Relationship of neuropsychiatric symptoms of Alzheimer's disease (AD) and driving behavior

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INTRODUCTION

- A significant percentage of patients diagnosed with Alzheimer's disease (AD) continue to drive (Eby et al, 2012).
- According to a wide number of studies, demented drivers show impaired driving behavior (Eby et al, 2012; Uc et al,2006) and are twice as likely to be involved in a car accident as healthy elders (Ott & Daiello, 2010).
- The majority of patients with AD suffer from neuropsychiatric symptoms, even in the early stages of the disease, and more specifically, depression and apathy are considered to be the most frequent symptoms in mild AD (Apostolova et al, 2007; Wadsworth et al, 2012).

OBJECTIVES

The aim of this study is to investigate the relationship of neuropsychiatric symptoms and driving ability in patients with mild AD.

PARTICIPANTS & METHODS

- **23 participants diagnosed with mild AD** (mean age=74.9 years ± SD=7.4, mean driving experience=43.6 years ± SD=10.1)
- **32 healthy individuals** (mean age=64.3 years ± SD=6.9, mean driving experience=38.2 years ± SD=5.9)

Inclusion criteria: a Clinical Dementia Rating (CDR) score <2, the presence of a valid driving license, driving experience more than three years, regular driving.

Phase 1: The participants underwent a detailed neurological and neuropsychological examination
Neuropsychiatric examination: Neuropsychiatric Inventory (NPI), Frontal Behavioral Inventory (FBI), Patient Health Questionnaire (PHQ-9) & Geriatric Depression Scale (GDS).
Phase 2: Driving experiment (after a 10 min practice session) included two conditions: a) rural road with low traffic volume and b) rural road with high traffic volume. Unexpected incidents occured in each driving condition (e.g. sudden appearance of an animal on the road).

•Driving was assessed with a Foerst FPF driving simulator

• Driving indexes: Average speed (km/h), Headway distance (m), Reaction time (sec), Accident probability (%).

RESULTS

Table.1 T test results for comparison between AD and healthy participants' performance in driving parameters

	AD		Controls			
LowTraffic	Mean	Std. Dev.	Mean	Std. Dev.	t	p.
Average Speed	32.90	8.12	41.20	7.73	3.43	0.00
Headway Distance	604.92	190.98	491.73	122.64	2.19	0.04
Reaction Time	2733.50	953.30	1742.19	555.57	3.80	0.00
Accident Prob.	0.25	0.45	0.04	0.19	1.81	0.09
HighTraffic						
Average Speed	33.48	8.68	38.92	6.33	2.54	0.01
Headway Distance	420.72	203.14	277.68	141.26	2.91	0.01
Reaction Time	2816.80	1170.39	2045.27	896.88	2.64	0.01
Accident Prob.	0.25	0.44	0.00	0.00	2.52	0.02

T test analysis showed that in comparison to the control group, patients with AD had a significantly worse performance to almost all the driving parameters.

Table.2 Simple linear regressions between neuropsychiatric symptoms and driving variables for both traffic conditions

	Headway distance				Reaction time				Accident probability			
LowTraffic	R^2	B	F	p	R^2	B	F	p	R^2	B	F	p
Apathy-NPI	0.10	18.75	1.89	0.19	0.34	158.17	8.18	0.01	0.02	0.02	0.36	0.56
Apathy-FBI	0.15	71.94	2.94	0.10	0.24	437.29	5.04	0.04	0.25	0.20	5.46	0.03
Lack of initiative-FBI	0.22	105.71	4.80	0.04	0.19	484.20	3.80	0.07	0.41	0.32	11.18	0.00
Irritability-FBI	0.10	49.89	1.97	0.18	0.09	241.22	1.53	0.23	0.32	0.21	7.52	0.01
Depressive symptoms PHQ-9	0.06	9.03	0.84	0.38	0.38	125.87	8.70	0.01	0.04	0.02	0.51	0.49
HighTraffic Anxiety	0.22	36.72	5.61	0.03	0.05	-101.74	1.03	0.32	0.14	-0.06	3.20	0.09
Depressive symptoms PHQ-9	0.00	0.33	0.00	0.96	0.51	175.77	17.54	0.00	0.44	0.06	13.28	0.00

According to linear regression model: a)**apathy** & **depression** predicted increased reaction time to unexpected events, b)**lack of initiative, apathy** & **irritability** predicted increased accident probability, c)**anxiety** & **lack of initiative** predicted increased headway distance.

Mann Whitney test was conducted, in order to compare driving behavior between AD patients with neuropsychiatric symptoms and patients without symptoms and showed that:

Patients with apathy presented decreased average speed [U=13.00, p<0.05] & increased reaction time [U=8.00, p<0.01]
Patients with lack of initiative presented increased reaction time [U=11.00, p<0.05]
Patients with depressive symptoms had increased reaction time [U=4.00, p<0.01] in LowTraffic condition & [U=12.00, p<0.05] in HighTraffic condition & increased accident probability in HighTraffic condition [U=14.50, p<0.05]

DISCUSSION/CONCLUSIONS

•Our research indicates that the presence and severity of neuropsychiatric symptoms affect driving performance of patients with mild AD.

•Especially, apathy and depression are associated with slower reactions and increased accident probability.

•Neuropsychiatric symptoms may constitute important risk factors for impaired driving behavior.

•To our knowledge, this is the first study that associates driving ability with these symptoms. Thus, further investigation should be conducted on their predictive value on impaired driving behavior.

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