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Full Length Research Paper

Test-retest reliability of short form of berg balance scale in elderly people

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Falls and fall-induced injuries in elderly people are a serious public health concern in contemporary societies with aging populations. Research has shown impaired balance to be a major factor associated with falls. The Berg Balance Scale (BBS) was originally developed to assess balance performance in geriatric persons or geriatric patients. It has shown high reliability and validity, but it takes more time to complete. So to simplify and to improve its utility, SFBBS was developed which include 7 best items from original BBS. The SFBBS was found to feature psychometric properties similar to those of the original BBS. Still no reliability study has been found in elder people. So the purpose of this study is to examine the test-retest reliability of SFBBS scores among elder people. This is a cross-sectional study which includes 76 normal elder people (25 male and 51 female) of 65 years and above age. The participants were screened for the inclusion and exclusion criteria. An informed consent was taken from the participants prior to the study. SFBBS is administered twice by the same assessor initially then after the 1 week retest will be done at a same time 1± hour of 1st occasion by the same rater. The test-retest reliability of the short form of berg balance scale was calculated using ICC values. Results shows there is a good test-retest reliability (ICC=0.95) of SFBBS in elder people. From this study we conclude that the short form of berg balance scale is a reliable test for Balance evaluation in elder population.

Keywords: Balance, Short Form of Berg Balance Scale, Test-Retest Reliability, Fall Assessment

INTRODUCTION

Aging involves gradual progressive and spontaneous deterioration of most physiological functions. Many studies on the process of aging have revealed decline in numerous sensory and motor functions in elderly. (Jonsson, 2006) Ageing in humans refers to a multidimensional process of physical, psychological, and social change. Most developed countries of the world have accepted the chronological age of 65 years as a definition of 'elderly' or older person. The ageing process is of course a biological reality which has its own dynamic, and largely beyond the human control. The physical, medical, psychological and social consequences include disability and deformity,curtailment of routine social activities and fear of repeated falls. (James et al., 2007)

Falls and fall-induced injuries in elderly people are a serious public health concern in contemporary societies with aging populations. Approximately one third of community-dwelling persons 65 years old and older and more than half of those living in residential care facilities or Nursing homes fall every year.(Kannus et al., 2007) Falls are the fifth most frequent cause of death among elderly people. They are one of the main causes of disability and reduction in the quality of life in this age group. Falls are the direct cause of the majority of limb and femoral neck fractures. Fall prevention is a difficult,

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expensive and underestimated problem (Czerwinski et al., 2008). The Rate of falls increases with age, as functional impairment and Disability are highest in frail elderly persons aged 90 years and older. Around 50% of adults aged over 80 years suffer a fall at least once a year. Falling leads to injuries, hospitalization and loss of independence and imposes high costs to public health and social services in community (Beauchet et al., 2007).

Balance is an ability to control center of gravity (COG) over the base of support (BOS) in a given sensory environment. (Darcy A Umphred, 2007) Maintenance of balance requires the co-ordination of sensory, neural and musculoskeletal system. Many of these undergo deterioration as people age. This has the potential to affect balance, restrict safe mobility, increase the likelihood of a fall and adversely affect quality of life. Therefore, the assessment of balance with older people is important to direct appropriate interventions to improve balance over time. (Langley and Mackintosh, 2007) Balance deficits in elderly adults can arise from the process of aging, such as age-related changes associated with the sensory system (vestibular, visual, and somatosensory) or diseases such as cerebrovascular accident, arthritis, peripheral neuropathies or disuse due to immobility. (Ching-Yi Wang et al., 2006) The impairment can lead to dramatic consequences such as dependency in activities of daily living (ADL), increased risk of falling, increased risk of experiencing recurrent and more severe falls and fractures, admission to nursing homes and increased mortality risk in older adults (Conradsson and Lundin-Olsson, 2007).

Research has shown impaired balance to be a major factor associated with falls, future disablement, institutionalization, or even death in older adults. Therefore, balance performance in the older individual deserves special attention from medical professionals and researchers. If the balance deficits of older adults can be identified early, health care professionals will be able to develop effective strategies to prevent subsequent decline in physical function (Ching-Yi Wang et al., 2006) and there is a need for valid and reliable instruments for evaluating the effects of treatment. It is crucial for the clinician to know whether a change in scores on functional tests is due to a real change in functioning or to measurement error (Conradsson and Lundin-Olsson, 2007).

