Why Study The Health Effects of Low Levels of Air Pollution?

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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 Western 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.

- At what level should we set ambient air quality standards?
- To what level of exposure should we estimate health impacts (and benefits of a reduction)?
The systematic review included studies up to October 2018.
Growing Number of Very Recent Studies also now in other geographical areas

All-cause mortality and long-term exposure to low level air pollution in the ‘45 and up study’ cohort, Sydney, Australia, 2006–2015

Ivan C. Hanigan\textsuperscript{a,b,c}, Margaret I. Rolfe\textsuperscript{b}, Luke D. Knibbs\textsuperscript{d,e}, Farhad Salimi\textsuperscript{b}, Christine T. Cowie\textsuperscript{e,f}, Jane Heyworth\textsuperscript{a,g}, Guy B. Marks\textsuperscript{h}, Yuming Guo\textsuperscript{i}, Martin Cope\textsuperscript{j}, Adrian Bauman\textsuperscript{b}, Bin Jalaludin\textsuperscript{a,j,k}, Geoffrey G. Morgan\textsuperscript{a,b}

Environment International 126 (2019) 762–770

Long-term residential exposure to PM$_{2.5}$ constituents and mortality in a Danish cohort

Ulla Arthur Hvidfeldt\textsuperscript{a,n}, Camilla Geels\textsuperscript{c}, Mette Sørensen\textsuperscript{a,b}, Matthias Ketzel\textsuperscript{c,d}, Jibran Khan\textsuperscript{c,e}, Anne Tjonneland\textsuperscript{a,f}, Jesper Heile Christensen\textsuperscript{c}, Jørgen Brandt\textsuperscript{c}, Ole Raaschou-Nielsen\textsuperscript{a,c}

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Environment International 133 (2019) 105268

Particulate air pollution from different sources and mortality in 7.5 million adults — The Dutch Environmental Longitudinal Study (DUELS)\textsuperscript{☆}

Paul H. Fischer\textsuperscript{a,x}, Marten Marra\textsuperscript{b}, Caroline B. Ameling\textsuperscript{b}, Guus J.M. Velders\textsuperscript{a,b}, Ronald Hoogerbrugge\textsuperscript{a}, Wilco de Vries\textsuperscript{a}, Joost Wesseling\textsuperscript{a}, Nicole A.H. Janssen\textsuperscript{a}, Danny Houthuijs\textsuperscript{a}

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\textsuperscript{b} Institute for Marine and Atmospheric Research Utrecht, Utrecht University, the Netherlands

Science of the Total Environment 705 (2020) 135778

Examining the Shape of the Association between Low Levels of Fine Particulate Matter and Mortality across Three Cycles of the Canadian Census Health and Environment Cohort

Amanda J. Puppin\textsuperscript{a}, Tanaya Chritisdh\textsuperscript{a}, Lauren L. Pipeline\textsuperscript{a}, Dan L. Crowe\textsuperscript{a}, Jeffrey R. Brook\textsuperscript{a}, Anders Eriksson\textsuperscript{a}, Ferry Hystad\textsuperscript{a}, Chi Li\textsuperscript{b}, Randall Y. Martin\textsuperscript{a}, Jun Meng\textsuperscript{a}, Scott Weichenthal\textsuperscript{a,m}, Aaron van Donkelaar\textsuperscript{a}, Michael Tjeleper\textsuperscript{a}, Michael Brasier\textsuperscript{a}, and Richard T. Burnett\textsuperscript{a}

Environmental Health Perspectives 127(10) October 2019

Long-term exposure to air pollution, mortality, and morbidity in New Zealand: Cohort study

Simon Hales\textsuperscript{a,b}, June Atkinson\textsuperscript{a}, Jayne Metcalfe\textsuperscript{b}, Gerda Kusche\textsuperscript{b}, Alistair Woodward\textsuperscript{c}

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Science of the Total Environment 801 (2021) 149580
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
Overall objectives of RFA 14-3

• Studies to assess health effects of long-term exposure to low levels of ambient air pollution --all-cause and cause-specific mortality and morbidity

• Exposure-response function(s) for PM$_{2.5}$ and other pollutants at low levels

• Develop statistical and other methodology
Key features of the three studies

• Very large populations, with millions in the US, Canada, and Europe; administrative and traditional cohorts

• High quality exposure assessment models at high spatial resolutions, using data from satellites, ground level monitors, other sources, and modeling

• 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 (~ 8 million)
PI: Francesca Dominici, Harvard (~ 60 million)
PI: Bert Brunekreef, Utrecht University (~28 million)

Average $\text{PM}_{2.5}$ levels:
- 15 $\mu g/m^3$ (Europe)
- 11 $\mu g/m^3$ (US)
- 7 $\mu g/m^3$ (Canada)
Teams

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

HEI Intensive Review of final reports
  - Formed special independent Review Panel to review the reports and prepare commentaries

The US and Canadian Phase 1 Reports and Panel commentaries were published in November 2019. The Phase 2 reports will be published late 2021 - early 2022.

Some joint analyses are ongoing across the 3 teams.

All HEI reports and commentaries are available on our website www.healtheffects.org
Conclusions US and Canadian Phase 1 reports

Initial evidence for an association between mortality and PM$_{2.5}$ exposure at levels below the current US National Air Quality Standards ($<12$ µg/m$^3$) with no observable thresholds

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The European study was published in September 2021.

Analyzed a pooled cohort of 9 well-characterized cohorts and 7 large administrative cohorts individually, followed by a meta-analysis.

In 11 European countries

- Mortality and morbidity
- PM$_{2.5}$, but also NO$_2$, Black carbon and ozone, modeled at residential address level
THANK YOU!

Check out our website www.healtheffects.org