Outdoor air pollution and risk of conversion from mild cognitive impairment to dementia: a cohort study

Tommaso Filippini[1], Annalisa Chiari[2], Giovanna Zamboni[2], Manuela Tondelli[2], Giulia Vinceti[2], Giuseppe Maffeis[3], Andrea Cherubini[3], Carlotta Malagoli[1], Marco Vinceti[1,4]

Introduction

Exposure to air pollutants has been linked to an excess risk of several chronic disease including a few neurodegenerative diseases, such as Alzheimer's dementia. In addition, recent findings suggested that chronic exposure to inhalable particulate matter could be neurotoxic and affect cognitive function. In this study, we aimed to evaluate the effect of outdoor air pollution on risk of onset of dementia in a cohort of subjects with mild cognitive impairment of non-vascular origin.

Methods

Using a Geographical Information System, we geocoded address of residence of a cohort of 53 subjects newly diagnosed with mild cognitive impairment in the Northern Italy province of Modena at the time of diagnosis of mild cognitive impairment (Table 1). We assessed outdoor air pollution exposure, by modeling air levels of particulate matter ≤10 µm (PM_{10}) from motorized traffic at geocoded subjects' residence. We investigated the relation of air pollution to subsequent conversion from mild cognitive impairment to dementia using a Cox proportional hazards model. We computed hazard ratio (HR) and its 95% confidence interval (CI) according to increasing PM_{10} exposure, also adjusting for sex, age, and education of participants, and hexavalent selenate.

Table 1. Baseline characteristics of all study subjects diagnosed with mild cognitive impairment, and divided by subsequent diagnosis during follow-up.

	Baseline MCI	Converted to dementia	Remaining MCI
	N (%)	N (%)	N (%)
All subjects	53 (100)	24 (100)	29 (100)
Sex			
Men	28 (52.8)	11 (45.8)	17 (58.6)
Women	25 (47.2)	13 (54.2)	12 (41.4)
Age at entry			
Mean (SD)	66.3 (7.5)	66.3 (7.1)	66.2 (8.2)
< 65 years	22 (41.5)	8 (33.3)	14 (48.3)
≥ 65 years	31 (58.5)	16 (66.7)	15 (51.7)
Education			
< 8 years	18 (34.4)	7 (29.2)	11 (37.9)
8 - 12 years	15 (28.3)	7 (29.2)	8 (27.6)
≥ 12 years	20 (37.7)	10 (41.6)	10 (34.5)
PM_{10} levels			
Mean (SD) µg/m³	9.7 (6.5)	11.0 (7.7)	8.6 (5.1)
< 5 µg/m³	28 (52.8)	11 (45.8)	17 (58.6)
5 - 10 µg/m³	19 (35.9)	9 (37.5)	10 (34.5)
10 - 20 µg/m³	5 (9.4)	3 (12.5)	2 (6.9)
≥ 20 µg/m³	1 (1.9)	1 (4.2)	0 (0.0)

Abbreviations: MCI, mild cognitive impairment; N, number of subjects; PM, particulate matter; SD, standard deviation.

Dr. Marco Vinceti, Department of Biomedical, Metabolic and Neural Sciences, Section of Public Health - University of Modena and Reggio Emilia, Via Campi, 287 – 41125 Modena. *marco.vinceti@unimore.it*

Results

During a median follow-up of 42 months, 24 participants converted to dementia (19 to Alzheimer's dementia, three to frontotemporal dementia and two to Lewy body dementia). Compared with exposure to PM_{10} concentrations below 5 µg/m³, we found an increasing risk of dementia at exposure of 5-10 µg/m³ (HR = 1.04, 95% CI 0.41 - 2.66), 10-20 µg/m³ (HR = 1.32, 95% CI 0.36 - 4.92), and above 20 µg/m³ (HR = 1.38, 95% CI 0.14 - 13.13) in the fully adjusted model (Table 2).

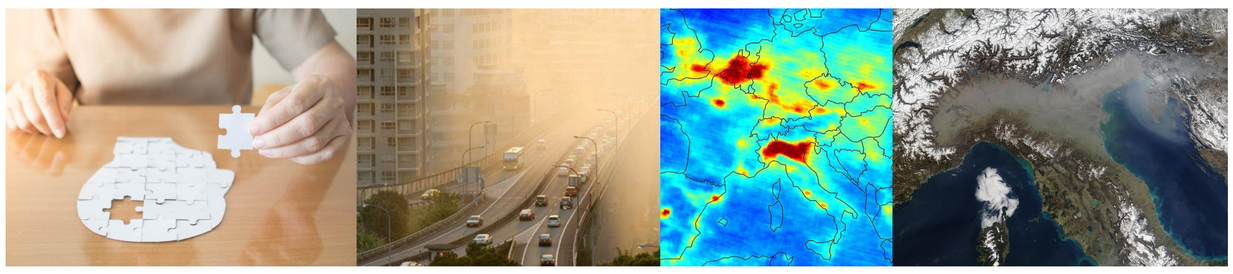

Table 2. Hazard ratio (HR) and 95% confidence interval (CI) of risk of conversion to dementia from mild cognitive impairment in relation to exposure to outdoor air pollution.

	HR	(95% CI)
	Model 1	
PM_{10} categories		
< 5 µg/m³	1.00	-
5 - 10 µg/m³	1.03	(0.43 - 2.50)
10 - 20 µg/m³	1.40	(0.39 - 5.05)
≥ 20 µg/m³	1.91	(0.24 - 15.03)
10 µg/m³ continuous increase	1.34	(0.61 - 2.96)
	Model 2	
PM_{10} categories		
< 5 µg/m³	1.00	-
5 - 10 µg/m³	1.04	(0.41 - 2.66)
10 - 20 µg/m³	1.32	(0.36 - 4.92)
≥ 20 µg/m³	1.38	(0.14 - 13.13)
10 µg/m³ continuous increase	1.24	(0.54 - 2.82)
	Model 3	
PM_{10} categories		
< 5 µg/m³	1.00	-
5 - 10 µg/m³	1.04	(0.41 - 2.64)
10 - 20 µg/m³	1.34	(0.36 - 4.96)
≥ 20 µg/m³	1.37	(0.14 - 13.08)
10 µg/m³ continuous increase	1.22	(0.53 - 2.81)

Model 1: crude model; Model 2: adjusted for age at entry, sex, and years of education; Model 3: further adjusted for levels of hexavalent selenate. PM, particulate matter.

Conclusions

Our results suggest that outdoor air pollution as assessed through PM_{10} concentrations exposure may increase the risk of dementia conversion from mild cognitive impairment, though the low sample size and the potential for unmeasured confounding suggest caution in the interpretation of study findings.

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Affiliations: [1]Environmental, Genetic and Nutritional Epidemiology Research Center (CREAGEN), Department of Biomedical, Metabolic and Neural Sciences, University of Modena and Reggio Emilia, Modena, Italy; [2]Department of Neurosciences, Policlinico University Hospital Baggiovara, Modena, Italy; [3]TerrAria, s.r.l., Milan, Italy; [4]Department of Epidemiology, Boston University School of Public Health, Boston, USA