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Dual Task Cost of Motor and Cognitive Performance in Individuals with Parkinson's Disease

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Dual Task cost of motor and cognitive performance in Individuals with Parkinson's Disease: A pilot study

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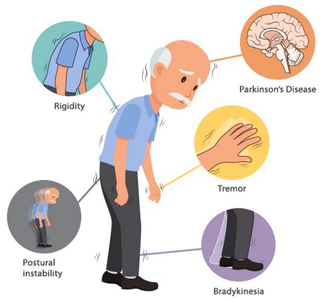
Introduction

Parkinson's Disease (PD) is the second most common neurodegenerative condition leading to motor, non-motor, and cognitive changes.

Hallmarks of the disease process include the following:

- Cardinal changes include tremors, rigidity, akinesia & postural instability
- Changes in motor performance may lead to frequent falls
- Cognitive decline causes problems with problem solving and navigating surrounding environment
- Ability to react to environmental changes decline



Bhatia, Manvir; 2021. Neurologysleepcenter.com

Falls among older adults often occur during dual-task conditions, with performance exacerbated among individuals with PD. Understanding dual-task performance under walking and standing conditions might elucidate these motor and/or cognitive deficits.

Purpose

The purpose of this study was to compare motor performance while walking at a self-selected comfortable speed versus walking with a verbal fluency task (dual task): Gait speed vs Movement of Center of Mass (CoM); and comparing cognitive performance: Reaction time vs Accuracy.

The researchers hypothesized that (1) dual task walking conditions will be associated with slower gait speed, in comparison to single-task walking, and (2) verbal fluency tasks performed in sitting will yield faster and more accurate response rates than walking verbal fluency tasks.

Participants

Participants Inclusion Criteria

* Adults with Parkinson's Disease between stages 1-3 on Hoehn and Yahr
* Able to walk at least 10 meters without assistance
* Excluded if any lower extremity amputation, visual impairment not correctable with lenses, or persistent dizziness or lightheadedness

	Average
Age	73.6 ±7 yrs
Gender (M/F)	11/8
# of Falls	4.58
# of Medications	6.47

Methods

Experimental Design

* Gait task: walking at slow, comfortable, fast speeds
* Verbal fluency task: under three conditions: sitting, standing, and walking, participants are asked to say as many words as they could that start with F, A, and S
* Single task: sitting cognitive; quiet standing, and walking
* Dual task: standing and responding to verbal fluency; walking and responding to verbal fluency

Data Collection

- Vicon Plug-In Gait Model, with 12-camera system collected marker trajectories.
- 39 retro-reflective markers were placed on bony landmarks of their body

Statistical Analysis

- Paired Wilcoxon signed rank test was run in SPSS 24 to identify the difference between two paired samples.

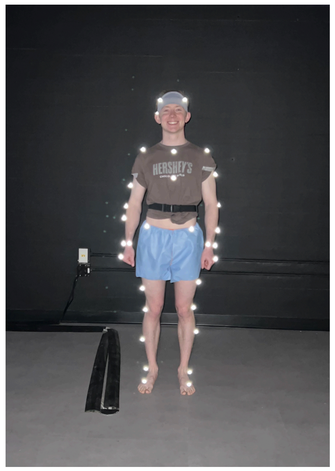


Fig. 1: Eric Matson models the 39 retro-reflective markers

*Gait speed – speed of walking during the normal walking condition
*Center of Mass – the point where whole body mass is concentrated
*Accuracy – during the verbal task, how many times participant made a mistake
* Reaction time –the delay between the instruction and the initiation of the task

Results

Table 2: Motor performance, comparison of normal walking and dual task conditions

	Normal Walking	Dual Task Walking	P- value (0.05)
Gait Speed (m/s)	0.87	0.57	**0.0003**
CoM-V (m/s)	0.034	0.039	**0.00758**
CoM- ML (m/s)	0.224	0.220	0.90448
CoM- AP (m/s)	5.81	6.01	0.4354

Table 3: Cognitive performance, comparison of normal walking and dual task conditions

	Sitting	Dual Task Walking	P- value (0.05)
Accuracy (%)	93	89.621	0.1362
Reaction Time (s)	2832	2336.001	0.4065

Discussion

- The results indicate that although reaction time was lower in dual tasks (Z= -0.8273, P= 0.4065), the accuracy of the task and the number of words produced during the task were higher in sitting conditions (Z= -1.4905, P= 0.1362).
- Additionally, the overall accuracy of the task was better in single task condition, however this is not significant.
- These results indicate that in individuals with PD, the accuracy and quantity of responses decrease, which may jeopardize their ability to safely and effectively perform complex tasks.
- Gait speed is significantly reduced in dual task conditions as opposed to single task, which signifies requirement of additional attentional focus during everyday activities in individuals with PD, making them more vulnerable to falls.
- CoM movement in the vertical direction is significantly different between the dual task and single task conditions, again demonstrating that complexity of task cam cause problems with gait in PD.
- This study allows for a better understanding of the impact that dual-tasking has on individuals with PD. Findings could help create rehabilitation. strategies for patients as they navigate day-to-day activities and aid in assessing individual dual-task costs. Understanding both the cognitive and balance (center of mass) dual-task costs can provide additional information and allow for improved rehabilitation strategies.

Conclusion

- Gait speed significantly decreases with dual task, which may lead to postural changes, and ultimately falls.
- The accuracy of dual task significantly decreases as evidenced by increased number of inaccurate answers, leading to confusion and decreased quality of life.
- The reaction time does not show any significant changes between a single task and a dual task trials.

Clinical Relevance

*The results of the present study demonstrates the dual tasking is affected during both motor as well as cognitive performance.

*Clinicians should take these changes into account, while creating a plan of care for individuals with Parkinson's disease.

References

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