



ISB 2013  
BRAZIL

XXIV CONGRESS OF THE INTERNATIONAL  
SOCIETY OF BIOMECHANICS

XV BRAZILIAN CONGRESS  
OF BIOMECHANICS

## POSTURAL CONTROL IN HEALTHY ELDERLY CHALLENGED BY DUAL-TASK

<sup>1</sup>Luiz Fernando Cuozzo Lemos, <sup>2</sup>Joane Severo Ribeiro and <sup>3</sup>Carlos Bolli Mota

<sup>1</sup>Federal University of Rio Grande do Sul; luizcanoagem@yahoo.com.br, web: www.ufsm.br/labiomec

<sup>2</sup>Federal University of Health Sciences of Porto Alegre

<sup>3</sup>Federal University of Santa Maria

### SUMMARY

This study aimed to evaluate the postural control of elderly people tested by dual-task (DT). The posture control was obtained by the oscillation of the center of mass, which was obtained by kinematics. The findings showed that elderly people had a higher body oscillations during all tests of DT compared to single task.

### INTRODUCTION

Human aging is marked by decreased functioning of various body systems [1]. Among these, the postural control system also undergoes changes with advancing of the age, enabling higher rates of falls for the elderly [1]. Therefore, the cognitive impairment is pointed as the main cause of imbalances, and recent evidence shows that the difficulty of allocating attention during the balance is a strong predictor of falls in this population [2]. The cerebral cortex works in managing concurrent tasks (postural control and cognitive demand) and, there's the possibility it co-ordinate a center of decisions between tasks [3]. Thus, recent studies are using adjacent tasks coupled with postural control, to seek a greater understanding of the behavior of the postural balance when is altered the cognitive demand, and this kind of challenge is called dual-task (DT) [1,4,5]. Therefore, this type of study in the elderly can provide important findings for this population, providing a better quality of life and thus acting as a preventive for maintaining the health of the elderly. Therefore, this study aimed to assess the postural control in healthy elderly in simple and dual-task.

### METHODS

The non-random sample was selected from an elderly community and was characterized as a convenience sample. The elderly were classified as active [6]. The sample size was calculated based on previous studies carried out. Study participants were 35 elderly individuals of both sexes (range: 65-70 years old), including 17 men and 18 women (age:  $67.11 \pm 2.04$ ; mass:  $75.99 \pm 14.70$ ; height:  $1.64 \pm 0.09$ ). Postural control was assessed by the displacement of the body center of mass (CM) with a fixed base of support. The CM values were obtained by VICON system (model 624, Oxford, UK), with VICON NEXUS 1.5.2 software to data record and process. Seven TX cameras with acquisition frequency of 100 Hz were used to recognize 39 reflexive markers (14 mm of diameter) placed on anatomic points of subject body, used to calculate the CM for each frame. The

markers position followed PluginGait (UPA & FRM) model. Only the data from CM projected on the floor were used, ignoring vertical oscillations. The variables analyzed were CM range of movement in anteroposterior (CM<sub>ap</sub>) and mediolateral (CM<sub>ml</sub>) axis, obtained by the difference between maximum and minimum values reached by CM on each direction, mean velocity of CM (CM<sub>vm</sub>), obtained by dividing total CM displacement by trial time duration; and sway area (CM<sub>sa</sub>) that is the area of the 95% confidence ellipse. It was also rated the postural control in simple task with opened eyes (OE) and closed eyes (CE). During all tests, subjects remained in an upright position with arms along the body (holding a laser pen or not), bare feet over a sheet where its position was marked and repeated once more for each condition. The average of two trials for each condition were used.

The DT test consisted in follow a moving circle in a projection in the wall in horizontal and circular tasks. The wall was 3.94 m away from the position where the individual stood and the projection had the following dimensions: 1.98 m long, 1.50 m in height, and this image was divided into 20 rectangles by 20 with 10 cm long by 7 cm in height; the circle has 14.5 cm diameter which had different initial heights. In horizontal tasks the test starts with the circle at an initial height of 1.39 m from the floor and in circular tasks at 1.89 m. There were four tasks, called right horizontal task (RHT), left horizontal task (LHT), right circular task (RCT) and left circular task (LCT). Individuals should hold in their hand a laser pen (corresponding to the side of the test: left or right) and the laser focus should follow the movement of the circle on the projection. The duration of each test was 30 seconds. More information about the test and to download the same information site of our Laboratory in the session "downloads".

Descriptive statistics was used. Data normality was verified by Shapiro-Wilk's test and variance homogeneity by Levene test. One-Way ANOVA was used for comparison between conditions OE, CE, RHT, LHT, RCT and LCT (the data was grouped according to the laterality of individuals). To check differences Tukey post-hoc test was used. The significance level was 5%.

### RESULTS AND DISCUSSION

The results of postural control in simple task and DT can be seen in Table 1. It is important to note that comparisons

were performed by observing the handedness of individuals and that all variables showed significant differences.

The lower values of body sway were always obtained during simple tasks. The elderly oscillated always more in the four tests of DT than in both simple task tested, however, it should be noted that the values of CMap and CMvm only were similar to the single task without the use of vision. Some authors expose that DT tests may negatively alter the values of postural control because they can cause a cognitive competition [5,7]. Therefore, our findings show that the adjacent tests used were able to such change differently for each test.

