



ISB 2013  
BRAZIL

XXIV CONGRESS OF THE INTERNATIONAL  
SOCIETY OF BIOMECHANICS

XV BRAZILIAN CONGRESS  
OF BIOMECHANICS

## COMPARISON OF DIFFERENT METHODS FOR BALANCE ASSESSMENT IN ELDERLIES INSTITUTIONALIZED IN A HOME FOR THE AGED

<sup>1,3</sup>Gabriel Espinosa, <sup>2,3</sup>Wagner Oliveira Batista, <sup>3,4</sup>Flávia Porto, <sup>1,2</sup>Edmundo Alves Junior, <sup>3</sup>Ricardo Braga and <sup>1,2,3</sup>Jonas Gurgel

<sup>1</sup>Multiprofessional Residency on Healthcare - Antonio Pedro University Hospital - Niterói - RJ - Brazil; <sup>2</sup>Post Graduation Program on Science of Care in Health - Nursing School of the Federal Fluminense University, UFF - Niterói - RJ - Brazil;

<sup>3</sup>Biomechanics Research Group, Institute of Physical Education, Fluminense Federal University, UFF, Niterói/ RJ, Brazil;

<sup>4</sup>Stricto Sensu Post Graduation in Exercise Science and Sports, Gama Filho University, UGF, Rio de Janeiro/RJ, Brazil.

email: gabrielespinosadasilva@gmail.com.

### SUMMARY

This study was realized in order to verify the association between functional tests for balance assessment and the stabilometric method in institutionalized elderly. It was found out a negative strong correlation between the stabilometric test and the Berg balance Scale. The results suggest this functional test as a valid instrument to assess the balance in this population.

### INTRODUCTION

The postural control is markedly decreased with aging. This capacity is physiologically maintained by the action of different systems and resources: biomechanical constraints (degrees of freedom, strength, limits of stability); movement strategies (reactive, anticipatory, voluntary); sensory strategies (sensory integration, sensory reweighting); spatial orientation (perception, gravity, surfaces, vision and verticality); control of dynamics (gait, proactive); and cognitive processing (attention, learning) [1]. Impairment in some of these systems drastically affects balance and postural control. Thereby raising the risk of falls within the elderly [1,2,3].

This context shows us how valuable is to assess balance in the aged for predicting risk of falls. Nevertheless, valid assessment advices are so expensive and not feasible on public healthcare system. Therefore, it is crucial to create feasible technologies that can be used for providers in public healthcare.

This study aimed to compare three different methods for balance assessment: i) Opened eyes stabilometric test on the force plate; ii) Closed eyes stabilometric test on the force plate; iii) The Berg Balance Scale (BBS) [4]; and iv) Get Up and Go test (TUG) [5].

### METHODS

All subjects of this study live in a home for aged. From a total of 96 aged institutionalized, 27 subjects were eligible to take part in this study. Nevertheless, 4 of them were lost during the study (1 death; 2 bed resting and 1 returned for the family). The final sample size was composed by 23

elderlies. All participants signed their informed consent and the study had the approval of university ethical committee.

The balance was assessed by three different methods. For the Berg Balance Scale, it was used the Brazilian-Portuguese validated version of the protocol [4]. The test consists in a set of 14 different balance-related daily tasks. Each one classified between 0 and 4 (0 for the worst and 4 for the best performance). The maximal score is 56 that indicate the minor risk of fall. It was adopted the 41 value as a cutoff as suggested by Lajoie and Gallagher [2].

The Get up and Go test was applied as proposed on the original protocol [5]. Volunteers had to get up from a chair, walk 3 meters and then return fast as they could to the starting position, sited on the chair. The time was registered, and 20 seconds was considered as cutoff value.

For the stabilometric tests, it was used a force plate [6]. For the opened eyes test, subjects were requested to stand during 45 seconds at the center of the plate on orthostatic position, barefoot (30° between feet). There was a reference marked point 2.5 meters from the center of the plate on the wall to keep viewing fixed. The closed eye test was performed at same position of the previous test. For signal acquisition, it was used an A/D converter (DataQ, National Instruments) with a 14 bits resolution and a voltage range of  $\pm 5$  Volts. The sampling frequency adopted was 100Hz. The signal was processed and analyzed in a computer through the software LabVIEW (National instruments, 2012, for windows) and MATLAB (MathWorks, R2012a, for windows) respectively. After processing of the signal, the statokinesigram was analyzed considering the Elliptical Area as 95% (1.96 standard deviation of x and y axis) according to Collins and De Luca [7].

