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

Joint HEI/ERS Webinar, October 12, 2021

Hanna Boogaard, Health Effects Institute

Why Study the Health Effects of Low Levels of Ambient Air Pollution?

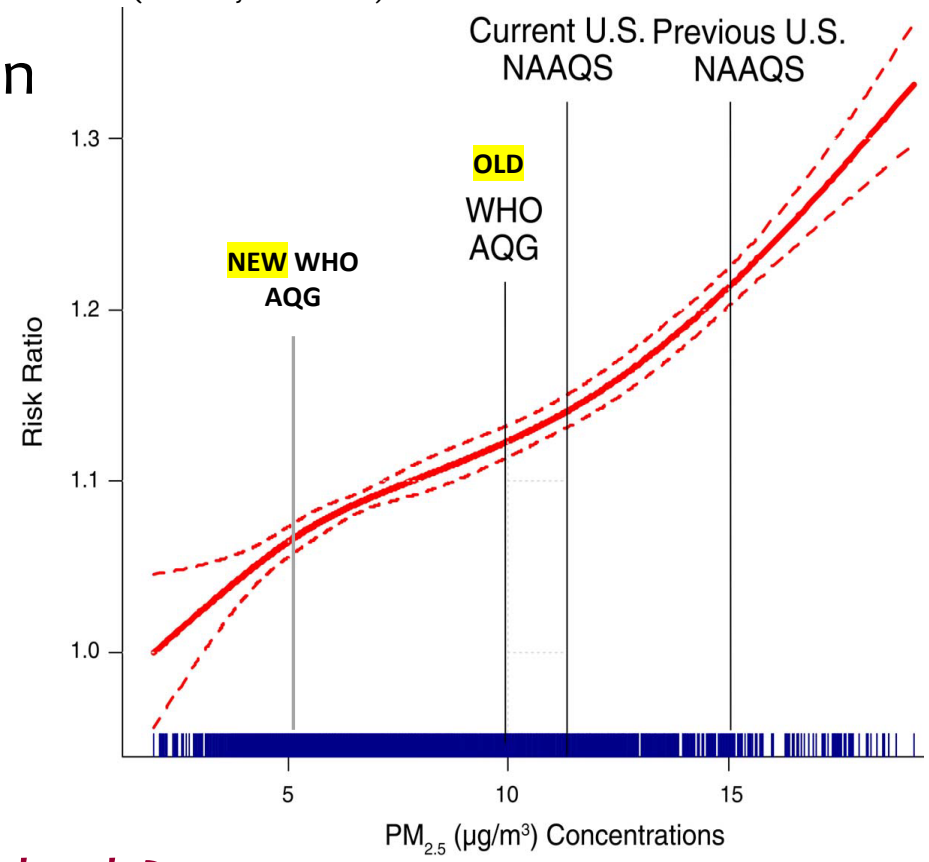
Levels of ambient air pollution have decreased over time in North America and Western Europe.

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.

2012 Canada Results

Shape of the concentration–response function for mortality associated with fine particulate matter in a Canadian Cohort. (Courtesy R. Burnett)



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)?*

Review article Environment International 143 (2020) 105974

Long-term exposure to PM and all-cause and cause-specific mortality: A systematic review and meta-analysis

Jie Chen*, Gerard Hoek

Institute for Risk Assessment Sciences, Utrecht University, the Netherlands

The systematic review included studies up to October 2018

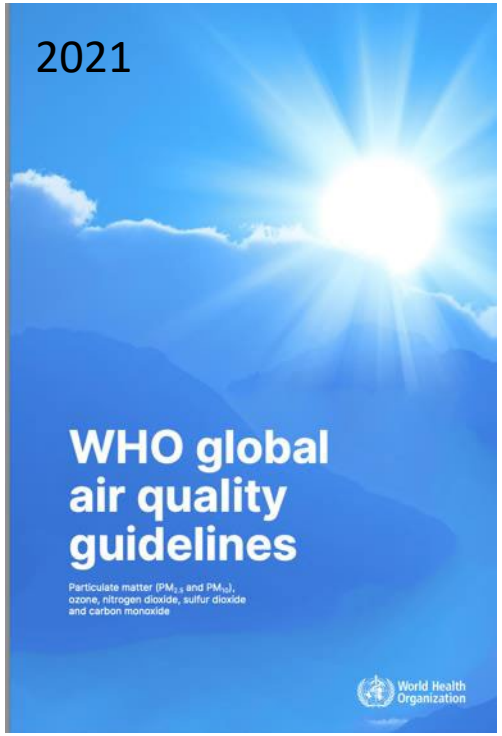


Table 3.2. Studies on long-term $PM_{2.5}$ exposure and all non-accidental mortality included in the systematic review by Chen & Hoek (2020), ordered by me(di)an concentration

