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# Analysis of correlation between instruments for evaluation of postural balance in institutionalized elderly

## Abstract

Nursing homes residents have a reduced mobility and a worse balance. The use of tools to screening the risk of falling is useful in identifying older adults who need intervention to prevent future falls, but there is a gap in studies assessing which tests have good agreement to assess the balance in institutionalized older people.

Objective: to analyze the correlation between tests used to assess the body balance in the elderly living in the nursing homes.

Methods: 45 nursing home residents were included. The balance was evaluated using the follow clinical tests: Berg Balance Scale (BBS), Short Physical Performance Battery (SPPB), Timed up and Go (TUG), gait speed by 10 meter walk test, the distance in the Six-minute walk test and Tinetti test.

Results: All tests used in the study showed a positive or negative correlation between them, with statistical significance: SPPB and BBS ($r=0.79$, $p<0.0001$), SPPB and TUG ($r=-0.72$, $p<0.0001$), SPPB and gait speed ($r=0.73$, $p<0.0001$), BBS and TUG ($r=-0.81$, $p<0.0001$), BBS and gait speed ($r=0.72$, $p<0.0001$), BBS and distance (6MWT) ($r=0.72$, $p<0.0001$), TUG and gait speed ($r=-0.75$, $p<0.0001$), TUG and distance (6MWT)($r=-0.85$, $p<0.0001$), gait speed and distance (6MWT)($r=0.80$, $p<0.0001$), distance (6MWT) and Tinetti ($r=0.70$, $p<0.0001$), SPPB and distance (6MWT)($r-0.66$, $p<0.0001$), BBS and Tinetti ($r=0.54$, $p=0.0001$), TUG and Tinetti ($r=-0.57$, $p<0.0001$, gait speed and Tinetti ($r=0.52$, $p=0.0002$), and SPPB and Tinetti ($r=0.39$, $p=0.007$.

Conclusion: the instruments showed a strong or moderate correlation and can be used to evaluate the postural balance in the nursing home residents.

**Keywords:** aged, homes for the aged, postural balance

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## Introduction

The United Nations evaluate that the number of people 60 years or older is expected to more than double until 2050.[1] The number of olders living in nursing homes (NHs) is also expected to rise.[2,3] In Brazil, the institutionalized elderly represented 1.5% of the elderly population.[4] Living in these institutions can promote social isolation and a reduction in mental and physical activities.

Older people living in a NHs are characterized by a reduced mobility and a worse balance when compared with community-dwelling elderly.[5–7] For this older adults, some activities which are apparently simple (such as walking, sit and stand up from a chair) can become risky and difficult to undertake. Consequently, this contributes to the failure to undertake ADLs, inducing a hypokinetic routine, and a vicious circle, which becomes a factor for falls. About 43% of nursing home residents fall at least once a year.[8]

The use of tools to screening the risk of falling is useful in identifying older adults who need intervention to prevent future falls. Karuka et al analyzed the correlation between the Functional Reach Test (FRT), the Berg Balance Scale (BBS), the Timed Up and Go (TUG) and the Performance-Oriented Mobility Assessment of Balance (POMA) in the community-dwelling elderly and concluded that it is reasonable to use these instruments together to obtain a better assessment of the balance of these elderly people.[9] In an another study, Persad et al reviewed a sample of available fall assessment approaches targeted at elderly residents in the community, ranging from simple questionnaires to more functional assessments and concluded that of the tests include in the review, many of the approaches were similarly effective in discriminating fallers from non-fallers and predicting future falls.[10]

Tiedemann et al examined the comparative ability and clinical utility of eight mobility tests for predicting multiple falls in older community-dwelling people and conclued that the sit-to-stand test with five repetitions, the alternate-step test and the six-metre-walk test were the best tests based on feasibility and predictive validity.[11]

Borowicz et al studied which balance test for older adults generates the most reliable results in terms of fall risk assessmentin nursing home residents. The authors concluded that the TUG and POMA were the most useful screening tests for balance and gait impairment in these patients and that two or more tests should be performed for more precise assessment of the risk of falling.[12] In the studies cited above, only community-dwelling elderly were evaluated, but there is a gap in studies assessing which tests have good agreement to assess the balance in institutionalized older people.

