

Body balance evaluation in osteoporotic elderly women

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Abstract

Summary Osteoporotic Brazilian women balance was evaluated by timed up and go test (TUG) and to the Berg balance scale (BBS). In the BBS, women with and without osteoporosis had normal range scores, even with history of fall. In the TUG test, women with osteoporosis were slower, but in the normal parameter. Results suggest that the references values of these tests are not appropriate for Brazilians.

Purposes The purposes of this study were to evaluate balance and functional mobility in women with osteoporosis and without osteoporosis and to verify if the history of falls has association to the TUG and to the BBS, both largely used in the clinical practice.

Materials and methods Forty-five women were divided into three groups: group 1, young women with normal body mineral density (BMD); group 2, elderly with normal BMD; and group 3, elderly with osteoporosis. BBS and TUG were performed, and the history of falls was collected. **Results** BBS and TUG showed differences in the scores obtained for young women compared with both elderly with and without osteoporosis. In the TUG test, there were differences between elderly with and without osteoporosis. The fall's history did not present correlations either for TUG or BBS.

Conclusions Although the results showed that all women were within the normal range for BBS and TUG, the results suggest that the reference values for TUG and BBS are not appropriate for Brazilian population.

Keywords Elderly women · Osteoporosis · Body balance · Berg balance scale · Timed up and go test

Introduction

Osteoporosis is a debilitating disease, which manifests itself more frequently in aged individuals. Due to the increase in life expectancy, the individual is at higher risk of presenting the disease. The presence of osteoporosis in elderly people may be related to a higher risk of falls, which not only increases the levels of morbidity and mortality but also the health care costs [11, 13].

In USA, about 55% of the population aged over 50 years has osteoporosis [4], whereas in Europe, this percentage drops to 23% for women at the same age group [3]. In Brazil, no clear-cut epidemiological data are available [1].

One of the most compromising aspects in elderly is the body balance, mainly when this population has associated osteoporosis [13]. Sinaki et al. [13] have shown that osteoporotic elderly individuals have more corporal oscillation compared to those without osteoporosis. However, further explanation on the influence of osteoporosis on the balance and functional ability of elderly are lacking, particularly regarding gait, sitting down, and standing up.

Studies reveal that poor balance results in difficulties in performing daily activities and increases the risk of falls [6, 13]. Therefore, investigating the body balance in elderly individuals with osteoporosis who face functional situations

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such as standing up and walking might help explaining the mechanisms underlying this relationship.

The Berg balance scale (BBS) has been largely used to evaluate body balance in elderly. It is a simple test regarding the ability to keep the balance in common daily activities, and it can be easily applied within approximately 15 min.

The “timed up and go” test (TUG) is another method usually applied to evaluate the mobility of elderly individuals. Although BBS and TUG tests are largely used to evaluate body balance and functional ability in elderly [2, 8, 18], no study on osteoporotic elderly women was found in the literature. As a result, the objective of the present study was to assess these issues by using both BBS and TUG test and compare the values obtained from elderly with osteoporosis to those from elderly without osteoporosis and healthy young individuals. In addition, the study examined whether such tests being applied are efficient to predict risk of falls in this population.

Materials and methods

This study was carried out in the Clinic Hospital’s Rehabilitation Centre at the Ribeirão Preto School of Medicine, University of São Paulo (USP), and the procedures were in accord with the standards of the Committee on Human Experimentations of the institution. Forty-five sedentary women were selected for study and then divided into three groups according to their age and bone mineral density (BMD) of spinal column (L1–L4). Group I consisted of young women ($n=15$) aged between 20 and 30 years old (21 ± 2.99 years) with mean weight of 56 ± 7.34 kg, mean height of 1.64 ± 5.96 m, and BMD T score better than -1 SD. Group II consisted of elderly women ($n=15$) aged between 61 and 76 years old (65 ± 4.11 years) with mean weight of 59.6 ± 12.17 kg, mean height of 1.52 ± 5.73 m, and BMD T score also better than -1 SD. Those women aged between 61 and 80 years old (72 ± 5.54 years) and presenting osteoporosis (BMD T score ≤ -2.5 SD) were included in group 3, where mean weight and mean height were, respectively, 63.4 ± 9.88 kg and 1.54 ± 8.08 m.

Exclusion criteria were the following: diabetes mellitus, history of fracture of spine and/or lower limbs, cognitive deficit, severe cardiac and pulmonary problems, and vestibulopathy.

All the subjects were submitted to balance and functional mobility tests in addition to answering a questionnaire about their history of falls during the past 6 months. The BBS consists of 14 items, and each item has five alternatives with score ranging from 0 (minimum score) to 4 (maximum score), thus totaling 56 points [2, 7]. A score not greater than 45 is indicative of change in the body balance [18].