	Study	Me(di)an (µg/m³)	SD	P5	P25	HR (95% CI)[a]
CCHS-Mortality Canada	Pinault et al. (2016)	5.9	–	3.0[b]	4.2	1.26 (1.19–1.34)
1991 CanCHEC Canada	Cakmak et al. (2018)	6.5	2.0	3.2[c]	–	1.16 (1.08–1.25)
2001 CanCHEC Canada	Pinault et al. (2017)	7.1	–	3.5[b]	5.4	1.18 (1.15–1.21)
AHS Canada	Weichenthal et al. (2014)	9.5	1.7	6.7[c]	–	0.95 (0.76–1.19)
CNBSS Canada	Villeneuve et al. (2015)	9.5	3.5	4.8[b]	–	1.12 (1.05–1.20)
Medicare 00-12 US	Di et al. (2017a)	11.5	2.9	7.1[b]	9.5	1.08 (1.08–1.09)
NHIS US	Parker, Kravets & Vaidyanathan (2018)	11.8	–	–	10.1	1.03 (0.99–1.08)
Veterans US	Bowe et al. (2018)	11.8	–	7.9[b]	10.2	1.08 (1.03–1.13)
Nurses Health US	Hart et al. (2015)	12.0	2.8	7.8[b]	10.2	1.13 (1.05–1.22)
ACS-CPSII US	Turner et al. (2016)	12.6	2.9	7.8[c]	–	1.07 (1.06–1.09)
National Cohort England	Carey et al. (2013)	12.9	1.4	10.6[c]	–	1.11 (0.98–1.26)
ESCAPE Europe	Beelen et al. (2014)	13.4	–	7.9[b]	11.3	1.14 (1.03–1.27)
NIH-AARP US	Thurston et al. (2016a)	13.6	3.6	8.9[b]	11.1	1.03 (1.01–1.06)
Trucking companies US	Hart et al. (2011)	14.1	4.0	7.8[b]	11.8	1.10 (1.02–1.18)
Harvard six city US	Lepeule et al. (2012)	15.9	–	–	–	1.14 (1.07–1.22)
Gazel France	Bentayeb et al. (2015)	17.0	–	–	–	1.16 (0.98–1.36)
Nurses Health Followup US	Puett et al. (2011)	17.8	3.4	12.2[c]	–	0.86 (0.72–1.02)
California Teachers US	Ostro et al. (2015)	17.9	–	–	13.1	1.01 (0.97–1.05)
Rome longitudinal Italy	Badaloni et al. (2017)	19.6	1.9	16.5[c]	–	1.05 (1.02–1.08)
CA CPSI – California	Enstrom (2005)	23.4	–	–	–	1.01 (0.99–1.03)
NLCS-AIR Netherlands	Beelen et al. (2008)	28.3	2.1	24.8[c]	–	1.06 (0.97–1.16)
Civil servants Taiwan	Tseng et al. (2015)	29.6	–	–	–	0.92 (0.72–1.17)
Chinese men China	Yin et al. (2017)	40.7	18.6	10.1[c]	–	1.09 (1.08–1.10)
Elderly Hong Kong	Yang et al. (2018)	42.2	–	–	–	1.06 (1.01–1.10)
AHSMOG California	McDonnell et al. (2000)	59.2	16.8	31.6[c]	–	1.09 (0.98–1.21)

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[a,b,c,*], Margaret I. Rolfe[b], Luke D. Knibbs[a,d], Farhad Salimi[a,b], Christine T. Cowie[a,e,f], Jane Heyworth[a,g], Guy B. Marks[a,h], Yuming Guo[a,i], Martin Cope[a,j], Adrian Bauman[k], Bin Jalaludin[a,l,m], Geoffrey G. Morgan[a,b]

Environment International 126 (2019) 762–770

Christidis et al. Environmental Health (2019) 18:84
https://doi.org/10.1186/s12940-019-0518-y

Environmental Health

RESEARCH Open Access

Low concentrations of fine particle air pollution and mortality in the Canadian Community Health Survey cohort

