

### Breathing Clean Air, Remembering Better

A cross-regional study of air quality and episodic memory in European older adults

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# MOTIVATION – COGNITION OF OLDER EUROPEANS



**Flynn effect:** memory higher for younger cohorts

Variations in cognitive functioning across Europe and within regions



SOURCE: Weber et al. 2017, Fig. 3

### MOTIVATION – AIR POLLUTANTS

#### **96% of the EU's urban population** exposed to PM2.5 above WHO annual level ( $5\mu$ g/m3)





# MOTIVATION – HEALTH IMPACTS OF AIR POLLUTION

Link between exposure to **air pollution** and **health** (e.g. asthma, type 2 diabetes, cancer,...) Brain functioning (e.g. **Alzheimer's disease** and **dementia**)



SOURCE: EEA, "Healthy environment, healthy lives," 2019



# RESEARCH ON COGNITION AND AIR POLLUTANTS

### Aim:

What is the relation between main pollutants and cognitive functioning of older Europeans?

#### Method:

Analyse the role of particulate matter and ozone on episodic memory at advanced adulthood



### SCIENTIFIC CONTRIBUTION - RELEVANCE

#### Cognitive competences are particularly relevant at advanced age

- for long economic activity
- to enable an independent life
- lower risk for diseases (e.g. AD, dementia) with higher cognitive levels

#### Need to identify role of air pollutants

- exposure to particulate matter
- urbanization linked to main pollutants
- older adults among most vulnerable





#### Survey of Health, Ageing and Retirement in Europe (SHARE)

- 2004-2020 (waves 1, 2, 4, 5, 6, 7, and 8)
- 100,890 participants aged 50+
- 25 European countries

#### Air Quality Health Risk Assessments (European Environment Agency)

- 2005-2021
- main pollutants (PM2.5, PM10, NO2 and O3) at country, NUTS3, and city levels



### MEASUREMENT

#### **Episodic memory (SHARE)**

- Summary score
- Immediate recall (recall 10 loud read out nouns immediately)
- Delayed recall (recall the 10 previously read out nouns after some delay about 5 min)

#### Main pollutants (EEA)

- particulate matter (PM 2.5, PM 10)
- Ozon (O3)



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**MERGED by country :** 

- NUTS2 or NUTS3
- degree of urbanization
- survey year



# METHOD: GROWTH CURVE MODEL

**Multilevel model** considering hierarchical structure; separately for men and women Model 1

 $Y_{tic} = \beta_0 + \beta_{1tic} age_{tic} + \beta_{2tc} AIR_{tc} + \beta_{3tic} age_{tic} * AIR_{tc} + \beta_{4tic} educ_i + \varepsilon_{tic}$  $+ v_{ic} + u_c$ 

AIR<sub>ir</sub> represents PM2.5, PM10 or O3

Random effects  $v_{ir}$ ,  $\varepsilon_{tic}$ ,  $u_r$  are assumed to follow normal distribution with zero means



# METHOD: GROWTH CURVE MODEL

Multilevel model considering hierarchical structure; separately for men and women

Model 2

 $Y_{tic} = \beta_0 + \beta_{1tic} age_{tic} + \beta_{2tc} AIR_{tc} + \beta_{3tic} age_{tic} * AIR_{tc} + \beta_{4tic} educ_i$  $+ \beta_{5tic} AIR_{tc} * educ_{tic} + \varepsilon_{tic} + v_{ic} + u_c$ 

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# **RESULTS - COGNITION OF OLDER EUROPEANS**

#### Variation in cognitive functioning within a country and across Europe





### RESULTS – AIR POLLUTANT PM2.5

#### decline of PM2.5 over time

#### some urban areas (Poland) still high levels



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### RESULTS – MEMORY AND PM2.5

	Women - Model 1	Women – Model 2	Men – Model 1	Men – Model 2
PM2.5: µg/m3	-0.0230***	-0.0124**	-0.0247***	0.0261***
Age	-0.1675	-0.1691	-0.1530***	-0.1539***
Low educated	-2.3938***	-2.1829**	-2.1924***	-2.1342***
Medium educated	-0.9928***	-0.7832**	-1.0528***	-1.1200***
PM2.5 x Age	0.0023***	0.0024***	0.0022***	0.0023***
PM2.5 x Low educ		-0.0154**		-0.0039
PM2.5 x Medium educ		-0.0154**		0.0046
Intercept	11.4516***	11.3197**	10.6924***	10.7107***

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- Mean values of air pollutant vary across countries and within countries + over time
- PM2.5 and PM10 significant **negative association**
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This work was supported by an OEAW APART-GSK grant

