How Low Should We Go? New Health Research on Low-level Ambient Air Pollution

Air pollution and Health: Recent Advances to Inform the European Green Deal
January 21-22, 2020, Brussels

Chairs:

Dorota Jarosinska, WHO Regional Office For Europe
Dan Greenbaum, Health Effects Institute
Why Study the Health Effects of Low Levels of Ambient Air Pollution?

Levels of ambient air pollution have decreased over time in North America and Europe.

New epidemiologic studies reported associations of air pollution with health effects at levels below current air quality standards.

Yet, uncertainty within these studies and especially about the exposure response function at the low end of the exposure curve.

This information is critical for use in risk assessment and regulation.

- How low should standards/limit values be set?
- Can benefits of regulation be estimated to the lowest levels?
Growing Number of Studies in Europe and North America – Need for Enhanced Analysis

Air Pollution and Mortality in Seven Million Adults: The Dutch Environmenta Longitudinal Study (DUELS)

Paul H. Fischer, i Maren Marra, i Caroline B. Ameling, i Gerard Hoek, ii Rob Beelen, i, i, i Kees de Hoogh, i, i, i, i, i, i
Oscar Breugelmans, i Hanneke Kruijssen, i Nicole A. H. Janssen, i and Danny Houthuijs i

Low-Concentration PM2.5 Effects in a Population-Blood-Cell Study: The LifeLines Study, Antonielle Zeneveld, i, i, i, i, i, i, i, i
And Diederik Joost Luijkx, i

All-cause mortality and long-term effects of PM2.5 in the '45 and up study' cohort, Sydney, Australia

Ivan C. Hanigan, a, b, c, Margaret I. Roby, a, b, c, Christine T. Cowie, a, b, c, Jane Heyworth, a, b, c, Adrian Bauman, a, Bin Jalaludin, a, b, c, Georgia J. G. Martin, a, b, c

Environment International

Effects of long-term exposure to PM2.5 on all-cause mortality: an analysis within the multicentre ESCAPE

Air Pollution and Health: Effect Estimates, Methodological Challenges, and Future Directions

Georgia Papadopoulou 1, Mariamh-Anna Klaoumourtzoglou 2, Danielle Braun 1, Antonella Zanobetti 1

Abstract

Purpose of Review: Fine particulate (PM2.5) levels have been decreasing in the USA over the past decades. Our goal was to assess the current literature to characterize the relationship between PM2.5 and adverse health at low exposure levels.

Recent Findings: We reviewed 26 papers that examined the association between short- and long-term exposure to PM2.5 and cardio-respiratory morbidity and mortality. There is evidence suggesting that these associations are stronger at lower levels. However, there are certain methodological and interpretational limitations specific to studies of low PM2.5 levels, and further methodological development is warranted.

Summary: There is strong agreement across studies that air pollution effects on adverse health are still observable at low concentrations, even well below current US standards. These findings suggest that US standards need to be revised, given that further improving air quality has the potential of benefiting public health.

Associations between fine particulate matter and mortality in the 2001 Canadian Census Health and Environment Cohort

Lauren L. Pinault 1, Scott Weichenthal 1, c, Daniel L. Crouse d, Michael Brauer e, Anders Erickson e, Aaron van Donkelaar 1, Randall V. Martin 1, c, Perry Hystad 1, Hong Chen d, Philippe Finès e, Jeffrey R. Brook k, Michael Tjepkema 1, Richard T. Burnett 1

Environmental Research 159 (2017) 406-415
Advantages

Greater statistical power

More representative of the general population
Challenges

Exposure assessment

Often individual-level information is limited

Harmonization of methods across cohorts can be difficult
RFA Objectives

Fund studies to assess health effects of long-term exposure to low levels of ambient air pollution, including all-cause and cause-specific mortality and morbidity endpoints. Studies should analyze and evaluate exposure-response function(s) for PM$_{2.5}$ and other pollutants at levels currently prevalent in North America, Western Europe, and other high-income regions and may also address related questions about health effects at low levels of ambient air pollution.

