

## Balance in single- and dual-task in Parkinson's disease

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### Abstract

Currently, there is still very little information regarding balance disturbances in Parkinson's disease. Thus, this study aimed to verify the differences between balance in single and dual-task in individuals with Parkinson's disease.

50 individuals, with Parkinson's disease were assessed through a pressure platform, which acquired the displacement and velocity of the centre of pressure.

It was possible to conclude that there are significant differences ( $p < 0.05$ ) in balance between the single- and dual-task.

**Author Keywords.** Centre of pressure; UPDRS - III; verbal fluency tasks; statistical analyze.

### 1. Introduction

Parkinson's disease (PD) is a chronic, progressive and neurodegenerative disorder affecting over 4 million people worldwide (Brauer et al. 2011, Matinolli 2009, Murphy and Tickle-Degnen 2001). Postural stability and, therefore, balance control are essential components of any locomotion system, being defined as the ability to maintain the body's centre of gravity over the body's support base while standing statically or moving. Individuals with PD face a number of mobility deficits, including difficulties in transfers, walking, posture and balance (Kara et al. 2012). It naturally happens that their centre of gravity is shifted to a more posterior position, in order to compensate for the postural deformities they acquire, associated with a tendency of leaning forward (Matinolli 2009).

Furthermore, it has been stated that gait and balance become more deteriorated in these individuals with PD when they are simultaneously performing a second task (Brauer et al. 2011, Brauer and Morris 2010). Several studies have shown these individuals have serious difficulties in processing simultaneous or sequential tasks adequately. Usually, they prioritize cognitive tasks over motor tasks, which leads to a series of issues in the individuals' daily lives (Matinolli 2009). The number of falls tends to increase, just as the patients' dependency of others, leading to a poor self concept, self esteem and quality of life (Brauer et al. 2011, Kara et al. 2012, Kelly, Eusterbrock, and Shumway-Cook 2012).

The aim of this study was to investigate the difficulties in balance, in single- (standing only) and dual-task (standing + cognitive task) in individuals with PD.

## 2. Materials and Methods

A non-probability sample of 50 individuals with PD, aged 50 years old or more was used. The data collection was carried in the Hospital Center between Douro and Vouga, EPE, Santa Maria da Feira, Portugal, being the purposes and procedures of the study clarified to every patient, who signed a declaration of informed consent, according to the Helsinki Declaration and guaranteeing anonymity and confidentiality, if they were willing to participate in the study. Every assessment was performed individually, with the administration of the sociodemographic questionnaire, the UPDRS - III, and the balance, through a pressure platform.

The balance under single-task condition was assessed in two situations: with eyes open (EO) and with eyes closed (EC). In dual-task condition, the participants were asked to execute EO while performing verbal fluency tasks: 1) A semantic fluency when individuals had to enunciate the name of as many species of animals (ANI) as possible; and 2) A phonemic fluency when individuals had to enunciate as many words as possible beginning with the letter R (WR) (Cavaco et al. 2013). The order of each test changed randomly, from individual to individual, in order to avoid a learning effect and fatigue. The centre of pressure (CoP) based parameters were further analyzed considering the most stable 30-second period of each test. For the statistical analyze, Predictive Analytics Software (PASW) was used. Paired samples t test was used to verify if there were significant differences between the balance in single- and dual-task.

## 3. Discussion

The PD sample comprised 50 subjects (62% male), with a mean age of 68.3 years old (SD=7.3) and a mean education of 5.2 years (SD=3.9). Most participants were classified in stage 2 of the the Hoehn and Yahr scale, and had a mean UPDRS score of 19.1 (SD=7.9). The information about the sample under study is shown in Table 1.