Tanya Christidis[1*], Anders C. Erickson[2], Amanda J. Pappin[1,13], Daniel L. Crouse[3], Lauren L. Pinault[1], Scott A. Weichenthal[4,5], Jeffrey R. Brook[6,12], Aaron van Donkelaar[7,11], Perry Hystad[8], Randall V. Martin[7,9,11], Michael Tjepkema[1], Richard T. Burnett[10] and Michael Brauer[2]

Environment International 133 (2019) 105268

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

Ulla Arthur Hvidtfeldt[a,*], Camilla Geels[c], Mette Sørensen[a,b], Matthias Ketzel[c,d], Jibran Khan[c,e], Anne Tjønneland[a,f], Jesper Heile Christensen[c], Jørgen Brandt[c], Ole Raaschou-Nielsen[a,c]

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[f] Department of Public Health, University of Copenhagen, Oester Farimagsgade 5, 1014 Copenhagen K, Denmark

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

Paul H. Fischer [a,*], Marten Marra [a], Caroline B. Ameling [a], Guus J.M. Velders [a,b], Ronald Hoogerbrugge [a], Wilco de Vries [a], Joost Wesseling [a], Nicole A.H. Janssen [a], Danny Houthuijs [a]

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Science of the Total Environment 705 (2020) 135778

Environmental Health Perspectives 127(10) October 2019

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. Pappin,[1] Tanya Christidis,[1] Lauren L. Pinault,[1] Dan L. Crouse,[2,3] Jeffrey R. Brook,[4] Anders Erickson,[5] Perry Hystad,[6] Chi Li,[7] Randall V. Martin,[7,8,9] Jun Meng,[7,9] Scott Weichenthal,[10,11] Aaron van Donkelaar,[7,9] Michael Tjepkema,[1] Michael Brauer,[5] and Richard T. Burnett[12]*

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

Science of the Total Environment 801 (2021) 149660

Simon Hales [a,*], June Atkinson [a], Jayne Metcalfe [b], Gerda Kuschel [b], Alistair Woodward [c]

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HEI

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


HEI

HEALTH EFFECTS INSTITUTE

December 2014

Request for Applications

Fall 2014 Research Agenda

RFA 14-3 Assessing Adverse Health Effects of Long-Term Exposure to Low Levels of Ambient Air Pollution

