

Update on air pollution work

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Vermeulen et al. 2020.Science 367(6476).

Expanding the Gateway Research Infrastructure on Exposome Studies

- **Aim:** to explore natural and physical environmental exposures as risk factors of cognitive impairment and dementia in ELSA-HCAP.
- Part of the Gateway of Global Ageing Data initiative, HCAP International Network of Studies
- USA, India, Ireland, N. Ireland, Mexico, Chile, Puerto Rico, Dominican Republic, China

Environmental exposures

Link natural and physical environmental exposure data from open sources to survey data

- **Total PM_{2.5}** 1km*1km 2000-2019 (**currently available for 2010-2016**)
- **PM_{2.5}** from different emission sources
- **NO₂** 1km*1km 1990 to 2020 (**currently available for 2010-2016**)
- **O₃** 1km*1km 1990 to 2017
- **Nighttime Light** 500m*500m 2012- 2020
- **Access to green and blue space**), 250m*250m (2013-current), 500m*500m (2001-2019)
- **Temperature and precipitation** hourly at 30km*30km 1950-current

Geocoding update

- The currently linked data on PM_{2.5} and NO₂ were linked on postcodes, to enhance the quality of linkage it was decided to geocode all ELSA addresses and use their coordinates to perform the linkage
- For waves 1 to 9 there were 25,526 addresses, of which 16,629 unique addresses for geocoding.
- We used a semi-automatic procedure in python, which gave:
 - 13,591 addresses geocoded with good quality using Google Maps;
 - 1,293 addresses geocoded in R using Bing Maps;
 - 1,678 addresses to be manually verified/searched.
- We are currently completing the manual geocode and when done we will perform the linkage

Research papers using the air pollutants from 2010-2016

- 1. Long-term exposure to air pollution and hospital admission due to obstructive airway disease among adults aged 50 years and older**
- 2. Associations of long-term exposure to air pollution and risk of cognitive impairment or dementia in English Longitudinal Study of Ageing (ELSA)**

Long-term exposure to air pollution and hospital admission due to obstructive airway disease among adults aged 50 years and older

Study population

Followed the core members of the ELSA study at wave 5 (N=6,323) until 31 Dec 2016.

Incident ORD hospitalization

Using Hospital Episode Statistics (HES) admitted patients care data

Primary or secondary diagnosis with ICD-10 code (asthma: J45-46; COPD: J41, J42, J43, J44)

Annual mean exposure levels for PM_{2.5} and NO₂

Estimates for year 2010-2016 from Data Integration Model for Air Quality^a at 1km×1km

Assigned based on postcodes for residential addresses at each wave.

Methods and materials : Statistical methods

Time-varying Cox proportional hazard model

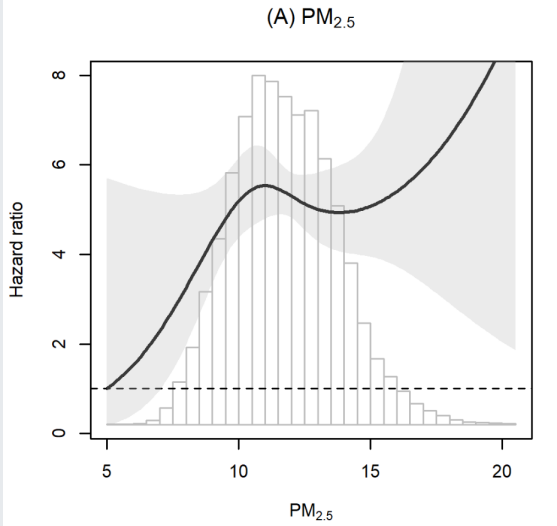
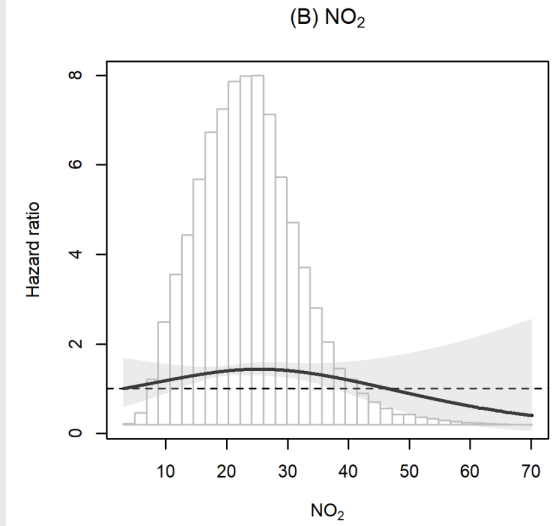
Age (underlying time scale), sex (strata), and calendar year (linear)

Adjusted variables : smoking status, level of physical activity, marital status, wealth, multiple deprivation index

The shape of the concentration-response function

Natural cubic spline with two or three degrees of freedom

Results: Associations between air pollution and hospital admission for ORD in the ELSA wave 5 (N=6,323, case=283).