Thus, when analyzing the type of test used (horizontal or circular) was possible to see that it influenced the characteristics of the findings. Overall, the circular tasks were more challenged in direction anteroposterior and the horizontal tasks were more challenged in direction mediolateral. This seems reasonably expected, because the demand of attention given to test causes the individuals, even wanting to maintain optimal postural control, move up more in the direction of the projection, as seen in the findings.

When analyzed the handedness it was observed that neither the circular nor the horizontal tests showed differences in the findings. Thus, this assay may not be sensitive enough to determine data based on postural control handedness. To evaluate these kinds of issues will be interesting in future studies to quantify the error values obtained by laser (number of times and number of rectangles outside the circle in motion).

Finally, an important point is the fact that there was no statistical difference between simple tasks with and without the use of vision. With the use of vision the individuals had higher sensory information than without, providing lower values of oscillation [1]. These findings may be related to the fact that the sample in this study is composed of active elderly people, so they are better able to maintain their postural control even in the absence of vision.

## CONCLUSIONS

**Table 1:** Variables obtained from the center of mass (CM): CMap = displacement amplitude of the CM in anteroposterior direction; CMml = displacement amplitude of the CM in the mediolateral direction; CMvm = average velocity of the CM; CMsa = sway area

Variables		OE	CE	HSP	HSNP	CSP	CSNP	p-value
<b>CMap (cm)</b>	<b>Mean</b>	1,66 <sup>a</sup>	1,68 <sup>ab</sup>	1,86 <sup>ab</sup>	1,89 <sup>ab</sup>	2,15 <sup>b</sup>	2,11 <sup>ab</sup>	0,014*
	<b>SD</b>	0,67	0,62	1,39	0,68	1,48	0,86	
<b>CMml (cm)</b>	<b>Mean</b>	0,77 <sup>a</sup>	0,77 <sup>a</sup>	2,73 <sup>d</sup>	2,64 <sup>cd</sup>	1,95 <sup>bc</sup>	1,68 <sup>b</sup>	<0,001*
	<b>SD</b>	0,38	0,35	2,34	1,76	1,94	0,88	
<b>CMvm (cm/s)</b>	<b>Mean</b>	0,31 <sup>a</sup>	0,37 <sup>ab</sup>	0,41 <sup>b</sup>	0,40 <sup>b</sup>	0,39 <sup>b</sup>	0,38 <sup>ab</sup>	0,003*
	<b>SD</b>	0,08	0,11	0,19	0,15	0,19	0,12	
<b>CMsa (cm<sup>2</sup>)</b>	<b>Mean</b>	1,37 <sup>a</sup>	1,27 <sup>a</sup>	6,34 <sup>b</sup>	7,04 <sup>b</sup>	4,96 <sup>b</sup>	4,71 <sup>b</sup>	<0,001*
	<b>SD</b>	1,17	1,06	7,20	7,22	5,07	4,61	

\* Indicate statistical difference (<sup>a,b,c and d</sup> indicates the different); OE = Open eyes in simple task; EC = Close eye in simple task; HSP = Horizontal task in preference side; HSNP = Horizontal task in non-preference side, CSP = Circular task in preference side; CSNP = Circular task in non-preference side, SD = Standard Deviation.

The findings showed that active elderly person when challenged by DT tests of additional cognitive demand have worse postural control in that simple task. Furthermore, they had no differences during simple tasks with eyes open and closed. Nor did the DT test show the difference between the left or right hand.

## ACKNOWLEDGEMENTS

The authors specially thank CAPES. We also acknowledge Prof. Mateus Corrêa Silveira, DDS, Renata Schlesner de Oliveira, and Prof. Daniel Pozzobon for their help in data collection and analysis. Furthermore, we also gratefully acknowledge all subjects who participated in this research and made this project possible.

## REFERENCES

- Berger I, Bernard-Demanze L. Age-related effects of a memorizing spatial task in the adults and elderly postural control. *Gait Posture*. 33:300–302, 2011.
- Guideline for the prevention of falls in older persons. American Geriatrics Society, British Geriatrics Society, and American Academy of Orthopaedic Surgeons Panel on Falls Prevention. *J Am Geriatr Soc*. 49(5):664-672, 2001.
- Makoshi ZZ, et al. Human supplementary motor area contribution to predictive motor planning. *J Mot Behav*. 43(4):303-9 2011.
- Teel EF et al. Balance and cognitive performance during a dual-task: Preliminary implications for use in concussion assessment. *J sci med sport*. In press.
- Hiyamizu M et al. Effects of dual task balance training on dual task performance in elderly people: a randomized controlled trial. *Clin Rehabil*. 26(1) 58–67, 2011.
- American College Of Sports Medicine. ACSM stand position on the appropriate intervention strategies for weight loss and prevention of weight regain for adults. *Med. sci. sports exerc*. 33(12): 2145-56, 2001.
- Huxhold O, et al. Dual-tasking postural control: aging and the effects of cognitive demand in conjunction with focus of attention. *Brain Res Bull*. 69:294–305, 2006.