objective of the study was to check inter- rater and intra-rater reliability.

The results which were obtained were considered significant if the value of $p<0.05$ and the confidence interval of 95%.

RESULTS

In this study, total 80 subjects were taken. Table 1 shows the descriptive statistics of age of all subjects.

Table 1: Descriptive Statistics of Age

	N	Minimum	Maximum	Mean	Std. Deviation
Age	80	30.00	79.00	55.4375	12.72279

Table 2: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Tester 1	80	.00	35.00	24.4250	7.09568
Tester 2	80	.00	35.00	24.4625	7.08706
Retest (Tester 1)	80	.00	35.00	24.5500	7.07626

Table 2 shows the descriptive statistics for mean and standard deviation with minimum and maximum values. Descriptive shows good reliability.

Table 3: ICC Inter rater reliability with CI

	95% Confidence Interval	
Inter class Correlation	Lower Bound	Upper Bound
0.999128	0.998555	0.999462
Intra class correlation	Lower Bound	Upper bound
0.999379	0.999302	0.999601

Table 3 shows the inter-class and intra-class correlation coefficient (ICC) for the inter-rater reliability taken by the tester 1 and tester 2 along with confidence interval (CI) with a p value <0.05. The ICC value shows good reliability.

The Bland-Altman chart is a scatter plot with the difference of the two measurements for each sample on the vertical axis and the average of the two measurements on the horizontal axis.

The horizontal reference lines are superimposed on the scatter plot- one line at the average difference between the measurements, along with lines to mark the upper and lower control limits of plus and minus 1.96*sigma, respectively, where sigma is the standard deviation of the measurement differences.

If the two methods are comparable, then difference should be the small, with the mean of the differences close to 0

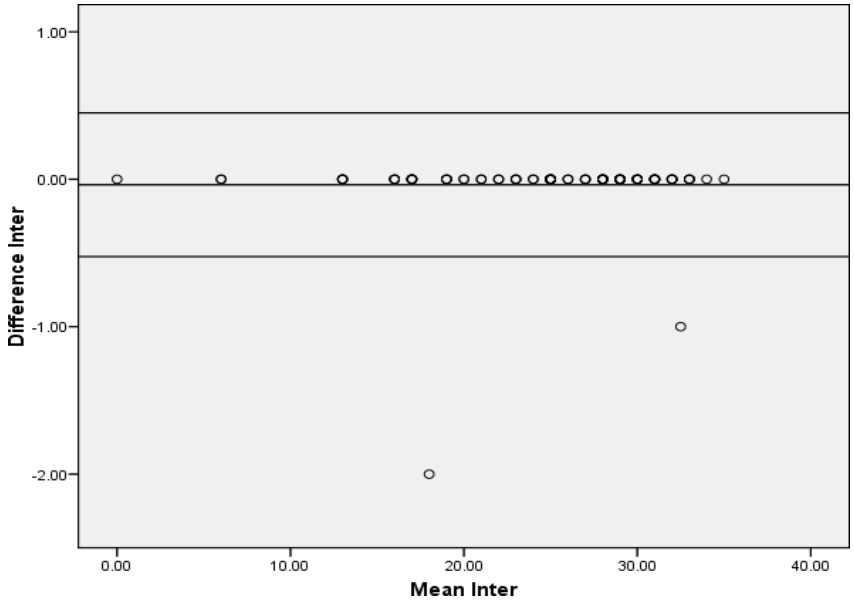

Figure 1: Bland-Altman limit of agreement analysis between two testers

Figure 1 shows reasonable agreement between the testers as most of the values fall in M ± 1.96SD ($p<0.05$). It indicates excellent reliability.