- 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

HEI

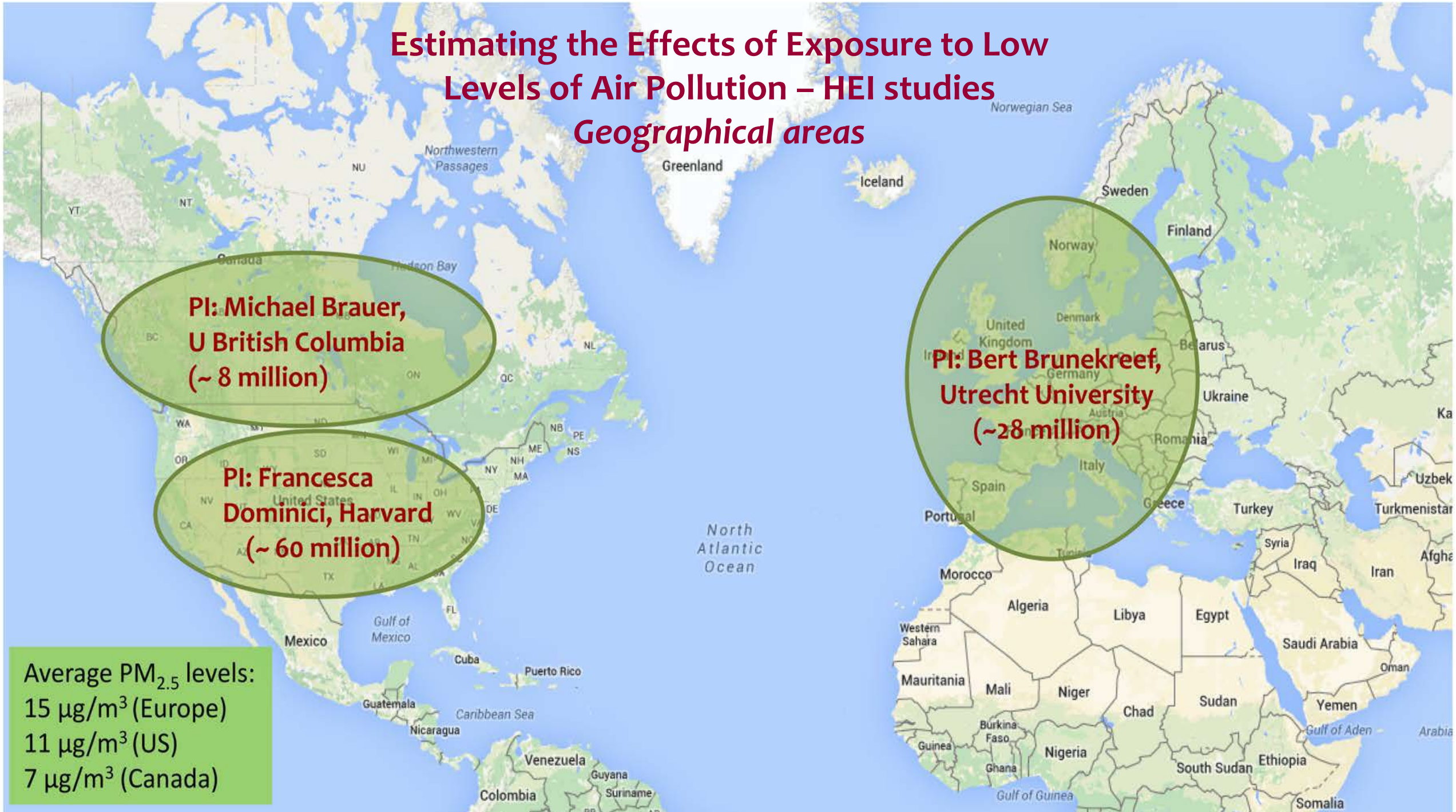
Key features of the three studies

- 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

HEI

Estimating the Effects of Exposure to Low Levels of Air Pollution – HEI studies

Geographical areas



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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

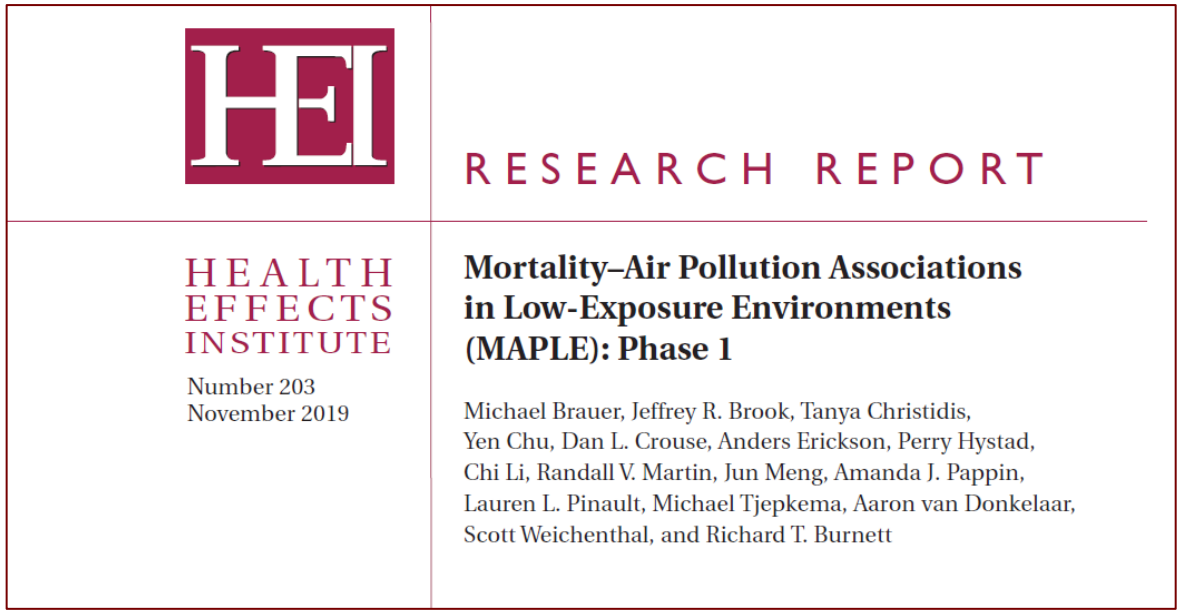
-Formed special independent Review Panel to review the reports and prepare commentaries