Thus, the objectives of this paper was to analyze the correlation between the tests used to assess the body balance in the elderly living in the nursing homes.

## Materials and methods

This was an observational study, with a transversal design. The data were collected between August 2016 and June 2017, in three NHs of Marília, São Paulo, Brazil.

Written informed consent was obtained from all patients before enrollment. The study was approved by the Research Ethics Committee of the Faculty of Philosophy and Sciences (UNESP), Marília, São Paulo, Brazil, and was conducted in accordance with Resolution No. 196/96 of the National Health Council (Protocol 1.779.430).

Of the 192 elderly people living in the three Nursing Home Institutions, 45 were included due the eligibility criteria (Figure 1).

### Inclusion and exclusion criteria in sample

Eligibility criteria: were excluded subjects with neurological or musculoskeletal disorders or pain that interfered with their daily activities, with lower extremity joint replacement, with orthostatic postural hypotension, with abnormal scores on the Mini-Mental State Examination according to the educational level and bedridden elderly.[8]

The cognitive status was evaluated by Mini Mental State Examination (MMSE), with the following cutoffs: 20 for illiterates; 25 for schooling level of 1 to 4 years; 26.5 for 5 to 8 years; 28 for 9 to 11 years; and 29 for higher levels of education.[13]

### Procedures for evaluating postural balance

The balance was evaluated using the follow clinical tests: Berg Balance Scale (BBS), Short Physical Performance Battery (SPPB), Timed up and Go (TUG), gait speed by 10 meter walk test, the distance in the Six-minute walk test and Tinetti test. The BBS was translated, adapted and validated for Brazil.[14] and consists of a battery of 14 tasks common to the ADLs, which quantitatively evaluate the risk of falls, through observation undertaken by the examiner. The SPPB is designed to measure functional status and physical performance, assessing walking speed, standing balance, and sit-to-stand performance. The SPPB was translated, adapted and validated for Brazilian Portuguese.[15]

Functional mobility was evaluated with the TUG test,[16] that measures the time it takes a subject to stand up from a chair, walk 3 m, turn around, walk 3 m back, and sit down again in the same chair, all at their normal pace. The 6MWT is the distance walked in a period of 6 minutes. This test was initially considered an endurance measure and developed to patients with lung diseases,[17] but more recently has been considered a broader measure of mobility and function.[18,19]

The Tinetti balance test (Performance Oriented Mobility Assessment II–POMA II), consist of 16 tasks on the balance and gait scales. The maximum score is 28, with a score above 24 points indicating a low risk of falls, a score between 19 and 24 points indicating a moderate risk of falls, and a score below 19 indicating a high risk of falls.[20,21] The questionnaire has been translated and validated for Brazilian Portuguese.[20]

### Statistical analysis

The normality of the distribution of data was evaluated by the Shapiro–Wilk test. Pearson or Spearman correlation test was performed to analyze the correlation between the balance tools used. All analysis were made using GraphPad Instat software, with $p \leq 0.05$. The following values were used to define the strength of correlation:[22] values between 0.0 and±0.3: negligible correlation; values between±0.3 and ±0.5: weak correlation ; values between ±0.5 and ±0.7: moderate correlation; values between ±0.7 and ±0.9: strong correlation; values between ±0.9 and ±1: very strong correlation

## Results

The mean age of the sample was 76.91±9.07 years (46.67% female); the BMI was 26.76±3.83. The literates were 75.56% of the sample. As for marital status, there were predominance of unmarried (42.22%) and widowed (37.78%).

The Table 1 shows the mean, minimum and maximum values of the applied tests, besides the cutoff reference values. It is possible to observe that in four tests (TUG, distance-6MWT, GS and Tinetti test) the mean values obtained were outside what is considered normal for the elderly population, indicating a moderate or high risk of falling.