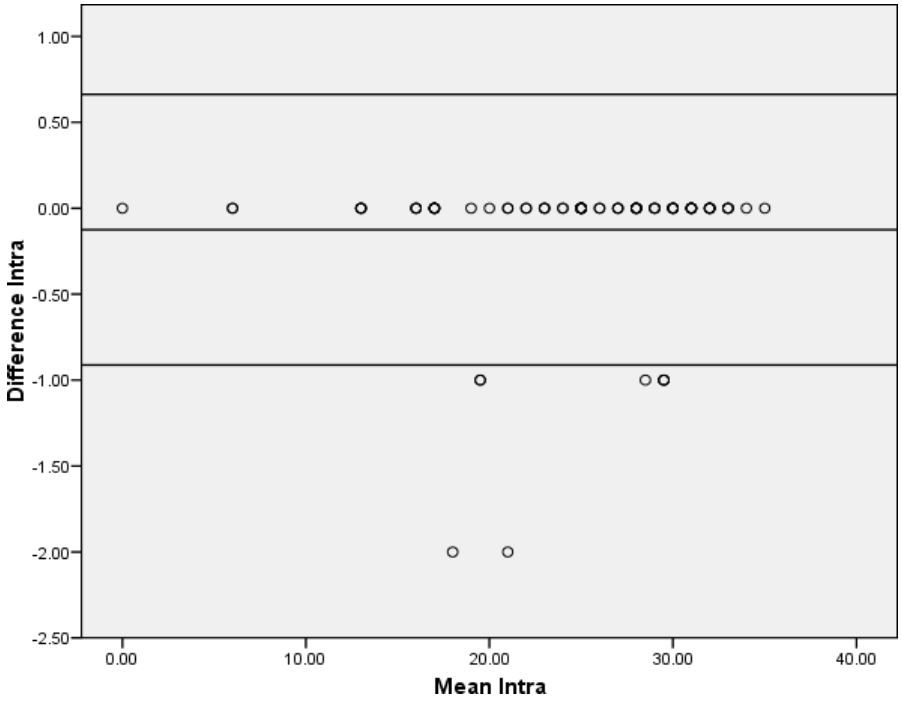

Figure 2: Bland-Altman limits of agreement analysis between scores taken by the same tester twice

Figure 2 shows reasonable agreement between the two ratings of rater as most of the values fall in M ± 1.96SD ($p<0.05$). It indicates excellent reliability.

	Variability in measurements between two testers	Variability in measurements of same tester
SEM	0.02721	0.04492
SEM	Measurements between two testers	Measurements of same testers
	0.05451	0.088304

The SEM value calculated for variability in measurements between the two testers is 0.02721 which is very small; whereas the variability in measurements of same testers is 0.04492 which is very small. Thus these measurements are reliable.

The true SEM value for variability in measurements between two testers (0.02721*1.96=0.05451) suggests that any individual value lies within the range of ±0.05451 PI from their measured value.

The true SEM value for variability in measurements of the same testers (0.04492*1.96=0.088034) suggests that any individual value lies within the range of ±0.1108 PI from their measured value.

Table 5: SRD Values

	Measurements between two testers	Measurements taken by same tester
SRD values	0.1511	0.244

The smallest real difference (SRD) value for variability of measurements between the two testers ($1.96*\sqrt{2}*SEM = 0.1511$) and between the measurements taken by the same tester ($1.96*\sqrt{2}*SEM = 0.244$) is claimed to be capable of representing the "real" change but these values cannot simply be generalised to symptomatic populations.

DISCUSSION

As stated earlier, the aim of the study was to assess the intra and inter-rater reliability of the Fullerton Advanced Balance (FAB) Scale in stroke condition.

Cross sectional study that aim to investigate intra and inter-rater reliability of the Fullerton Advanced Balance (FAB) Scale assessment on the first day and after one week, this test includes following task: Participant standing with feet together and eyes closed (item 1), reaching forward to retrieve an object (item 2), turning in a circle (item 3), stepping up and over a bench (item 4), tandem walking (item 5), standing on 1 leg (item 6), standing on foam with eyes closed (item 7), jumping for distance (item 8), walking with head turns (item 9), and recovering from an unexpected loss of balance (item 10). [6]

The present study is in agreement with the study done by Rose DJ, which was done on 46 community residing older adults. The test re-test reliability score was high (0.96). Inter-rater reliability for total score ranged from .94 to .97 whereas intra-rater reliability ranged from .97 to 1.00.They had also calculated Homogenicity (*H*) Coefficient which is also greater than 0.75. [5] Only the difference between the studies is population consideration. They have assessed this scale on older adults with and without balance problems whereas we have assessed on chronic stroke individuals.

