Evidence of the impacts of air pollution on NCDs even at low-level concentrations

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and
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Environment and Health Committee

Geneva, 31 October, 2018
What are low levels?

Exposure response function, annual PM$_{2.5}$ and mortality

Low levels

US EPA Standard

WHO AQG

EU Limit Value

Hazard Ratio

PM$_{2.5}$ - $\mu$g/m$^3$

Burnett, PNAS 2018
Importance of low levels

Example: Background NO$_2$ exposure in Germany and hypothetical ERFs

Huge impact on burden of disease => Preventive potential
Effects at low level - Challenges

• Large to very large studies (millions)
• Detailed information on socioeconomic and lifestyle variables
• Excellent exposure assessment
• Information on concurrent exposures
PM2.5 and mortality in Canada
The Canadian Community Health Survey Cohort

- Appr. 300,000 adults, 26,300 deaths
- PM$_{2.5}$ from satellite, CTM, land use and monitoring at 1x1 km
- Individual data on smoking, BMI, alcohol, diet, socioeconomic status
- Several area-level socioeconomic covariates

Hazard Rate 1.26 (1.19 – 1.34) per 10 µg/m$^3$ PM$_{2.5}$

Comparison: WHO HRAPIE recommends HR 1.06
Air Pollution and Mortality in Seven Million Adults: The Dutch Environmental Longitudinal Study (DUELS)

Paul H. Fischer,¹ Marten Marra,¹ Caroline B. Ameling,¹ Gerard Hoek,² Rob Beelen,¹,² Kees de Hoogh,³,⁴,⁵ Oscar Breugelmans,¹ Hanneke Kruize,¹ Nicole A.H. Janssen,¹ and Danny Houthuijs¹

Effects sustained when adjusted for co-pollutants

PM$_{2.5}$

NO$_2$

<table>
<thead>
<tr>
<th></th>
<th>PM$_{10}$</th>
<th>NO$_2$</th>
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<tbody>
<tr>
<td>Unadjusted</td>
<td>1.04 (1.07, 1.08)</td>
<td>1.06 (1.06, 1.06)</td>
</tr>
<tr>
<td>Individual cov</td>
<td>1.04 (1.04, 1.04)</td>
<td>1.06 (1.06, 1.06)</td>
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<tr>
<td>Full model</td>
<td>1.04 (1.03, 1.06)</td>
<td>1.02 (1.02, 1.02)</td>
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<tr>
<td>Two-pollutant model</td>
<td>1.04 (1.03, 1.06)</td>
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EHP 2015
Air Pollution and Mortality in the Medicare Population

Qian Di, M.S., Yan Wang, M.S., Antonella Zanobetti, Ph.D., Yun Wang, Ph.D., Petros Koutrakis, Ph.D., Christine Choirat, Ph.D., Francesca Dominici, Ph.D., and Joel D. Schwartz, Ph.D.

- 61 Million Medicare beneficiaries
- PM$_{2.5}$ and O$_3$ modeled at 1x1 km using satellites, CTM, land use and monitor data
- Data on smoking, BMI, income only in subsample of 57,000 (low correlation with air pollution

NEJM 2017
Effects of Low-Level Air Pollution: a Study in Europe
- ongoing study, results expected in 2019

- Mortality, lung cancer incidence, CVD events (MI, stroke), extension to other outcomes possible (i.e. diabetes, cognition)

- Exposure modeling combining LUR, CTM, measurements, satellite

- ~ 380,000 subjects from 10 cohorts with individual level information

- ~ 35 million subjects from seven administrative/national cohorts
Key messages

• Potential large impact on burden of disease in many areas
• Many important health outcomes still understudied
• Huge preventive potential
• Regulatory impact
  – WHO AQG under revision
  – EPA PM ISA draft under revision
    EPA Ozone ISA under development
  – Ongoing EU Air Quality Directives Fitness Check and potential revision
Thank you

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Potential questions to panel

• How low is low enough?
• Is WHO likely to reduce its air pollution guideline values given the increasing evidence from these low level studies?
• Which other health effects are most important (besides mortality)? What is necessary for their assessment?
Effects of air pollution on NCD – other than mortality...

- Respiratory disease mortality
- Respiratory disease morbidity
- Lung cancer
- Pneumonia
- Upper and lower respiratory symptoms
- Airway inflammation
- Decreased lung function
- Decreased lung growth

- Insulin resistance
- Type 2 diabetes
- Type 1 diabetes
- Bone metabolism

- High blood pressure
- Endothelial dysfunction
- Increased blood coagulation
- Systemic inflammation
- Deep venous thrombosis

- Stroke
- Neurological development
- Mental health
- Neurodegenerative diseases

- Cardiovascular disease mortality
- Cardiovascular disease morbidity
- Myocardial infarction
- Arrhythmia
- Congestive heart failure
- Changes in heart rate variability
- ST-segment depression

- Skin ageing

- Premature birth
- Decreased birthweight
- Decreased fetal growth
- Intrauterine growth retardation
- Decreased sperm quality
- Pre-eclampsia

Thurston et al. 2017