

THE RELATIONSHIP BETWEEN BALANCE AND COGNITION IN PARKINSON'S DISEASE

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INTRODUCTION

Parkinson's disease (PD) has traditionally been designated as a motor disorder characterized by tremor, rigidity, akinesia, and postural instability. However, non-motor symptoms, specifically cognitive impairment, is often concomitant with the disease process further complicating quality of life for the patient [1]. The cognitive deficits demonstrated in PD impact a variety of domains; most notably executive function and working memory.

Recently studies have demonstrated that cognitive impairment may be closely linked to specific subsets of motor symptoms within the clinical spectrum of Parkinson's disease. In particular, motor symptoms not influenced by dopaminergic stimulation, including postural instability, have been associated with accelerated cognitive decline [2]. To date however, studies examining this relationship have relied mainly on subjective motor measures provided by Unified Parkinson's Disease Rating Scale (UPDRS). Unfortunately, clinical measures, such as the UPDRS, frequently used to assess postural stability are too simplistic and fail to capture the essence of postural instability in this population [3]. Therefore, to further understand to impact of motor symptoms on cognitive status, motor function must be objectively quantified. A clear understanding of the relationship between postural instability and cognition is important to not only understanding the disease process itself but also for designing and implementing appropriate interventions.

Therefore, utilizing center of pressure (COP) sway area as a measure of postural instability and standard neuropsychological measures to evaluate cognition, this study investigated the relationship between postural instability and cognition in PD.

METHODS

Twenty individuals with PD participated (age: 63 ± 2 ; Modified Hoehn & Yahr stage of 1 to 3). All biomechanical and neuropsychological testing was performed in the Applied Neuromechanics Laboratory, Center for Exercise Science at the University of Florida, Gainesville, Florida.

Ground reaction forces (GRF) were recorded (360 Hz) from one forceplate (Type 4060-10, Bertec Corp., Columbus, OH) embedded level with the laboratory floor. GRF and moments were then used to calculate the COP.

During quiet stance trials, participants were asked to stand with their feet comfortably apart (a self-selected stance width) with both feet on the adjacent forceplate. Foot positioning was marked on the initial trial and used for all subsequent trials. Participants were asked to stand as still as possible for 20 seconds with their arms comfortably at their side. Participants performed four experimental trials. Trials where voluntary movements were observed were rejected and additional trials were performed.

Once the COP was calculated, the peak displacements in the mediolateral and anteroposterior directions were determined and the COP sway area was calculated.

In a quiet room, standard neuropsychological tasks were utilized to evaluate both executive function and working memory and included:

1. Digit Span backward: Participants recalled an increasingly long string of digits in the reverse order of presentation. Digit backward span is commonly utilized as an evaluation of working memory [4].
2. Color-word Interference Test: Participants say the color in which another color word is printed in (e.g., for BLUE printed in red ink, the answer is

'red'). This is a commonly-used executive function task [4].

3. Letter Verbal Fluency: Participants produce as many words (F, A, or S) as they can that begin with that letter in 60 seconds. This is generally considered a measure of a verbal component of executive function [4].

4. Semantic Verbal Fluency: Participants produce as many words as they can that fit a particular category (animals) in 60 seconds. This is generally considered a measure of a verbal component of executive function [4].

To establish the inter-relationships between the different variables, correlations between COP sway area, digit span backward, color-word interference test, letter verbal fluency, semantic verbal fluency were examined using Pearson product. An alpha level of 0.05 was used for all tests. All analyses were conducted with SPSS (16.0 for Windows, Chicago, IL, USA).

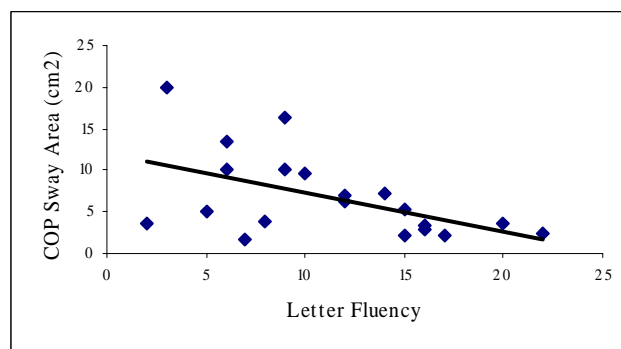
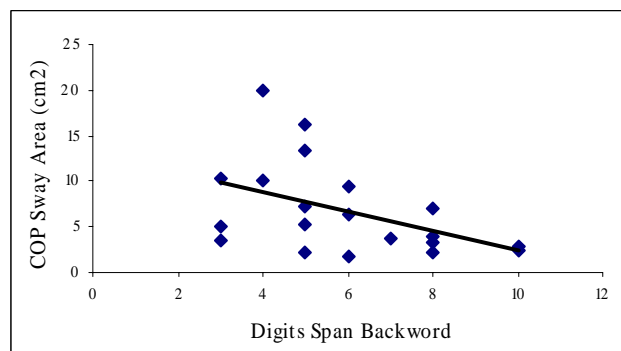
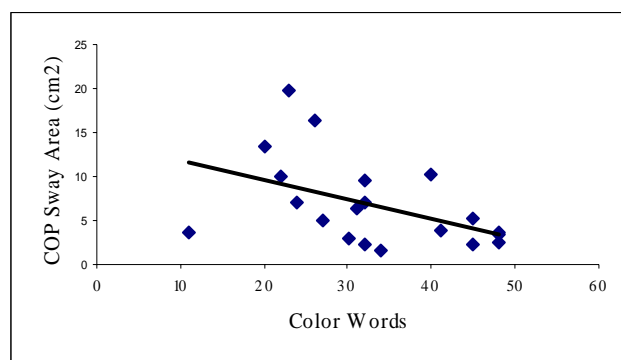
RESULTS AND DISCUSSION

Significant negative correlations were demonstrated between three of the four cognitive measures; digit span backward ($r = -.4601, p < .05$), color-word interference test ($r = -.4602, p < .05$), letter verbal fluency ($r = -.5162, p < .05$), semantic verbal fluency ($r = -.1420, p > .05$).

The results demonstrate that as cognitive scores (executive function and working memory) decrease COP sway area and thus postural instability increases. Similar with previous research, this study suggests that cognitive impairment may correlate with motor severity. For example, Levy et al. found that both bradykinesia and axial symptoms were associated with an increased incidence of dementia [5]. Additionally, Aarsland and colleagues noted that akinesic dominant PD is a risk factor for dementia. Cognitive impairment is common and has devastating implications on the quality of life for patients with PD. Thorough motor examinations may provide insight into those patients that may be at risk for developing dementia and who may be a candidate for early and preventative therapy.

CONCLUSIONS

Results of this study provide further evidence that motor function, specifically postural control may be negatively influenced by cognitive dysfunction in PD.



REFERENCES

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