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


RESEARCH REPORT

HEALTH EFFECTS INSTITUTE

Number 203
November 2019

Mortality–Air Pollution Associations in Low-Exposure Environments (MAPLE): Phase 1

Michael Brauer, Jeffrey R. Brook, Tanya Christidis, Yen Chu, Dan L. Crouse, Anders Erickson, Perry Hystad, Chi Li, Randall V. Martin, Jun Meng, Amanda J. Pappin, Lauren L. Pinault, Michael Tjepkema, Aaron van Donkelaar, Scott Weichenthal, and Richard T. Burnett


RESEARCH REPORT

HEALTH EFFECTS INSTITUTE

Number 200
November 2019

Assessing Adverse Health Effects of Long-Term Exposure to Low Levels of Ambient Air Pollution: Phase 1

Francesca Dominici, Joel Schwartz, Qian Di, Danielle Braun, Christine Choirat, and Antonella Zanobetti

Initial evidence for an association between mortality and $PM_{2.5}$ exposure at levels below the current US National Air Quality Standards (<12 µg/m³) with no observable thresholds

All HEI reports and commentaries are available on our website **www.healtheffects.org**

For today….

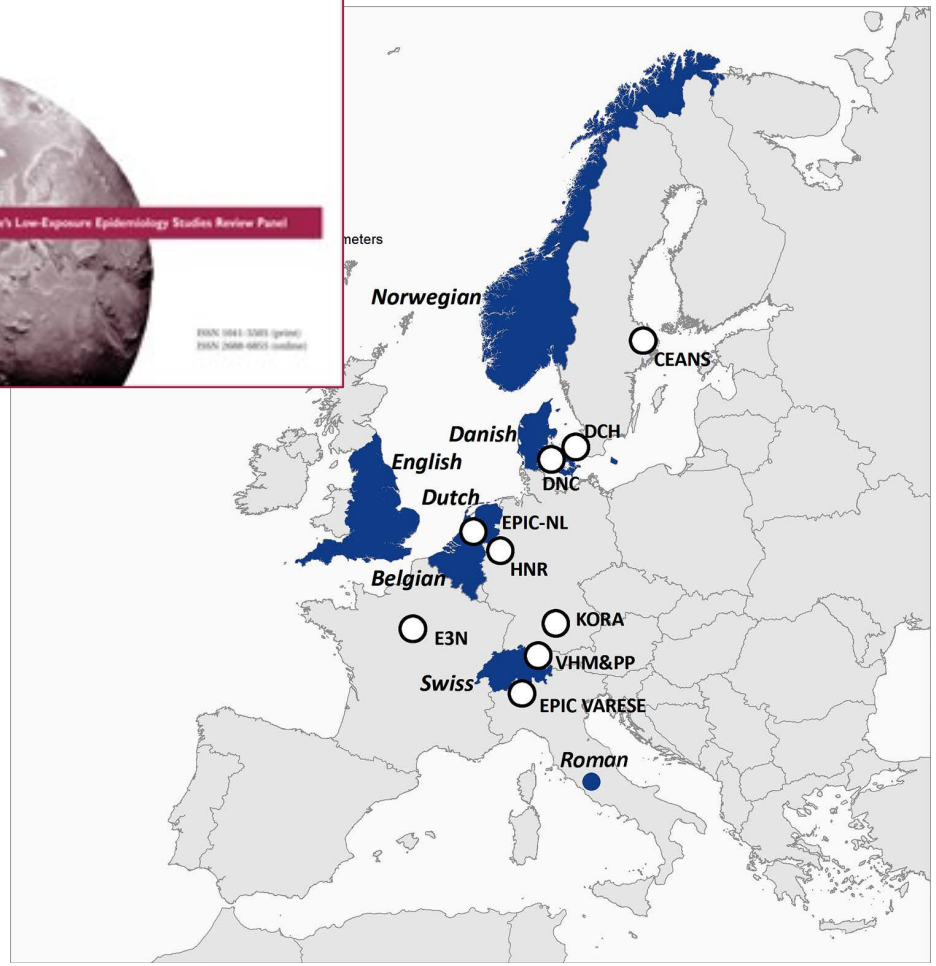
The European study was published in **September 2021.**

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

Figure 1. Study cohorts. Shaded regions indicate the areas included in the administrative cohorts; open circles indicate the cohorts included in the pooled cohort.



THANK YOU!

Check out our website www.healtheffects.org