Develop statistical and other methodology required for, and specifically suited to, conducting such research including, but not limited to, evaluation and correction of exposure measurement error.
Three HEI studies, with key features:

• Populations with millions in the US, Canada, and Europe; administrative and traditional cohorts

• Satellite data and ground level exposure measurements; high quality exposure assessment models at high spatial resolutions

• Development and application of novel statistical methods
Estimating the Effects of Exposure to Low Levels of Air Pollution – HEI studies

Geographical areas

PI: Michael Brauer, U British Columbia (~10 million)
PI: Francesca Dominici, Harvard (~60 million)
PI: Bert Brunekreef, Utrecht University (~28 million)

Average annual PM$_{2.5}$ levels:
15 µg/m$^3$ (Europe)
11 µg/m$^3$ (US)
7 µg/m$^3$ (Canada)
Michael Brauer
Jeff Brook (University of Toronto)
Rick Burnett (Health Canada)
Dan Crouse (University of New Brunswick)
Anders Erickson (University of British Columbia)
Perry Hystad (Oregon State University)
Randall Martin, Aaron van Donkelaar (Dalhousie University)
Mike Tjepkema (Statistics Canada)
Scott Weichenthall (McGill University)

Bert Brunekreef
Richard Atkinson (University of London, UK)
Marie-Christine Boutron-Ruault (French Institute of Health and Medical Research (INSERM))
Kees de Hoogh, Danielle Vienneau (Swiss Tropical and Public Health Institute (TPH))
Francesco Forastiere (King’s College London)
John Gulliver (Imperial College, UK)
Ole Hertel (University of Aarhus, Denmark)
Gerard Hoek, Maciej Strak (Utrecht University, Netherlands)
Barbara Hoffmann (University of Düsseldorf, Germany)
Nicole Janssen (National Institute of Public Health and the Environment (RIVM))
Klea Katsouyanni (University of Athens, Greece)
Goran Pershagen (Karolinska Institute, Sweden)
Annette Peters (Helmholtz Zentrum, Germany)
Ole Raaschou-Nielsen (Danish Cancer Society)
Per Schwarze (Norwegian Institute of Public Health (NIPH))
Gudrun Weinmayr (University of Ulm, Germany)

Francesca Dominici
Joey Antonelli
Danielle Braun
Christine Choirat
Brent Coull
Qian Di
Marianthi Kioumourtzoglou
Petros Koutrakis
Rachel Nethery
Ben Sabbath
Joel Schwartz
Richard Yun Wang
Thomas Ander Wilson
Xiao Wu
Antonella Zanobetti
Ensuring the Highest Quality from the Studies

• Detailed and continuing HEI oversight
  - Oversight Committee:
    Progress reports every 5 months
    Annual, detailed renewal requests
    Webinars and annual meeting
  - QA/QC audits

• HEI Intensive Review of First Reports
  - Requested Phase 1 reports, summarizing results to-date
  - Formed special Review Panel, with Sverre Vedal (chair, University of Washington) plus six additional experts in epidemiology, exposure assessment and biostatistics
  - Reports and Panel commentary are published in **November 2019**, with aim to inform NAAQS, WHO, Limit Values process [www.healtheffects.org](http://www.healtheffects.org)

• Final reports – after review, to be published with commentaries during **2021-2022**
Aim of this session

To present results of three studies investigating the health effects of low-level exposure in very large populations in the United States, Canada, and Europe, address their strengths and weaknesses, and discuss potential implications for future risk assessment and regulation.
Speakers

• Gerard Hoek, Utrecht University
  Evidence from Europe - Effects of low-level air pollution: A study in Europe (ELAPSE)

• Michael Brauer, The University of British Columbia
  Evidence from Canada - Mortality-air pollution associations in low exposure environments (MAPLE)

• Marianthi-Anna Kioumourtzoglou, Columbia University
  Evidence from the US - Air pollution and mortality in the Medicare population
THANK YOU!

Check out our website www.healtheffects.org