	PM _{2.5}	NO ₂ HR (95% CI)
Linear associations HR (95% CI)	1.18 (0.83, 1.67)	1.00 (0.87, 1.15)
Exposure-response curve	 <p>(A) PM_{2.5}</p>	 <p>(B) NO₂</p>

- Hazard ratio (HR) and 95% confidence interval (CI) were calculated per 5µg/m³ for PM_{2.5} and 10µg/m³ for NO₂
- Solid spline line and grey shade in plots indicate HRs at certain levels of pollutants compared to the risk at minimum levels of exposures and 95% CIs, respectively.
- Histograms indicates distributions of each pollutant.

Conclusion

- This study presents the suggestive associations of PM_{2.5} with hospital admission for obstructive respiratory disease in elderly population in England.
- Associations were supra-linear
- Effect modification by alcohol assumption, with positive association in non-drinker group
- More analyses are being undertaken to analyse the associations separately for COPD and asthma

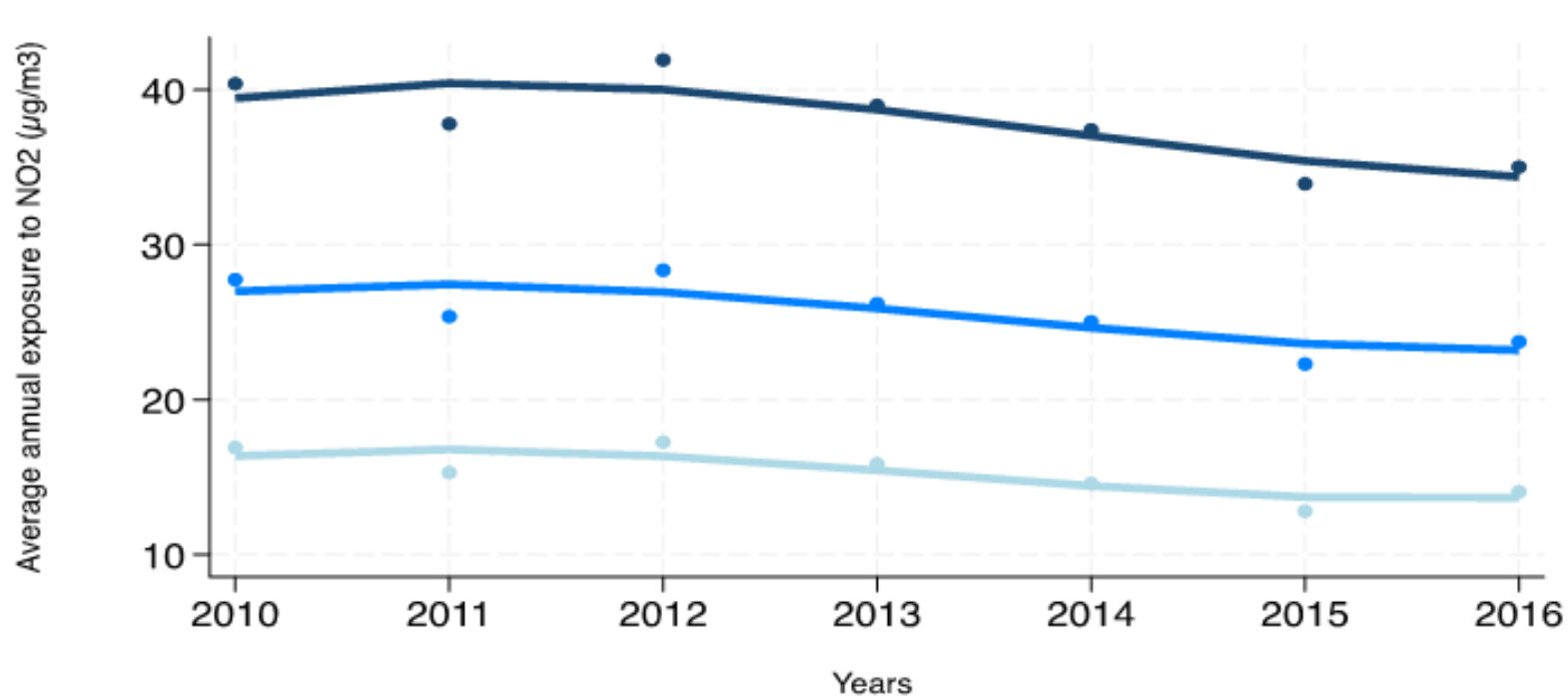
Associations of long-term exposure to air pollution and risk of cognitive impairment or dementia