Functional mobility was assessed by using the TUG test, which consists in recording the time spent by an individual

to stand up from a chair, walk a distance of 3 m, turn, walk back to the chair, and sit down again [10]. The 3-m distance was determined with an adhesive tape fixed to the floor to be used as a reference line. The test started and ended with the subject seated in an armless chair with seat height of 43 cm and keeping the knees flexed to 90° and arms at side for balance. Furthermore, the subject was asked not to use the hands to stand up and sit down again. The test was conducted three times, and a mean value was calculated for study. The results indicate that the more time spent on performing the test, the worse the performance. Some authors have suggested that a 13-s test duration can indicate high risk of fall for elderly people [8, 15].

The statistical analysis was done by using the Shapiro–Wilks normality test and the Levene test for homogeneity of variance; it was observed that the overall mean values of all variables showed normality and homogeneity of variance. As a result, two analyses of variance (ANOVA) were carried out using the group’s performances on BBS and TUG tests as dependent variables. Post hoc Tukey’s tests were used when needed, and Pearson’s correlation tests were also applied in order to verify the relationship between experimental tests and history of falls. The value of alpha was set at 0.05.

Results

Figure 1 shows the results on the performance on Berg test for all three groups. ANOVA revealed a group effect [$F_{(2,44)}=14.50$, $p<0.05$]. Post hoc tests indicated differences between young women (group 1) and elderly ones with either normal BMD (group 2) or osteoporosis (group 3), as the former had a better performance compared to the other two groups. Both elderly women with normal BMD

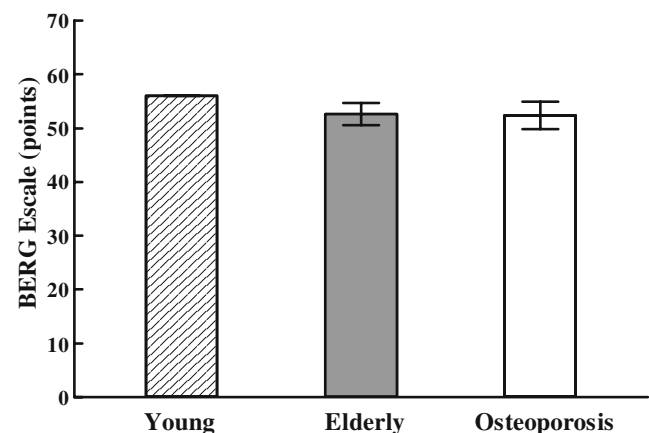


Fig. 1 Means and standard deviations regarding the scores obtained on the Berg balance scale for groups 1, 2, and 3. Berg balance scale (points) \times young \times elderly \times osteoporosis

and those with osteoporosis had similar performance on the BBS.

Figure 2 shows the results on the performance on TUG test for the three groups, with ANOVA revealing group effect [$F_{(2,44)}=38.37$, $p<0.05$]. Post hoc tests indicated differences between young women (group 1) and elderly ones with either normal BMD (group 2) or osteoporosis (group 3). A difference was also observed between elderly women with normal BMD and those with osteoporosis. Group 1 had a better performance compared to the other two groups, whereas elderly women with normal BMD had a better performance compared to those with osteoporosis.

The Pearson's correlation tests did not indicate significant correlations ($p>0.05$) between the BBS and history of falls ($r=0.03$) as well as between TUG test and history of falls ($r=-0.12$). Approximately 13% of osteoporotic women reported a fall in the past 6 months before data collection. For women with normal BMD, the rate of falls was 40%.

Discussion

The BBS and the TUG test are largely used to predict both function and risk of fall in elderly [17]. In the present study, we have compared the results of both tests applied to three groups of subjects, namely, healthy young women (group 1), elderly women with normal BMD (group 2), and elderly women with osteoporosis (group 3).

The results obtained with the BBS were found to be significant only when group 1 was compared to groups 2 and 3. This was also observed with regard to TUG test, where the results indicated differences between group 1 and the other two groups. In addition, there was a difference in TUG scores when elderly women with normal BMD were compared with those women with osteoporosis. However,

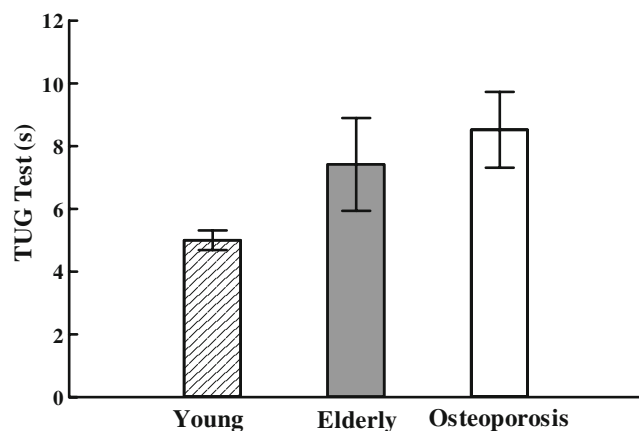


Fig. 2 Means and standard deviations regarding the time (seconds) spent to perform the TUG test for groups 1, 2, and 3. TUG test (seconds) \times young \times elderly \times osteoporosis

the values obtained in all three groups were within the normal limits for Berg's test (group 1=56, group 2=53 \pm 2.06, group 3=53 \pm 2.92) as well as for TUG test (group 1=5 \pm 0.30 s, group 2=7.1 \pm 1.48 s, group 3=8.4 \pm 1.22 s).

