Mortality, Morbidity and Low Level Air Pollution in a Pooled Cohort of 392,826 Adults in Europe in the ELAPSE Project

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BACKGROUND

- Cohort studies have consistently found associations between longterm exposure to outdoor air pollution and morbidity and mortality endpoints
- Uncertainty about the shape of the concentration response function exists at **low concentrations**

OBJECTIVES

- Investigate the **association** and **shape** of the concentrationresponse function between long-term exposure to PM2.5, NO₂, BC, (warm season) O_3 and:
 - Natural and cause-specific mortality
 - Incidence of cardiac events and lung cancer

METHODS

- **Pooling** nine ESCAPE study cohorts and Danish Nurse Cohort with detailed individual lifestyle information
- **Common codebook** harmonizing individual and area-level variables between cohorts
- Europe-wide **hybrid LUR models** (100*100 m grid) for 2010 supplemented with back-extrapolation for PM2.5, NO₂, O₃ and BC to assess long-term residential exposure
- Cox proportional hazard models to **investigate associations** between air pollution and health endpoints, adjusting for individual and area-level confounders
- Different (non-parametric) methods to assess **shape of the** concentration-response relationship
- **Subset** and **threshold** analysis
- Multi-pollutant models to disentangle role of individual pollutants

RESULTS

- Cox proportional hazard models:

	Mortality (N=325,367)					Incidence			
	Natural	CVD	IHD	CeVD	Respiratory	COPD	CE (N=137,175)	Stroke (N=137,175)	Lung cancer (<i>N</i> =307,550)
PM2.5 (per 5 μg/m ³)									
NO₂ (per 10 μg/m ³)									
BC (per 0.5 *10 ⁻⁵ /m)									
Ο₃ (per 10 µg/m ³)									

Adjusted for cohort id, age, sex, year of baseline visit, smoking (status, duration, intensity²), BMI, marital status, employment status and 2001 neighbourhood-level mean income (*CE* and stroke incidence additionally adjusted for education) *CVD: cardiovascular disease; IHD: ischemic heart disease; CeVD: cerebrovascular disease; COPD: chronic obstructive pulmonary disease; CE: coronary events*

• Subset analysis for natural mortality:

	Subset	n	HR (95%
	< 40 µg/m ³	310,643	
NO ₂ (ner 10 μσ/m ³)	< 30 µg/m³	247,039	
	< 20 µg/m³	88,510	
	< 25 µg/m³	325,339	
	< 20 µg/m³	316,540	
PM2.5 (ner 5 μσ/m ³)	< 15 µg/m³	151,250	
	< 12 µg/m³	52,528	
	< 10 µg/m ³	25,422	

CONCLUSIONS

 Long-term exposure to outdoor air pollution (PM2.5, NO2, BC) was associated with morbidity and mortality in a pooled European cohort, with associations persisting at low concentrations

• Mean (SD) exposure: **PM2.5** 15.4 (3.5) μ g/m³, **NO**₂ 25.3 (SD 8.2) μ g/m³, **BC** 1.6 (0.4) *10⁻⁵/m, warm season **O**₃ 86.2 (9.4) μ g/m³



PM2.5 and **NO₂** effect estimates were stable in two- and three-pollutant models for mortality. **Ozone** was highly and negatively correlated with the other three pollutants. Ozone in the warm season showed an unexpected negative association with mortality and coronary events, which was attenuated, but not quite eliminated, in two- and threepollutant models.

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• Splines for natural mortality (NS, 3 df):



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