For the statistical analyses, firstly Shapiro-Wilk test was applied for verification of data's normality, after that the correlations between the 4 methods of balance assessment were determined. Regarding most of the variables shows non parametric distribution (only age and berg balance scale had a parametric distribution) Spearman's correlation test was applied. The significance level was set at  $\alpha=0.05$ .

Data was analyzed using statistical software (SPSS Statistics v.2.1 for Windows).

## RESULTS AND DISCUSSION

Descriptive data of the studied sample and results of the Shapiro-Wilk tests can be seen in the table 1.

The results of Spearman correlation are shown on table 2. As expected the Elliptical Area (EA) opened eyes had a significant and strong correlation with closed eyes.

Regarding the relation between stabilometric tests and the functional balance tests, it was found a significant correlation only relating EA – opened eyes and BBS. All other correlations, even BBS and TUG, didn't have significant association.

The strong negative correlation found between EA – Opened eyes and BBS, strengthen the utilization of BBS as a functional balance test in the studied population. Additionally, the validity of BBS was tested (concurrent criterion validity) with stabilometric tests [8]. The Brazilian-Portuguese version, does not have this comparison, it was evaluated just the reproducibility of the Portuguese BBS version [4].

## CONCLUSIONS

There were no significant associations between some of the variables. The negative correlation between the elliptical area in the opened eyes test and the Berg balance Scale, suggests that the BBS appears to be a valid instrument for balance assessment in elderlies institutionalized in home for the aged in Brazil. Furthermore, regarding the low costs and the no need of sophisticate resources for the BBS test, this is a feasible method to be used.

## REFERENCES

1. Horak FB. *Age and Ageing*, v.35, suppl.2, p. ii7-ii10, 2006 Mathias S.; Nayak. USL. *Arch Phys Med Rehabil.* 67:387-389, 1986.
2. Lajoie Y.; Gallagher SP. *Arch. Gerontol. Geriatr.*, v.38: n.1, p.11–26, 2004.
3. Woollacott MH., Shumway-Cook A., *Physical Therapy*, v.70, n.12, 1990
4. Miyamoto ST. et al. *Braz J Med Biol Res.* v. 37, n.9 p.1411-1421, 2004.
5. Mathias S.; Nayak USL. *Arch Phys Med Rehabil*, v.67, p.387-389, 1986
6. Alvarenga. et al. *Portuguese Journal of Sport Science.* Porto. v.11: suppl. 2, p. 961-964. 2011.
7. Collins JJ., De Luca CJ. *Exp Brain Res.* v.95, p. 308-18, 1993.
8. Berg K. et al. *Canadian Journal of Public Health*, v. 83, Suppl. 2, p. S7-S11, 1992.

## ACKNOWLEDGEMENTS

This study was partially supported by Capes, FAPERJ and CNPq.

**Table 1:** Descriptive data of the sample and normality test results.

Variables	n	Mean	Standard Deviation	Median	Interquartile range	Shapiro-Wilk test (p)
Length of Institutionalization(months)	23	74.17	58.58	65.00	81.00	0.027
Age (years)	23	74.82	6.70	76.00	11.00	0.289*
Body Mass Index (kg/m <sup>2</sup> )	23	23.78	5.33	22.71	7.16	0.062
EA - Opened Eye (cm <sup>2</sup> )	23	15.30	10.32	13.12	12.90	0.067
EA - Closed Eye (cm <sup>2</sup> )	23	14.31	11.86	11.84	14.30	0.008
Berg Balance Scale (score)	23	38.43	8.27	39.00	12.00	0.479*
Get-up and Go test (s)	23	24.90	13.40	21.00	16.56	0.001

\*Nom parametric distribution; EA= Elliptical Area; p=significance level ( $\leq 0.05$ )

**Table 2:** Matrix of correlation tests between de methods for balance assessment in elderlies institutionalized in a home for the aged.

Tests (n=23)	EA Opened Eye		EA Closed Eye		Berg Balance Scale		Get-up and Go test	
	( $\rho$ )	(p)	( $\rho$ )	(p)	( $\rho$ )	(p)	( $\rho$ )	(p)
EA - Opened Eye	1	---						
EA - Closed Eye	0.698	0.0002*	1	---				
Berg Balance Scale	0.392	0.05*	0.295	0.71	1	---		
Get-up and Go test	0.208	0.34	0.178	0.41	-0.647	0.0008*	1	---

EA= Elliptical Area;  $\rho$ = Spearman correlation coefficient; p=significance level ( $\leq 0.05$ )