Aim: To evaluate associations between long-term exposure to PM_{2.5}/NO₂ and cognitive impairment or dementia; memory; and executive functioning

Methods

- **Sample:** 5,443 English participants interviewed at baseline in 2011/2012, again in 2018/2019, and with available data on air pollution between 2010 and 2016.
- **Outcomes:** Cognitive functioning (no impairment vs mild impairment or dementia), memory, and executive functioning
- **Exposures:** Annual average concentrations of PM2.5 and NO2
- **Analysis:** Group based trajectory modelling to identify patterns of long-term exposure to pollutants. Multivariable logistic and linear regression to estimate the associations between PM2.5 and NO2 trajectories and cognitive outcomes, adjusted for age; sex, education, wealth, marital status, urbanicity, and area-level deprivation.

Results: Trajectory groups of NO₂ long term exposure



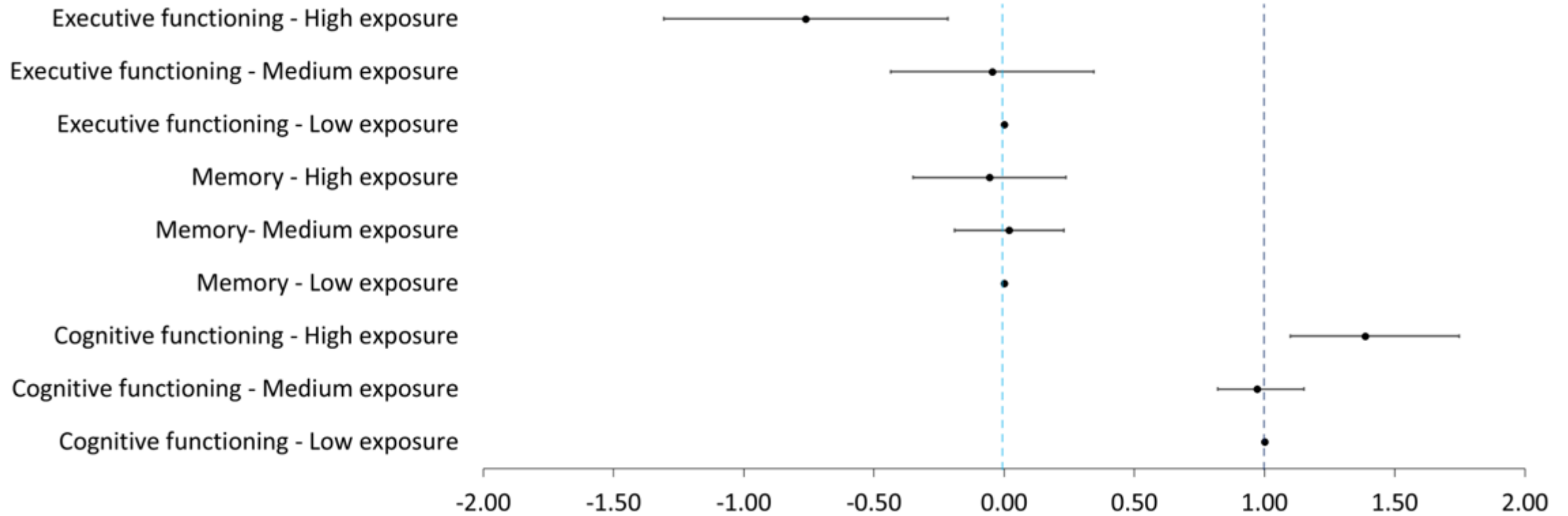
We identified 3 distinct groups for long-term exposure to NO₂ using group-based trajectory modelling. The three groups have relatively parallel trajectories that declined over time:

Group 1 (Low): 36.9% (17.6 - 14.5 µg/m³)

Group 2 (Medium): 47.8% (27.4 - 23.7 µg/m³)

Group 3 (High): 15.3% (38.6 - 33.5 µg/m³)

Associations between NO2 exposure groups and CF



Multivariable logistic and linear regression models estimates of the association between NO2 exposure trajectory groups and cognitive functioning, memory, and executive functioning outcomes. All models adjusted for age and sex, area-level deprivation, urbanicity, level of education, household wealth and marital status

Conclusions

- Higher levels of long-term exposure to NO₂ were associated with poorer executive functioning and an increased risk of cognitive impairment or dementia, even after adjusting for known confounding factors.
- PM_{2.5} exposure was associated with poorer executive functioning only
- No evidence of an association between long-term exposure to higher levels of PM_{2.5} or NO₂ and memory scores