Table 2 shows the correlation values between the applied tests. It is possible to observe that there was a correlation between all tests, with statistical significance.[23–27]

**Table 1** Mean, minimum and maximum values of applied tests

| | Cutoff reference values | Mean±DP | Min-Max |
|---|---|---|---|
| SPPB | >6[23] | 7.55±2.92 | 01-Dec |
| BBS | >45[24] | 47.84±7.81 | 20-56 |
| TUG (s) | <12.47 [25] | 15.07±7.17 | 7.12-36.81 |
| GS (m/s) | >1[26] | 0.80±0.28 | 0.09-1.5 |
| Distance 6MWT (m) | >500 [27] | 274.13±100.47 | 76.0-510.0 |
| Tinetti | >24 [21] | 20.66±6.38 | May-28 |

SPPB, short physical performance battery; BBS, berg balance scale; TUG, timed up and go; GS, gait speed; 6MWT, six-minute walk test

**Table 2** Correlation coefficients between the applied tests

| | SPPB | BBS | TUG | GS(10m) | Distance | Tinetti |
|---|---|---|---|---|---|---|
| SPPB | ------ | 0.79* | -0.72* | 0.73* | 0.66* | 0.39h |
| BBS | ------ | ------ | -0.81* | 0.72* | 0.72* | 0.54£ |
| TUG | ------ | ------ | ------ | -0.75* | -0.85* | -0.57* |
| GS (10m) | ------ | ------ | ------ | ------ | 0.80* | 0.52¢ |
| Distance (6MWT) | ------ | ------ | ------ | ------ | ------- | 0.70* |

SPPB, short physical performance battery (não normal); BBS, berg balance scale (não normal); TUG,timed up and Go (não normal); GS, gait speed (normal); 6MWT, six-minute walk test (normal). *P <0.0001; hp, 0.007; £ p, 0.0001; ¢p, 0.0002.

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## Discussion

The present study aimed to investigate the correlation between the instruments to evaluate the postural balance in the elderly living in the nursing homes.

All tests used in the study showed a positive or negative correlation between them, with statistical significance (Table 2). The majority of the statistical evaluations presented a strong correlation between the balance tests: SPPB and BBS, SPPB and TUG, SPPB and gait speed, BBS and TUG, BBS and gait speed, BBS and distance (6MWT), TUG and gait speed, TUG and distance (6MWT), gait speed and distance (6MWT), distance (6MWT) and Tinetti. In four analyzes, were find a moderate correlation: SPPB and distance (6MWT), BBS and Tinetti, TUG and Tinetti, gait speed and Tinetti. In one analyze, was find a weak correlation: SPPB and Tinetti.

Institutionalized older adults have fewer opportunities to participate in daily living activities and tasks in an independent manner, with greater deleterious effects on the physiological losses inherent to aging and with increased gait and balance impairment compared to community-dwelling older adults.[5,28,29] Because of this, institutionalized elderly people are at greater risk of falling. Therefore, it is important to know if the instruments used for the evaluation of postural balance maintain a good correlation for this population.

The results show that the instruments evaluated can be used to assess postural balance and to track the risk of falls, as well as to indicate the elderly who need more attention in nursing homes. Of all tests applied in the study, the least used and researched test for postural balance evaluation is the 6MWT.

The 6MWT is a commonly used physical performance measure in clinical research[19] and their performance has been used as a measure of cardiovascular and respiratory exercise capacity. More recently, it has been recognized that the 6MWT may be a general indicator of overall physical performance and mobility in older people.[18,30] Harada et al reported moderate correlations between 6MWD and mobility measures, including standing balance, chair stands, and gait speed in older people.[18] In our study, the 6MWT showed a moderate correlation with the Tinneti and SPPB test and a strong correlation with the BBS, TUG and gair speed.

