M Strak, D Vienneau, K Wolf, U Hvidtfeldt, M Stafoggia, M Bauwelinck,
Z Andersen, J Klompmaker, R Atkinson, B Oftedal, F Forastiere,
B Hoffmann, O Raaschou-Nielsen, S Rodopolou, E Samoli,
K Katsouyanni, K de Hoogh, J Chen, G Hoek, B Brunekreef

ON BEHALF OF THE ELAPSE PROJECT TEAM
Background

Associations between air pollution and health have been observed at **low concentrations**

Objectives

Investigate **associations** between long-term exposure to **PM2.5, NO₂, O₃, BC** and:

- Natural and cause-specific mortality
- Incidence of lung cancer and cardiovascular events

PM₂.₅ = particulate matter < 2.5 μm in aerodynamic diameter
O₃ = ozone
NO₂ = nitrogen dioxide
BC = black carbon
Methods

• Pooling eight ESCAPE cohorts and Danish Nurse Cohort (N = 392,826)

• Large administrative cohorts from seven countries in Europe (N = 27,910,693)

• Common codebook harmonizing individual- and area-level variables between cohorts

• Central exposure assessment of PM$_{2.5}$, NO$_2$, O$_3$ and BC at 100x100 m resolution
Pooled cohort

- N = 392,826
- Extensive covariate information
Administrative cohorts

- Belgian
- Danish
- Dutch
- English
- Norwegian
- Rome
- Swiss

- N = 27,910,693
- Limited covariate info (except English)
- Analyzed individually -> Meta-analysis
Central exposure assessment

Europe-wide **hybrid** land use regression models (100x100 m)

Land use and road data, with **satellite** observations and **dispersion model** estimates as additional predictors

Local exposure models

Existing LUR and/or dispersion models
Methods

- Cox proportional hazard models to investigate associations between air pollution and health
- Splines and other methods to assess shape of the concentration-response relationships
- Subset and threshold analysis
- Random-effects meta-analysis of cohort-specific effect estimates
POOLED COHORT RESULTS
### Descriptives | Pooled cohorts

<table>
<thead>
<tr>
<th></th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td>All</td>
<td>392,826</td>
</tr>
<tr>
<td>Main model</td>
<td>325,367</td>
</tr>
</tbody>
</table>
$PM_{2.5}$ ($\mu g/m^3$)

- **EU Limit Value**
- **EPA NAAQS**
- **WHO AQG**

CEANS  | DCH  | DNC  | E3N  | EPIC-NL | HNR  | KORA | VHM&PP
---|---|---|---|---|---|---|---

$PM_{2.5}$ = fine particulate matter; EU = European Union; EPA NAAQS = US EPA National Ambient Air Quality Standard; WHO AQC = World Health Organization Air Quality Guideline
$\text{NO}_2$ (µg/m³)

- CEANS
- DCH
- DNC
- E3N
- EPIC-NL
- HNR
- KORA
- VHM&PP

EU Limit Value
WHO AQG
HRAPIE (EEA)

$\text{NO}_2$ = nitrogen dioxide; HRAPIE = Health risks of air pollution in Europe; EEA = European Environmental Agency
ADMINISTRATIVE COHORTS RESULTS
PM$_{2.5}$

PM$_{2.5}$ = fine particulate matter

NO$_2$

NO$_2$ = nitrogen dioxide

Belgian, Danish, Dutch, English, Norwegian, Rome, Swiss
Correlations

Very positive between BC and NO$_2$, strongly negative between O$_3$ and all others

<table>
<thead>
<tr>
<th></th>
<th>NO$_2$</th>
<th>BC</th>
<th>O$_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM$_{2.5}$</td>
<td>.51 - .76</td>
<td>.50 - .70</td>
<td>-.41 - -.68</td>
</tr>
<tr>
<td>NO$_2$</td>
<td>.86 - .93</td>
<td></td>
<td>-.67 - -.80</td>
</tr>
<tr>
<td>BC</td>
<td></td>
<td></td>
<td>-.64 - -.82</td>
</tr>
</tbody>
</table>

O$_3$ = ozone  
NO$_2$ = nitrogen dioxide  
BC = black carbon  
PM$_{2.5}$ = fine particulate matter
## Descriptives | Administrative cohorts

<table>
<thead>
<tr>
<th></th>
<th>Population</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Cases</td>
<td>Person-Years</td>
</tr>
<tr>
<td><strong>COMBINED</strong></td>
<td>24,166,141</td>
<td>2,733,245</td>
<td>213,719,849</td>
</tr>
<tr>
<td><strong>Belgian</strong></td>
<td>5,474 K</td>
<td>707 K</td>
<td>54,575 K</td>
</tr>
<tr>
<td><strong>Danish</strong></td>
<td>2,773 K</td>
<td>524 K</td>
<td>40,063 K</td>
</tr>
<tr>
<td><strong>Dutch</strong></td>
<td>10,465 K</td>
<td>604 K</td>
<td>50,436 K</td>
</tr>
<tr>
<td><strong>Rome</strong></td>
<td>1,263 K</td>
<td>235 K</td>
<td>15,300 K</td>
</tr>
<tr>
<td><strong>Swiss</strong></td>
<td>4,188 K</td>
<td>661 K</td>
<td>53,344 K</td>
</tr>
</tbody>
</table>
Strengths

- Multiple cohorts pooled with individual level covariates
- Large administrative databases
  - Surveys with individual level covariates
- Central Europe-wide exposure assessment
  - In addition, local exposure models
- Common analysis scripts
Limitations

- Most subjects at > 10 µg/m³ PM$_{2.5}$ (but still sufficient power in some administrative databases)
- Missing lifestyle data in large administrative cohorts
Conclusions (so far...)

• Long-term exposure to PM$_{2.5}$, NO$_2$, BC was positively associated with morbidity and mortality in pooled cohort and in five large administrative database cohorts

• Associations remaining at low levels

PM$_{2.5}$ = fine particulate matter
NO$_2$ = nitrogen dioxide
BC = black carbon
THANK YOU