Mortality, Morbidity and Low-Level Air Pollution in a Population of 28 million in Europe – Analysis of Administrative Cohorts in the ELAPSE Project

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BACKGROUND

- Recent evaluations by WHO and GBD study suggest that associations between long-term exposure to outdoor air pollution and morbidity and mortality may persist at very **low concentrations**

OBJECTIVES

- Investigate the **association** and **shape** of the concentration-response function between long-term exposure to **$PM_{2.5}$, NO_2, BC,** (warm season) **O_3** and natural and cause-specific (cardiovascular, respiratory, lung cancer) mortality

METHODS

- In addition to a pooled cohort of 392,826 participants (see our other poster), we analysed data from **five large administrative cohorts** (28 million subjects) geographically spread across Europe
- **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 $PM_{2.5}$, NO_2, O_3 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
- Indirect adjustment for missing **individual confounder** data
- Random-effects **meta-analysis** of cohort-specific effect estimates

RESULTS

- Cohorts' descriptives:

	Population				Exposure		
	N	Cases	Person-Years	Rate (*100,000)	$PM_{2.5}$ Mean (P5, P95) ($\mu g/m^3$)	NO_2 Mean (P5, P95) ($\mu g/m^3$)	O_3 Mean (P5, P95) ($\mu g/m^3$)
COMBINED	24,166,141	2,733,245	213,719,849	1.28			
Belgian	*5,474,548*	*707,146*	*54,575,223*	*1.30*	*18.6 (15.5, 20.8)*	*30.5 (20.2, 44.9)*	*76.9 (68.3, 83.6)*
Danish	*2,773,976*	*524,713*	*40,063,377*	*1.31*	*12.4 (10.0, 15.3)*	*20.3 (9.3, 35.8)*	*80.2 (70.3, 85.4)*
Dutch	*10,465,730*	*604,309*	*50,436,554*	*1.20*	*16.3 (13.7, 18.2)*	*31.4 (19.4, 42.9)*	*74.8 (61.4, 81.6)*
Rome	*1,263,712*	*235,543*	*15,300,400*	*1.54*	*16.7 (15.1, 18.2)*	*32.9 (21.4, 42.5)*	*94.6 (89.1, 98.8)*
Swiss	*4,188,175*	*661,534*	*53,344,296*	*1.24*	*15.9 (11.6, 19.0)*	*23.7 (12.5, 37.1)*	*94.8 (86.2, 106.0)*

Results for BC not shown; BC was highly correlated with NO_2 (0.85-0.93)

- Subset analysis for natural mortality:

	Subset	Cohorts	n	HR (95% CI)
NO_2 *(per 10 $\mu g/m^3$)*	< 40 $\mu g/m^3$	4	17,277,638	
	< 30 $\mu g/m^3$	4	10,486,848	
	< 20 $\mu g/m^3$	2	2,970,478	
$PM_{2.5}$ *(per 5 $\mu g/m^3$)*	< 25 $\mu g/m^3$	4	18,684,896	
	< 20 $\mu g/m^3$	4	18,626,157	
	< 15 $\mu g/m^3$	3	5,626,707	
	< 12 $\mu g/m^3$	2	1,454,076	

- Cox proportional hazard models for natural mortality:

	HR (95% CI)		
	$PM_{2.5}$ *(per 5 $\mu g/m^3$)*	NO_2 *(per 10 $\mu g/m^3$)*	O_3 *(per 10 $\mu g/m^3$)*
COMBINED			
Belgian			
Danish			
Dutch			
Rome			
Swiss			

*Adjusted for age, sex, year of baseline visit and a number of **individual** and **area-level** potential confounders*

- **NO_2** effect estimates were stable in two- and three-pollutant models, whereas **$PM_{2.5}$** effect estimates attenuated after adjusting for NO_2. **Ozone** was negatively correlated with the other three pollutants; its associations in single-pollutant models attenuated in multi-pollutant models.
- Analysis of two more cohorts – English and Norwegian, accounting for additional 3.75 million participants, is ongoing
- Indirect adjustment analysis is ongoing

CONCLUSIONS

- Long-term exposure to outdoor air pollution ($PM_{2.5}$, NO_2, BC) was **associated** with **natural mortality** in five large European cohorts, even at **low concentrations**

Effects of Low-Level Air Pollution: A Study in Europe

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