**Table 1.** Sociodemographic features of the participants. ( $p < 0.05$ )

		<b>M (SD)</b>	<b>Min-Max</b>
Age		68.3 (7.3)	51-83
Level of Education (years)		5.2 (3.9)	0-22
Height (cm)		165.0 (8.5)	145-183
Weight (Kg)		72.8 (13.0)	41-104
Body Mass Index		26.7 (4.2)	18.2-37.4
MMSE		27.0 (1.9)	23-30
		<b>Frequency</b>	<b>Percent</b>
Gender	Female	19	38
	Male	31	62
Walking Aids	Yes	7	14
	No	43	86

A clear distinction in terms of performance was found between the tasks, being the CoP oscillation was significantly different in single-task condition with eyes open relatively to the remaining tests, Table 2. The greatest difficulty in maintaining the balance with eyes closed has been seen in other study (Fernandes et al. in Press) and can be explained by the fact that with increasing age and the consequent sensory losses, individuals tend to rely more on their vision to control their balance (Targino et al. 2012, Ricci, Gazzola, and Coimbra 2009). Thus, when the individuals had to perform a task without using their vision, they instantly showed increased instability, the same happen when they had to cope with a second task. The difficulties in performed dual-task compared with single-task with eyes open, may be explained by the serious difficulties of individuals with PD in processing simultaneous or

sequential tasks adequately (Matinolli 2009). In fact, when two tasks are performed at the same time, competition for the limited resources results in dual-task interference and deterioration in the performance of one or both tasks (Kelly, Eusterbrock, and Shumway-Cook 2012).

Recently, studies have shown that individuals with PD can more easily generate words from a certain letter of the alphabet, than generate words belonging to a semantic category (Kara et al. 2012, Brauer and Morris 2010). These two tasks activate distinct parts of the brain and represent a different level of complexity for different people (Brauer and Morris 2010). However, there is a gap with regard to the objective assessment of balance during these tasks, as well as evaluations in the early stages of PD. Here, no significant differences were found between the dual-task conditions phonetic task and semantic task.

**Table 2.** Values for single- and dual-task in every component ( $p < 0.05$ ), for individuals with PD.

		<i>M (SD)</i>	<i>T</i>	<i>Df</i>	<i>Sig.</i>
Mediolateral Displacement	EO/EC	-0.273 (0.953)	-3.008	109	<b>0.003*</b>
	EO/ANI	-0.612 (1.970)	-3.008	109	<b>0.002*</b>
	EO/WR	-0.605 (1.978)	-3.210	109	<b>0.002*</b>
	OC/ANI	-0.339 (2.202)	-1.613	109	0.110
	OC/WR	-0.332 (2.228)	-1.564	109	0.121
	ANI/WR	0.006 (1.007)	0.068	109	0.946
Anteroposterior Displacement	EO/EC	-0.387 (0.879)	-4.614	109	<b>0.000*</b>
	EO/ANI	-0.385 (1.617)	-2.498	109	<b>0.014*</b>
	EO/WR	-0.232 (1.388)	-1.758	109	0.082
	OC/ANI	0.002 (1.689)	0.010	109	0.992
	OC/WR	0.154 (1.400)	1.153	109	0.251
	ANI/WR	0.152 (0.969)	1.650	109	0.102
Total Velocity	EO/EC	-0.279 (0.351)	-8.335	109	<b>0.000*</b>
	EO/ANI	-0.373 (0.961)	-4.067	109	<b>0.000*</b>
	EO/WR	-0.328 (0.994)	-3.458	109	<b>0.001*</b>
	OC/ANI	-0.943 (1.064)	-0.929	109	0.355
	OC/WR	-0.489 (1.088)	-0.471	109	0.638
	ANI/WR	0.045 (0.329)	1.448	109	0.151

\*The values in bold correspond to the variables that present significant differences.

#### 4. Conclusions

The present study showed that the balance of individuals with PD is worse in dual-task condition or when perform a task with the eyes closed. This evidence should provide some guidance for further studies and for the planning of therapeutic interventions, with the aim to improve the functional performance of individuals with PD and delay the oncoming of further disabilities.

Future studies should focus on how different cognitive tasks affect the balance, as well as to further investigate the relationship between the single task condition with eyes closed and the remaining single- and dual-task conditions, in PD.

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