A balance measure that is deemed useful in a clinical setting must be both psychometrically sound and not lengthy to administer. (Chia-Yeh Chou et al., 2006) A psychometrically sound balance assessment instrument is useful in documenting the balance performance of independent older adults, monitoring changes, and identifying those at an early phase of deterioration and in need of intervention as early as possible (Ching-Yi Wang et al., 2006). Various assessments of balance and physical mobility like, Questionnaires, such as the Rivermead Mobility Index (RMI) (Linda and Roberta, 1996) and the Activities Balance Specific (ABC) scale, Laboratory measures such as force platforms and Functional performance based tests such as the Functional Reach Test (FRT) and Timed Up and Go Test (TUG) are used in geriatric rehabilitation. (Langley and Mackintosh, 2007) One of the most frequently used clinical scale for assessing balance in elderly people is the Berg Balance Scale (BBS) (Benaim et al., 1999). BBS is also been used widely in order to evaluate balance performance for people with stroke (Chia-Yeh Chou et al., 2006) and was originally developed to assess balance performance in geriatric persons or geriatric patients (Ching-Yi Wang et al., 2006). The BBS can be easily administered in community settings, and its application to the assessment of balance performance in community-dwelling older adults has been suggested. It is a valid instrument used for evaluation of the effectiveness of interventions and for quantitative descriptions of function in clinical practice and research (Conradsson and Lundin-Olsson, 2007).

However 3 issues have been hampering the widespread utility of the BBS. First, the BBS may take about 20 minutes to complete. Second, the BBS consists of five-level items with scoring criteria varying from item to item; and the Third, the extremely high internal consistency of the BBS indicates to some extent about item redundancy. So to simplify and to improve its utility, SFBBS (short form of BBS) was developed by Chia-yeh Chou et al., (2006) and was found to feature psychometric properties similar to those of the original BBS. It is having good variability (22.1-25.4), good internal consistency (0.96), concurrent validity (0.99), and responsiveness (0.75). The SF-BBS has 3 rather than 5 categories for each item, scored as 0, 2, or 4 for a maximum total score of 28, with higher scores indicating better balance. Compared with the original BBS, the 7-item BBS-3P is improved in 3 significant aspects. First, the number of items is reduced by half. Second, the scoring levels are reduced from 5 to 3, thereby reducing the possibility of scoring inconsistency. Third, administration of the 7-item BBS-3P requires fewer assessment tools. Thus, the 7-item BBS-3P may be used interchangeably with the original BBS. The internal consistency, concurrent validity, convergent validity, predictive validity, and responsiveness of SFBBS have been found in stroke patients (Chia-Yeh Chou et al., 2006). No study has been found on test-retest reliability of SFBBS in elder people. As the original berg balance scale was developed to measure balance in elder people, finding the evidence on reliability of SFBBS will be useful for the physical therapists to use more frequently in their practice. So the purpose of this study is to examine the test-retest reliability of SFBBS scores among elder people.

METHODOLOGY

Sample

To find out the test-retest reliability of SF-BBS, cross sectional observation method was followed. 76 subjects were selected from the following old age homes like, Matrugruh, Chandranagar old age home, Bharti ashram, Sarkhej old age home, and Income tax old age home in Ahmadabad, Gujarat. All the included older people were of the age group of above 65 years. (Mean age 74.96 $\pm$ 6.45) A purposive Sampling technique was adapted for the selction of the subjects based on certain criteria for the inclusion.

All Male and female elders with 65 years of age and above with the Mini mental state examination score more than 23were included in the study and the elderly who ambulate independently with or without any assistive device were selected particularly. The elderly person with any uncontrolled / acute exacerbation of any cardio-respiratory conditions, and the persons with any neurological condition which may affect the participation of the individual were excluded from the participation. Even the persons who cannot understand and follow the commands were excluded from participation.

The study consisted of 25 males and 51 females, out of 76 participants. People who want voluntarily to participant in this study were included in this study. Prior to the participation in this study the individuals were explained about the study for their maximum co-operation. The participants were screened for the inclusion and exclusion criteria and those who fulfilled the criteria were considered for the study. An informed consent was taken from the participants stating the voluntary participation in the study.

