Motor abilities and driving performance in Parkinson's disease (PD)

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Abstract

Introduction: UPDRS motor scores during the "on" phase have not been consistently associated with the driving performance of patients with Parkinson's disease (PD)

Objective: to explore the capacity of motor tests to predict various driving indexes by applying a driving simulator experiment.

Methods: Inclusion criteria required a valid driver's license, a score ≤ 0.5 on the CDR, and a score ≤ 3 in the Hoehn&Yahr scale. Motor tests included: Rapid Pace Walk, Tandem Walking, and Tandem Walking with Reverse Number Counting.

Results: The Tandem Walking Task showed the strongest correlations with various indexes of driving performance, namely average speed, speed variation, headway variation, wheel position variation, sudden brakes, and speed limit violations.

Conclusion: It appears that sensitive motor measures of balance and movement coordination are useful predictors of driving performance in the PD population.

Background

- The multimodal clinical picture of PD influences negatively aspects of cognition, behavior and motor control that are linked to the capacity of an individual to maintain adequate driving skills.
- Previous research indicates that drivers with PD face more difficulties than controls both on on-road and driving simulator evaluations.
- UPDRS motor scores during the "on" phase, a popular choice in previous driving studies, are not consistently associated with the driving performance of individuals with PD.
- Neuropsychological tests that engage executive, visuospatial and attentional resources appear to be stronger predictors of driving performance than motor measures in PD patients.

Objective

to explore the capacity of various motor tests to predict indexes of driving performance in patients with PD.

Driving Indexes measured were: average speed, speed variation, headway variation, wheel position variation, number of sudden brakes, and number of speed limit violations.

Methods

- Inclusion criteria were the presence of a valid driver's license, regular car driving, a Clinical Dementia Rating (CDR) score ≤ 0.5 and between 1 and 3 in the scale of Hoehn & Yahr.
- Twelve male individuals with PD (Age: Mean=63.75, SD=10.50) and 12 male cognitively intact individuals (Age: Mean=63.50, SD=10.43) participated in the study. Data collection included: a comprehensive neurological/ neuropsychological assessment and a driving simulation experiment.
- Motor tests included: Rapid Pace Walk, Tandem Walking, and Tandem Walking with Reverse Number Counting.

Driving was assessed with a Foerst FPF driving simulator. Patients with PD were all in the ON state.

Phase 1: Practice session (5-10 min.)

Phase 2: Driving session: driving on a two-lane rural road for 20 min. The sudden appearance of animals on the rural road played the role of unexpected incidents during the driving assessment.

Figure. 1 Driving under the rural Condition

Results

Table.1 PD vs Control Group on Motor & Driving Indexes

	PD		Control Group		t-test	
	Mean	SD	Mean	SD	t	p
UPDRS-motor	14.75	7.53	–	–		
Rapid Pace Walk	6.03	1.37	5.01	0.81	2.15	.043*
Tandem Walking	7.45	1.96	5.48	1.23	2.85	.010*
Tandem Walking-RNC	8.72	2.32	6.51	0.73	3.14	.008*
Average Speed	37.13	13.93	46.77	8.25	2.06	.051
Speed Variation	11.49	4.83	13.73	4.60	1.16	.257
Headway Variation	265.44	121.96	181.07	53.57	2.19	.044*
Wheel Position Var.	16.41	3.97	17.87	1.69	1.17	.259
Sudden Brakes	2.08	2.75	2.42	0.79	.40	.609
Speed Violations	0.50	1.17	0.58	1.51	.15	.881

RAPID PACE WAIK

1)PD group: no significant correlations were observed with driving indexes
2)Control group: no significant correlations were observed with driving indexes

TANDEM WALKING

1) PD group: average speed* (r=-.72, p=.008), speed variation* (r=-.72, p=.008), headway variation (r=.59, p=.045), wheel variation* (r=-.60, p=.041), sudden brakes* (r=-.61, p=.037), and speed limit violations* (r=-.64, p=.025).
* : Statistical significance was retained after controlling for general cognitive functioning.
2) Control group: no significant correlations were observed with driving indexes

TANDEM WALKING WITH RNC

1)PD group: speed variation (r=-.60, p=.039), sudden brakes (r=-.57, p=.050)
2)Control group: no significant correlations were observed in the control group.

UPDRS motor

PD group: speed variation (r=-.65, p=.023), wheel variation (r=-.73, p=.008)

Summary

- Based on the present findings, it appears that sensitive motor measures of balance and movement coordination are useful predictors of driving performance in the PD population.
- In the cognitively intact group the same predictors were not contributing to the prediction of driving performance
- The comparison between Tandem Walking and UPDRS more scores shows an advantage of the former measure on predicting driving performance in individuals with PD
- To the best of our knowledge this was the first study that utilized Tandem Walking as a predictor of driving performance in individuals with PD.
- Next steps: (a) evaluation of Tandem Walking on predicting driving performance with the use of multivariate models; (b) exploration of the capacity of Tandem Walking to predict driving performance during on-road driving conditions

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