

Association between motor ability tasks and driving parameters in healthy, patients with mild cognitive impairment (MCI) and mild Alzheimer's disease (AD)

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driver BRAIN

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INTRODUCTION

- In our days, as the percentage of older people is constantly increasing (Baldock et al., 2007), together with the high level of motorization (Yannis et al., 2011), the need for investigating the driving capability in MCI becomes a high priority.
- Although older drivers may adjust-regulate their driving behavior according to environmental demands (Backman and Dixon, 1992) it is not yet clear how MCI drivers self regulate their driving behavior (Okonkwo, 2009). However MCI drivers demonstrate lower driving performance than age matched drivers with no cognitive impairment, but this decline is far from being a frank impairment (Frittelli et al., 2009, Wadley et al., 2010)
- Patients with AD, have been found in several studies to face considerable driving difficulties on on-road evaluations as well as on driving simulator experiments (Frittelli et al., 2009; Hunt et al., 1997; Ott et al., 2008; Uc et al., 2004; Uc et al., 2006).
- Cognitive Impairment does not only lead to cognitive deficits, but also to a decline in physical performance (Blankevoort et al., 2013). In MCI and AD performance in motor tasks that measure stance and gait, is worse than healthy controls (Eggermong et al., 2010). This difference deteriorates in conditions of dual-tasking tests (Muir, 2012)
- Rapid Paced Walk (RPW) is and has been related with driving performance. (Marottoli et al., 1994, Ball et al., 2003). It is currently in use as a screening tool in the evaluation of the driving skills in older drivers in the US (Staplin et al., 2003).
- However, the usefulness of Tandem walking -a motor task of the everyday neurological examination that evaluates gait and balance- has not been studied in drivers with MCI and mild AD.

AIM

The present study investigates the association between motor tasks (Rapid Paced Walk [RPW], Tandem Walking [TW] and Tandem Walking-reverse counting) and driving behavior in a Driving Simulator in patients with aMCI, mild AD and healthy individuals.

METHODS

Participants:

- 45 patients with aMCI
- 45 patients with mild AD
- 38 healthy controls (HC)

The diagnosis of aMCI were made by the Petersen criteria (2004)

The diagnosis of mild AD were made by the McKhann criteria (2011)

Inclusion & Exclusion Criteria

Participants should:

- Have a valid driving license (usage >3 years)
- Be regular drivers (>2500km/year, >10km/week)
- Have a CDR score: for the MCI ≤ 0.5 , for the AD ≤ 1
- Not have any significant motor or visual disorder or psychiatric history of psychosis

Driving Indexes measured:

- Average speed
- Average speed variation
- Lateral Vehicle position
- Lateral position variability
- Headway distance
- Reaction time
- Accident probability



Procedure

(a) All the participants underwent a complete neurological, neuropsychological and ophthalmological assessment.

Motor tests included:

- Rapid Paced Walk 3 meters forward and 3 meters backwards
- Tandem Walking (Time) at 2 meters
- Tandem Walking with Reverse Number Counting (Time) at 2 meters

(b) The participants went through a driving simulator experiment.

Driving was assessed with a Foerst FPF driving simulator.

- Phase 1: Practice session (5-10 min.)
- Phase 2: One driving session (about 20 min.) on a two-lane rural road.

An unexpected incident - sudden appearance of an animal on the rural road. Reaction time refers to the time between the first appearance of the incident on the road and the very first moment the driver starts to brake. Accident Probability refers to the proportion of total crashes to the total number of incidents happened

Demographic and Cognitive characteristics of controls, amnesic MCI and Alzheimer participants

Variables	Controls		aMCI		AD		ANOVA		Post-Hoc
	M	SD	M	SD	M	SD	F	p	
Age	61.7	8.4	69.9	9.6	74.5	7.6	17.5	.000	HC<MCI**, HC<AD**
Education	15.5	3.2	13.1	3.2	16.8	26.3	5.5	.006	
Driving Exp.	35.2	9.2	42.8	9.3	42.6	9.7	49.9	.000	HC<MCI*, HC<AD*
MMSE	29.3	.8	27.6	1.9	22.7	4.2	.69	.50	HC>MCI>AD**



Rapid Paced Walk



Tandem Walking Test



An unexpected incident - sudden appearance of an animal on the rural road.

RESULTS

Table 1. Correlations between RPW, TW, TW-RC in MCI patients

Driving Indexes	MCI patients = 45					
	Rapid Paced Walk		Tandem Walking		Tandem Walking-RC	
	r	p-value	r	p-value	r	p-value
Average speed	-.195	0.284	.116	.526	.086	.644
Average speed variation	-.163	.374	.217	.233	-.143	.442
Lateral position	-.010	.955	.108	.555	.18	.925
Lateral position variation	-.230	.205	-.078	.673	-.144	.439
Head way distance	.169	.356	-.118	.520	-.129	.490
Reaction time	.670	.000**	.370	.037*	.614	.000**
Accident probability	.188	.303	.392	.026*	-.008	.964

Table 2. Correlations between RPW, TW, TW-RC in mild AD patients

Driving Indexes	mild AD patients = 45					
	Rapid Paced Walk		Tandem Walking		Tandem Walking-RC	
	r	p-value	r	p-value	r	p-value
Average speed	-.403	.108	-.403	.109	-.714	.001**
Average speed variation	-.430	.085	-.355	.188	-.571	.017*
Lateral position	-.305	.234	-.352	.166	-.027	.918
Lateral position variation	.064	.808	.096	.715	-.221	.393
Head way distance	.466	.060	.569	.017*	.721	.001**
Reaction time	.262	.309	.201	.440	.434	.082
Accident probability	-.281	.275	.498	.05*	.498	.050*

*p=.05. **p<.001

➤ In the healthy individuals group no correlation was found between RPW, TW, TW-RC and driving indexes

CONCLUSION

- Tandem Walking (time) was strongly correlated with accident probability in all groups, especially in the AD patients in which Rapid Paced Walk (RPW) was not correlated.
- Our findings demonstrate that the aforementioned motor tests are strongly associated with important parameters of driving behavior in patients with MCI and mild AD. These motor tasks can be easily administered in clinical practice and may offer predictive value of driving performance in individuals with MCI and AD.

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