Testing Procedure

74 subjects were selected from the various old age homes in Gujarat. The data were collected in the period of February-April 09. All subjects were screened for cognition using Mini Mental State Examination scale (Mean MMSE 27.39 ± 2.25139) prior to the administration of SFBBS, which includes components like orientation, registration, attention and calculation, recall, language, repetition, 3-stage command, reading, writing, and copying. In MMSE some questions were asked to subjects, according to the responses and answers of questions scoring was given to the subjects. For correct answer 1 score and for wrong answer 0 score was given. Total scores for MMSE is 30 and cut-off scores for MMSE is 23, it means a score of 23 or lower is indicative of cognitive impairment and a score above 23 is indicative of cognitively intact. Scoring for MMSE took 10-15 minutes for each subject.

All subjects were examined for balance by short form of Berg Balance Scale (SFBBS). Prior to applying the scale all the participants were instructed and explained about the all components of SFBBS and demonstrated if necessary. In SFBBS assessment consists of 7 activities routinely performed in daily living. The activities are ranked in order from least to most difficult to perform. Scoring is given based on the ability to perform the items independently and to meet certain time or distance requirements. It is a 7 –items scale which has 3 categories for each item, scored as 0, 2, or 4 for a maximum score of 28, with higher score indicating better balance. Tasks include both static and dynamic balance tasks, these activities are Sitting to standing, Standing unsupported with eye closed, Reaching forward with outstretched arm while standing, Pick up the object from the floor from a standing position, Turning to look behind over left and right shoulders while standing, Standing unsupported one foot in front and Standing on one leg.

Each task was scored on a 3-point ordinal scale, with scores ranging from 0-2-4. Descriptive criteria were provided for scoring each level: a score of 4 used to indicates that the person performs independently and meets time and distance criteria and a score 0 is used for unable to perform. Individual task scores are summed for a maximum of 28 points. Time spent for examining the SFBBS score for each subject was 10-15 minutes.

Test-retest reliability was established over a period of 7 days in all participants. Subjects were tested twice with SFBBS by the same rater, with 1 week gap between tests for test-retest reliability. SFBBS score was taken on 1st occasion, only date and time of first occasion were remembered by the tester, and were kept in an envelope which was sealed by the examiner. On the next occasion after one week, retest was done at a same time $\pm$1 hour of 1st occasion by the same rater. Scores of retest were also kept in an envelope after that which is sealed by the examiner.

Statistical analysis

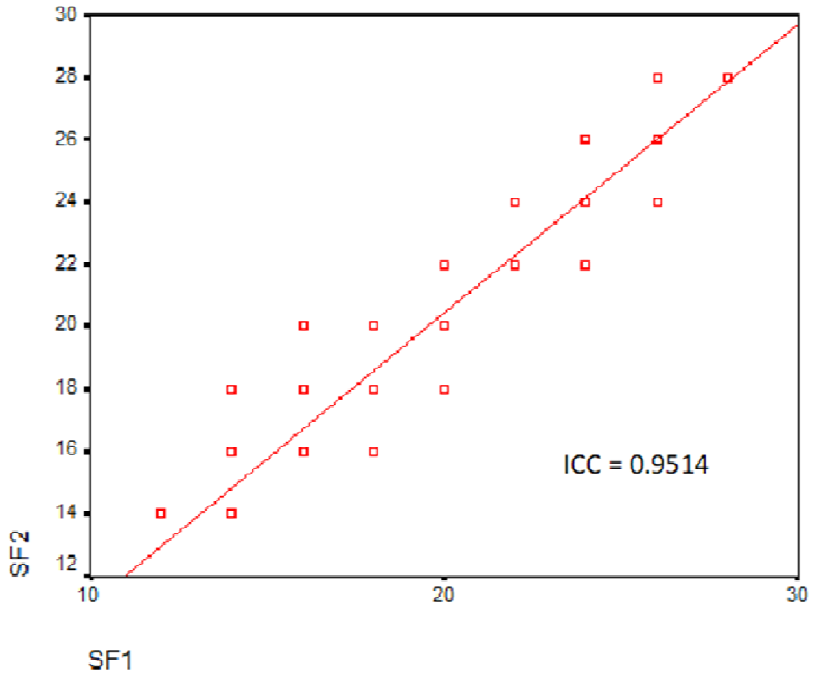
Data were collected in the data collection sheet (SFBBS Score sheet). Data were properly organised and tabulated with proper variables for analysis and interpretation. After that data were coded to prevent the difficulty while analysing their meaning later on. To find the co-relation between the first and second assessment to find out the reliability of the tool, the data were analysed with intra-class correlation coefficient (ICC) in this study. Significance level was set at p=0.05. The statistical software SPSS 11.5 version was used for the analysis of the data and Microsoft word and excel have been used to generate graphs, Tables.