All instruments used in the study are low cost and easy to apply, presenting positive and negative characteristics. The choice of which test to apply in the assessment of postural balance depends on some important questions: knowledge of the test, space to perform the test, characteristics of the test, among others. The 6MWT, for example, requires a corridor with a minimum length of 15 meters. On the other hand, the BBS, SPPB and Tinetti tests have a ceiling effect, making it difficult to evaluate people with better physical conditions. TUG test have a problem with the standardization of the chair used, as well as the gait speed during the test.

Another important issue in the choice of evaluation tools is: what characteristics of the postural balance one wants to evaluate. The BBS was developed to evaluate abilities in both static and dynamic balance through the direct observation of three domains: sitting, standing, and changing posture.[24] The TUG measures the time (in seconds) necessary for a person to rise from a chair with armrests, walk 3 m at a comfortable walking speed, turn, return to the chair, and sit down.[16] Poor TUG performance has been associated with low muscle strength, poor balance, slow gait speed, fear of falling, and physical inactivity [31]. Gait speed is measured over a relatively short distance and thus does not include endurance as a factor. A subject's ability to increase or decrease walking speed above or below a "comfortable" pace suggests a potential to adapt to varying environments and task demands. The 6MW is used to measure the maximum distance that a person can walk in 6 minutes and the endurance is include as a factor. SPPB consists of three tasks representing standing balance, walking speed, and repeated chair stands. The Tinetti mobility test (TMT) measures static, dynamic, reactive, and anticipatory balance and of ambulation and transfer ability.[32]

Then, as each test evaluates different items of postural balance, it is important to apply at least two tests to have a broader assessment of this important subject related to the institutionalized elderly.

## Conclusion

The instruments showed a strong or moderate correlation and can be used to evaluate the postural balance in the nursing home residents.

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## Conflicts of interests

Authors declare that there is no conflict of interest

## References

1. http://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2013.pdf
2. Pickard L, Comas HA, Costa-Font J, et al. Modelling an entitlement to long-term care services for older people in Europe: projections for long-term care expenditure to 2050. *J Eur Soc Policy*. 2007 Feb 24;17(1):33–48.
3. de Meijer CAM, Majer IM, Koopmanschap MA, et al. Forecasting lifetime and aggregate long-term care spending: accounting for changing disability patterns. *Med Care*. 2012;50(8):722–729.
4. http://repositorio.ipea.gov.br/bitstream/11058/4962/1/DiscussionPaper_113.pdf
5. https://repositorio.unesp.br/bitstream/handle/11449/150340/faber_lm_me_rcla.pdf?sequence=8&isAllowed=y
6. Nitz JC, Josephson DL. Enhancing functional balance and mobility among older people living in long-term care facilities. *geriatr nurs*. 2011;32(2):106–113.
7. Álvarez BF, del Pozo-Cruz B, del Pozo-Cruz J, et al. Factors associated with the risk of falls of nursing home residents aged 80 or older. *Rehabil Nurs*. 2016;41(1):16–25.
8. Rubenstein LZ, Josephson KR. The epidemiology of falls and sincope. Clin Geriatr Med. 2002;18(2):141–58.
9. Karuka AH, Silva JAMG, Navega MT. Análise da concordância entre instrumentos de avaliação do equilíbrio corporal em idosos. *Rev Bras Fisioter*. 2011;15(6):460–466.
10. Persad C, Cook S, Giordani B. Assessing falls in the elderly: should we use simple screening tests or a comprehensive fall risk evaluation?. *Eur J Phys Rehabil Med*. 2010;46(2):249–259.
11. Tiedemann A, Shimada H, Sherrington C, et al. The comparative ability of eight functional mobility tests for predicting falls in community-dwelling older people. *Age Ageing*. 2008;37(4):430–435.

12. Borowicz A, Zasadzka E, Gaczkowska A, et al. Assessing gait and balance impairment in elderly residents of nursing homes. *J Phys Ther Sci*. 2016;28(9):2486–2490.

13. Brucki SMD, Nitrini R, Caramelli P, et al. Sugestões para o uso do mini-exame do estado mental no Brasil. *Arq Neuropsiquiatr*. 2003;61(3B):777–781.