The Present study was also in agreement with study by Hernandez D et al where Binary logistic regression analysis was used. A sample of 192 older adults was included, fall history was obtained using retrospective self-report by participants. FAB scale score served as a predictor variable and faller status (by history of falls in past 12 months) constituted the criterion variable. The results of Binary logistic regression analysis indicated that a test of the full model was significantly reliable. It also indicated that the total FAB scale score was predictive of faller status. Though a different method of statistical analysis has been used, but the end results were found significant reliable of FAB Scale. [7,8]

The present study is the first one to evaluate inter-rater and inter-rater reliability of FAB Scale in chronic stroke patients. According to present study, the intra class correlation coefficient (ICC) for the inter-rater reliability between the two testers is 0.999 and intra-rater is 0.999. Preliminary results suggest FAB Scale is highly reliable balance assessment tool suitable for stroke patients.

In all test situation there is a learning effect that may improve test results of the second test. [9] The choice of seven days between testes was made to limit the learning effect. A time interval of seven days mentioned in studies of Rose DJ et al.

[6] The time period between repetitions of the measures should be long enough to avoid memorisation of data by examiners, but short enough to ensure that there were no clinical changes in the participants. Usually 1 or 2 week would be ideal, but there may be reason for the choice of another interval.

In the present study , the findings of Bland Altman limits of agreement showed, excellent inter- rater agreement between the raters (LOA) indicating that measure related to the tester 1 were in agreement with tester 2 in 95% occasion. Similarly we found excellent intra-rater agreement (LOA), which means that measures relating to first test were in agreement with second test in 95% of occasion.

Study by Brauer et al [10] BBS showed that the BBS was unable to predict faller status in a group of higher functioning older adults. Berg et al [11] acknowledged that the lack of an item that requires a postural response to an external stimulus or uneven support surface is a limitation of the scale. Lima CA et al, [12] did a systemic review on BBS as a screening tool to predict fall risk. According to their study from 1047 studies, 8 studies were included. Which concluded that the use of BBS to predict falls is insufficient and should not be used alone to determine the risk of falls.

Our primary concern is to evaluating balance in chronic stroke individuals and using a functional assessment tool that could assist in the identification of balance problems in chronic stroke individuals. Balance is maintained by sensory, musculoskeletal, neuromuscular systems. Activities which can effectively measure all these three systems should be there. BBS is most common tool for balance assessment but it does not evaluate impairments in the multiple sensory systems and also unable to detect postural challenge measures, it has more items of sitting balance. BBS evaluate balance in only static environment not in dynamic. So, it is difficult to detect subtle balance deficits with BBS. We need a balance scale that measures multiple dimensions of balance.

FAB Scale includes items which are specifically designed to challenge the balance abilities, evaluates multiple dimensions of balance (motor, sensory, musculoskeletal systems) such as turn Standing with feet together and eyes closed (item 1), Turn 360 in both the directions(item 3), step up and over on bench(item 4), stand on one leg (item6). This scale evaluates balance in both static and dynamic environments by asking patient to stand on foam with eyes closed (item7), two footed jump (item 8) and walk with head turns (item 9). Item – 4 Reach forward to retrieve an object with outstretched arm measures anticipatory postural control. Item 10 – Reactive postural control measures a balance –control mechanism different from that measured by other nine items. FAB Scale is developed in such a way that individual test items involve different balance control systems to varying degrees. So, FAB Scale can effectively measure subtle changes in balance in all dimensions. Through, early detection of balance and mobility limitations, preventive strategies can be implemented to reduce fall risk factors and fall related injuries.
Hence, FAB Scale is highly reliable balance assessment tool for stroke individuals.

Limitations of the Study

Small sample size.
Psychometric properties like specificity and sensitivity is not checked.

CONCLUSION

The result of this study demonstrates that the FAB Scale is highly reliable tool to measure balance in people with chronic stroke. On the basis of the results, FAB Scale is a very promising new balance assessment tool which can efficiently evaluate multiple dimensions of balance. From the results of the scale one can effectively built treatment programme and preventive fall strategies. Therapist can check responsive outcome measure for

showing changes after a treatment intervention.

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How to cite this article: Katerawala S, Shah K. To check inter-rater & intra-rater reliability of Fullerton advanced balance (FAB) scale in stroke patients. Int J Health Sci Res. 2020; 10(5):17-23.

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