Table 1. Descriptive Statistics of Baseline characteristics and SF-BBS Score.

Characteristics	N	Minimum	Maximum	Mean	Std. Deviation
AGE	76	65.00	91.00	74.9605	6.45898
MMSE		23.00	30.00	27.3947	2.25139
SF1		12.00	28.00	20.6053	4.07947
SF2		14.00	28.00	20.9737	3.96644

Table 2. Assessment of Test-Retest Reliability of Short Form of Berg Balance Scale

Measure	ICC value	95%confidence interval		Sig.
		Lower bound	Upper bound	
Single rater	0.9514	0.9207	0.9698	0.0000



Graph 1. Correlation between the day-1 score and the day-2 scre score of SF-BBS

RESULTS

A total of 76 subjects (25 males and 51 females) above 65 years age for test-retest reliability of short form of berg balance scale (SFBBS). All the subjects were taken from the various old age homes of Gujarat. Then they were screened for the inclusion and exclusion criteria. SFBBS was applied twice by the same rater with one week gap between them. The baseline characteristics of the subjects like age and MMSE are presented in the Table-1. The Maximum age was 91years and the minimum age was 65 years. There is maximum people (17%) falls in the age group of 70 years and less people (1%) in the age group of 82 years, 89 years, 90 years, and 91 years. rest of the age groups having almost equal distribution.

The minimum MMSE value found was 23 and maximum value of 30 with mean value is 27.39 $\pm$ 2.25. Here it shows that maximum people (22%) got the highest score of 30, and less people (7%) got the minimum score of 23. 5% people got the 24 score in MMSE. Remaining participants shows almost equal score distribution. Total 76 subjects, out of that 51 are female and 25 are male with the percentage of 67.10% and 32.90% respectively. It shows that there is more number of female in this study than male.

Table 1 further shows the descriptive statistics for first test of Short form of berg balance scale (SF1) and second test of short form of berg balance scale (SF2) with total no. of samples, minimum value, maximum value, mean value, and std. deviation. During the first test

(SF1) of SFBBS minimum value found is 12 and maximum value is 28 with the mean age of 20.60 ± 4. 07.years After the gap of 1 week, during the second test (SF2) of SFBBS minimum value found is 14 and maximum value is 28 with mean age of 20.97 ± 3.96 years. During first test of SFBBS (SF1) participants (21%) scored maximum score is 22, and only 1% people scored minimum score of 12 out of total score of 28. During the second test of SFBBS (SF2), 8% of the people got the maximum score of 28 and 7% of people got the minimum 14 score. Most of the people 18% falls in the 22 score category

Table 2 shows the intra class correlation co-efficient (ICC) of the short form of berg balance scale (SFBBS)**.** It shows the ICC = 0.95 indicated that the good test retest reliability of SFBBS. In 95% confidence interval lower bound value is .92 and upper bound value is .96.it shows all the data are falling between these two values. The graphical representation of the values can be seen in the graph 1, which shows the positive linear co-relation between test 1 and test 2 of SFBBS which indicate that there is good test-retest reliability of the short form of berg balance scale.

DISCUSSION

Aging involves gradual progressive and spontaneous deterioration of most physiological functions and ageing process itself has deleterious influence on balance. Aging related deterioration in balance or postural control exerts a significant negative impact on ability to perform everyday activities safely. (Jonsson, 2006) Falls are one of the major health care concerns for older adults and their impact is a significant public health problem. (Tenetti et al., 1988, Downton et al., 1991) Nickens **(**1985) identified impaired balance as a risk factor in attempts to reduce falls and injuries resulting from falls.

Balance is required for maintaining a position, remaining stable while moving from one position to another, performing activities of daily living, and moving freely. However, a decline in balance ability has been shown to occur with increasing age.(Harry and Rhonda 2003) A psychometrically sound balance assessment instruments is useful in documenting the balance performance of independent older adults (Ching-Yi Wang et al., 2006). Although the Berg Balance Scale (BBS) was originally developed to assess balance performance in geriatric population. There were some difficulties found while performing the BBS like it takes more time to complete, variability in scoring, and there are more items in the scale which needs to reduce some amount of items from the BBS (Chia-Yeh Chou et al., 2006).