Osteoporosis leads to changes in the body configuration, which can interfere with postural control. In addition, elderly people are more likely to suffer falls due to physiological alterations resulting from the aging process [4]. However, osteoporosis was not found to be an aggravating factor for postural control among our subjects, since the results of BBS and TUG test were within the normal range.

According to Swanenburg et al. [17] and Madureira et al. [6], a BBS score not greater than 45 points would be indicative of risk for falls. On the other hand, Sumway-Cook and Woollacott [16] state that individuals who cannot achieve more than 36 points are almost 100% more likely to suffer a fall. Each 1-point decrease means an increase of 6–8% in the risk of fall among individuals who achieved 46 and 54 points and between 54 and 56 points for each 1-point decrease means 3–4% increase in the risk of falls.

With regard to TUG scores reported in the literature, we can also observe differences among the authors. For Madureira et al. [6], TUG scores greater than 10 s may indicate poor mobility, whereas Shumway-Cook et al. [14] have suggested that individuals spending more than 14 s to complete the test are more likely to suffer falls. On the other hand, Podsiadlo and Richardson [10] have reported that elderly individuals with TUG scores below 20 s can performed their daily activities independently, whereas those taking longer than 30 s to complete the test had high levels of dependency.

The lack of sensibility in the tests used in the study is another factor to be considered. Schaubert and Bohannon [12] have further examined the BBS and showed that the majority of items were considered of easy execution for elderly subjects, since they had achieved high scores. Only a few items such as standing on one foot and putting one foot in front of the other caused some difficulties for elderly subjects, thus corroborating the findings observed in the present study.

Some studies have shown that TUG test becomes more efficient when performed in combination with other tasks (e.g., carrying a glass of water while walking). For instance, combining cognitive tasks with the TUG test can also be a way to better determine those elderly subjects with functional mobility problems [5, 14].

According to the literature, there are different manners of performing the TUG test. This is one of the possible factors explaining the different outcomes between the studies. An armless chair with a seat height of 43 cm and thin foam layer was used in the present study. Paula et al. [9], for instance, have used an armless chair with seat height of

45 cm and no foam layer. In fact, some authors do not even mention the chair characteristics [6, 15].

In the present study, the subjects were asked to stand up from the chair, walk a distance of 3 m as quickly as possible, walk back, and sit down again. Similarly to the studies by Sumway-Cook et al. [15] and Paula et al. [9], the subjects were also asked to walk as quickly as they could during the test. However, Madureira et al. [6] did not mention the speed at which the tasks were performed.

With regard to the number of repetitions, different information exists as well. In the present study each test was conducted three times and an average was calculated. Paula et al. [9] had an average corresponding to only two repetitions, whereas Ching-YI Wang et al. [19] did not mention how many times the tasks were executed, limiting themselves to report that the subjects had practiced the tasks once in order to understand the correct way of doing them.

In fact, the methodological differences between our study and earlier studies [9, 15] might explain the discrepancies found for TUG and BBS tests. However, our most interesting finding was that elderly women with and without osteoporosis showed a similar performance on BBS test, and elderly women with normal BMD did it better than osteoporotic women on TUG test. Despite the possible methodological differences in relation to other studies, the subjects participating in the present study had rigorously followed the same data collection procedures. By considering the BBS, therefore, it seems that osteoporotic women have function and balance similar to those of women with normal BMD. On the other hand, the TUG test suggests that osteoporotic women have functional difficulties compared to those elderly with normal BMD. Individuals with osteoporosis can present associated muscular strength deficit [13]. Because such tests also require a moderate level of muscular strength and potency, we have put forward the hypothesis that osteoporotic women would have a worse performance on both tests compared to elderly women with normal BMD. Interestingly, this was observed only in the TUG test, which might be explained by the low-demand tasks [5, 12, 14]. However, we believe that further studies employing different levels of tasks should be carried out in order to clarify this possibility.

The results obtained from the questionnaire showed that women with normal BMD suffered more falls than women with osteoporosis during the past 6 months before data collection. This finding contradicts our initial hypothesis. One explanation for such a fact is the greater susceptibility to bone fractures among osteoporotic women, who might be more careful in performing their daily activities or even use compensatory strategies in order to improve their postural balance. Nevertheless, further investigations are needed to support this hypothesis.

Although the results point to differences between young women (group 1) and elderly women with and without osteoporosis (groups 2 and 3, respectively), both BBS and TUG test were not found to be efficient in predicting risk of falls and functional impairment in elderly individuals, since the scores obtained in groups 2 and 3 were within the normal range, and many of these women had a history of fall in the past 6 months. Hence, the results suggest that the reference values should not be appropriated for Brazilian population.

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Conflicts of interest None.

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