14. Miyamoto ST, Lombardi JI, Berg KO, et al. Brazilian version of the Berg balance scale. *Brazilian J Med Biol Res*. 2004;37(9):1411–1421.

15. http://repositorio.unicamp.br/bitstream/REPOSIP/252485/1/Nakano_MarciaMariko_M.pdf

16. Podsiadlo D, Richadson S. The timed "Up and Go" test: A test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc*. 1991;39(2):142–148.

17. Guyatt GH, Sullivan MJ, Thompson PJ, et al. The 6-minute walk: A new measure of exercise capacity in patients with chronic heart failure. *Can Med Assoc J*. 1985;132(8):919–921.

18. Harada ND, Chiu V, Stewart AL. Mobility-related function in older adults: assessment with a 6-minute walk test. *Arch Phys Med Rehabil*. 1999;80(7):837–841.

19. Lord SR, Menz HB. Physiologic, psychologic, and health predictors of 6-minute walk performance in older people. *Arch Phys Med Rehabil*. 2002;83(7):907–911.

20. Ishizuka M. Tradução para o português e validação do teste POMA II " Performance-oriented mobility assessment II " Tese apresentada à faculdade de medicina [Internet]. Faculdade de medicina da universidade de São Paulo; 2008.

21. Santana JCS De, Sauaia BA, Soares KVB de C. O perfil postural do idoso asilado e sua relação com o nível de equilíbrio postural. *Rev Pesqui em Saúde*. 2011;12(2):9–12.

22. Hinkle D, Wiersma W, Jurs S. Applied Statistics for the Behavioral Sciences. 5a. Boston: Houghton Mifflin; 2003.

23. Veronese N, Bolzetta F, Toffanello ED, et al. Association between short physical performance battery and falls in older people: the progetto veneto anziani study. *Rejuvenation Res*. 2014;17(3):276–284.

24. Park S, Lee Y. The diagnostic accuracy of the berg balance scale in predicting falls. *West J Nurs Res*. 2017;39(11):1502–1525.

25. Alexandre TS, Mizuta SK. Accuracy of timed up and go t est for screening risk of falls among community-dwelling elderly. 2012;16(5):381–388.

26. Seino S, Yabushita N, Kim M ji, et al. Comparison of a combination of upper extremity performance measures and usual gait speed alone for discriminating upper extremity functional limitation and disability in older women. Arch Gerontol Geriatr. 2012;55(2):486–491.

27. Cataneo D, Kobayasi S, De Carvalho L, et al. Accuracy of six minute walk test , stair test and spirometry using maximal oxygen uptake Acurácia do teste de caminhada de seis minutos , teste de escada e espirometria usando o consumo máximo de oxigênio como padrão ouro. *Acta Cirúrgica Bras*. 2010;25(2):194–200.

28. da Silva Borges EG, de Souza Vale RG, Cader SA, et al. Postural balance and falls in elderly nursing home residents enrolled in a ballroom dancing program. *Arch Gerontol Geriatr*. 2014;59(2):312–316.

29. Pereira C, Baptista F, Cruz FA. Role of physical activity, physical fitness, and chronic health conditions on the physical independence of community-dwelling older adults over a 5-year period. *Arch Gerontol Geriatr*. 2016;65:45–53.

30. Duncan PW, Chandler J, Studenski S, et al. How do physiological components of balance affect mobility in elderly men?. *Arch Phys Med Rehabil*. 1993;74(12):1343–1349.

31. Takahashi T, Ishida K, Yamamoto H, et al. Modification of the functional reach test: Analysis of lateral and anterior functional reach in community-dwelling older people. *Arch Gerontol Geriatr*. 2006;42(2):167–173.

32. Curcio F, Basile C, Liguori I, et al. Tinetti mobility test is related to muscle mass and strength in non-institutionalized elderly people. Age (Omaha). 2016;38(5–6):525–533.

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