The SFBBS is found to be easy to apply because in this the number of items are reduced by half than original BBS, and requires fewer assessment tools. For example, a stool was not necessary for the SFBBS because of the removal of the item "placing alternate foot on stool." All of these improvements allowed the raters to complete the SFBBS within half the time required to complete the original BBS (less than 10 of the original 20 minutes). This advantage of the SFBBS decreases the possibility of incomplete data collection due to time constraints and contributes to efficiency in examination (Chia-Yeh Chou et al., 2006).

The 3-point change which made in the SFBBS may be clinically meaningful, because the amount of change that clinically meaningful on this measure has not yet been established, this finding may be useful in future studies using it to assess outcomes (Richard and Cheryl Hawk, 2009). Reliability is the stability of the measuring instrument; that is, a reliable instrument will obtain the same results with repeated administrations of the test (Leslie and Watkins, 2000). The result of this study will help us to know, the effectiveness of measurement properties of SFBBS used to measure balance which will be of great use to the physiotherapist in clinical practice. So, this study examined the test retest reliability of the short form of berg balance scale (SFBBS) in elder people.

76 healthy subjects were taken from the various old age homes of Gujarat with consent from the office managers of respective homes. Then the cognition of all the subjects was assessed by applying MMSE to all elder people. Subjects who scored more than 23 were selected for the study and subjects who scored below 23 were excluded from this study because they were considered as having low cognition level which may affect the study. In this study SFBBS was applied on the subjects twice by the same rater with one week gap between two tests. Retest was done at a same time ±1 hour of 1st occasion by the same rater. Both the test and retest were done mostly in afternoon time. In SFBBS maximum score is 28 and cut off score is 23. In this study minimum score found was 12, maximum score was 28 and mean score was 20.

To find the co-relation between 1st test and 2nd test score of SFBBS, Intra-class Correlation Coefficient (ICC) was used in this study. The results of the present study showed that test and retest SFBBS scores are closely related with each other. The high test-retest reliability (ICC= 0.95) was found in this study. In 95% confidence interval, lower bound value found was 0.92 and upper bound value was 0.96. In the first test of SFBBS the 7% people scored maximum 28 score and only 1% scored minimum 12 score. Remaining 21%, 9%, 11%, 18%, 11%, 8%, and 14% got the score of 22, 24, 26, 20, 14, 16, and 18 respectively. In the second test (retest) of SFBBS maximum score of 28 showed in 8% of subjects while no one scored the 12. While in other 11% of people got the 16 and 24 score, 17% of subjects scored 18 and 20, 18% scored 22, 12% scored 26, and 7% scored 14 out of the 76 subjects. While applying SFBBS, It was found that most of the subjects had difficulty in performing two tasks that were tandem standing and

standing on one leg. Remaining all tasks they got good scores.

The high internal consistency reliability (0.96), validity (0.99), and responsiveness (0.75) for SFBBS were also found in other study in different population such as stroke patients (Chia-Yeh Chou et al., 2006, Wang et al., 2004). As a consequence, it is recommended for monitoring the recovery and measuring the outcome of patients with stroke. From another point of view, the SFBBS would benefit people who are able to attain or maintain upright stance without support, because testing easy tasks (eg, unsupported sitting) appears to be irrelevant for these people.

But, Cheryl Hawk and Jerrilyn Cambron (2009) found the use of the SF-BBS in their study was disappointing. This may be due to the fact that this instrument was developed for post stroke patients, and so, its applicability to a different population of older adults may not be appropriate. They also showed in their study that the SF-BBS did not show a great deal of clinical responsiveness in the study population of adults 65 years or older with impaired balance.

As per the results of this study, the use of the SFBBS in clinical and research settings can be an improvement over the use of the original BBS as the SFBBS has excellent agreement with the original BBS. Further, it was found already that there were no difference in scores between the the SFBBS and the original BBS. The SFBBS is especially useful when the time available for examination is short, such as at follow-up or when the clients are too weak to endure long examinations (Chia-Yeh Chou et al., 2006). This study was limited only to the measure the test-retest reliability and no any other psychometric properties were evaluated. Test-retest reliability should be evaluated in stroke patients and in other diseased population also.

CONCLUSION

Based on the findings of this study we conclude that, Short form of berg balance scale (SFBBS) is a reliable test for Balance evaluation in elderly population.

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