



Question for Consideration:
Should the Search Continue?

HEI Annual Conference (webinar)
Session on Particle Components and Associated
Health Effects

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“We know they’re out there and continue to search for evidence, but . . . ”



RESEARCH REPORT

National Particle Component Toxicity (NPACT) Initiative: Integrated Epidemiologic and Toxicologic Studies of the Health Effects of Particulate Matter Components

Morton Lippmann, Lung-Chi Chen, Terry Gordon, Kazuhiko Ito, and George D. Thurston

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Integrated Science Assessment for Particulate Matter

All EHP content is accessible to individuals with disabilities. A fully accessible (Section 508-compliant) HTML version of this article is available at <http://dx.doi.org/10.1289/ehp.1307568>.

Associations of Fine Particulate Matter Species with Mortality in the United States: A Multicity Time-Series Analysis

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BACKGROUND: Epidemiological studies have examined the association between $PM_{2.5}$ and mortality, but uncertainty remains about the seasonal variations in $PM_{2.5}$ -related effects and the relative importance of species.

OBJECTIVES: We estimated the effects of $PM_{2.5}$ species on mortality and how infiltration rates may modify the association.

METHODS: Using city-season specific Poisson regression, we estimated $PM_{2.5}$ effects on approximately 4.5 million deaths for all causes, cardiovascular disease (CVD), myocardial infarction (MI), stroke, and respiratory diseases in 75 U.S. cities for 2000–2006. We added interaction terms between $PM_{2.5}$ and monthly average species-to- $PM_{2.5}$ proportions of individual species to determine the relative toxicity of each species. We combined results across cities using multivariate meta-regression, and controlled for infiltration.

RESULTS: We estimated a 1.18% (95% CI: 0.93, 1.44%) increase in all-cause mortality, a 1.03% (95% CI: 0.65, 1.41%) increase in CVD, a 1.22% (95% CI: 0.62, 1.82%) increase in MI, a 1.76% (95% CI: 1.01, 2.52%) increase in stroke, and a 1.71% (95% CI: 1.06, 2.35%) increase in respiratory deaths in association with a $10\text{-}\mu\text{g}/\text{m}^3$ increase in 2-day averaged $PM_{2.5}$ concentration. The associations were largest in the spring. Silicon, calcium, and sulfur were associated with more all-cause mortality, whereas sulfur was related to more respiratory deaths. County-level smoking and alcohol were associated with larger estimated $PM_{2.5}$ effects.

CONCLUSIONS: Our study showed an increased risk of mortality associated with $PM_{2.5}$, which varied with seasons and species. The results suggest that mass alone might not be sufficient to evaluate the health effects of particles.

CITATION: Dai L, Zanobetti A, Koutrakis P, Schwartz JD. 2014. Associations of fine particulate matter species with mortality in the United States: a multicity time-series analysis. *Environ Health Perspect* 122:837–842; <http://dx.doi.org/10.1289/ehp.1307568>

Research

> 1 day. Thus, when one uses separate time series for components that are measured only 1 day in 6 or 1 day in 3, this will bias downward estimates, possibly more for some components than others. In addition, the loss of two-thirds to five-sixths of the data substantially reduces power.

U.S. adults—particularly the elderly, who dominate mortality statistics—spend approximately 90% of their time indoors (U.S. EPA 1989). Although particles penetrate indoors, the infiltration rates vary with the extent to which windows and doors are open, which in turn can vary with local temperature and may therefore modify the association. Previous studies have reported such modification (Franklin et al. 2008; Stafoggia et al. 2008; Zanobetti et al. 2009). In this paper we address these issues and also examine more species, add an additional year of observation, and look at specific causes of death.

Materials and Methods

Study sites. We included 75 U.S. cities in our study (see Supplemental Material, Table S1).

Chronic Inhalation Exposure of Mice to $PM_{2.5}$ from Five Airsheds and Mortality

Morton Lippmann

In vitro and in vivo Toxicity of Exposure to Coarse, PM_{10} from Five Airsheds

Morton Lippmann, Arthur Nádas, and Christina Hickey

Time-Series Analysis of Mortality, Hospitalizations, and Its Components

Morton Lippmann, Jiang Zhou, Arthur Nádas, Morton Lippmann, and George D. Thurston

Mortality and Long-Term Exposure to $PM_{2.5}$ and Mortality in the American Cancer Society's Cancer Cohort Study II Cohort

George D. Thurston, Kazuhiko Ito, Ramona Lall, Richard T. Burnett, Daniel Krewski, Yuanli Shi, Michael J. Spapstrup, W. Ryan Diver, and C. Arden Pope

HEI Perspectives 3

January 2013

Insights from HEI's research

Understanding the Health Effects of Ambient Ultrafine Particles

HEI Review Panel on Ultrafine Particles

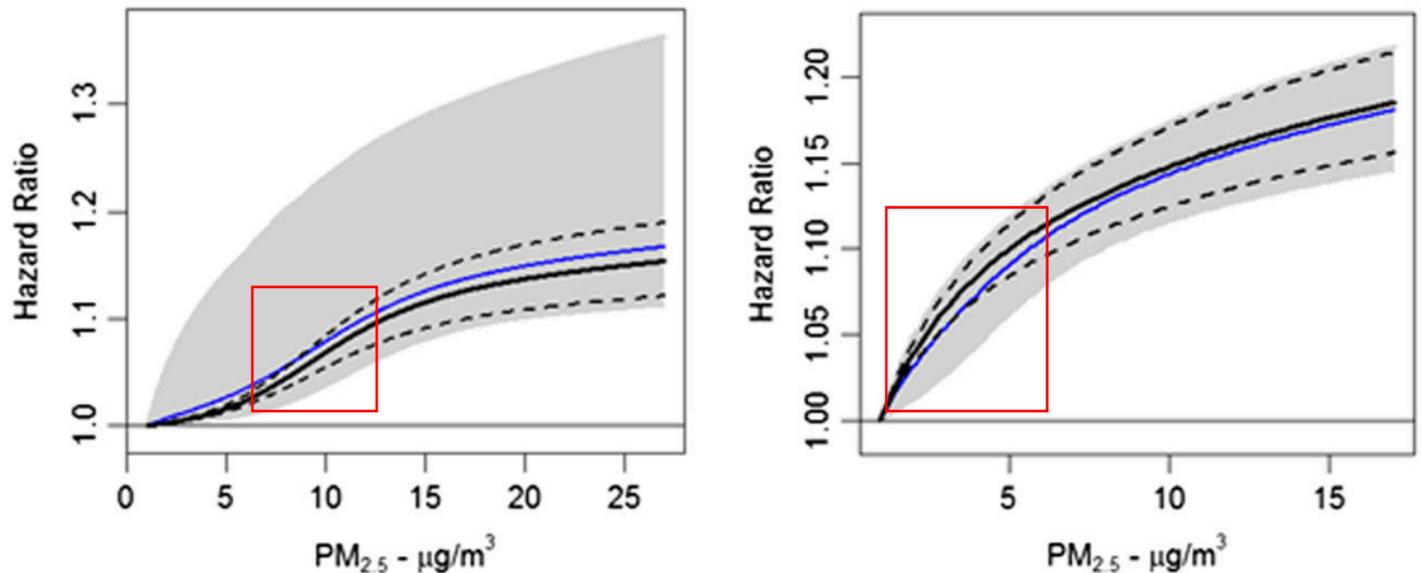
Signals?

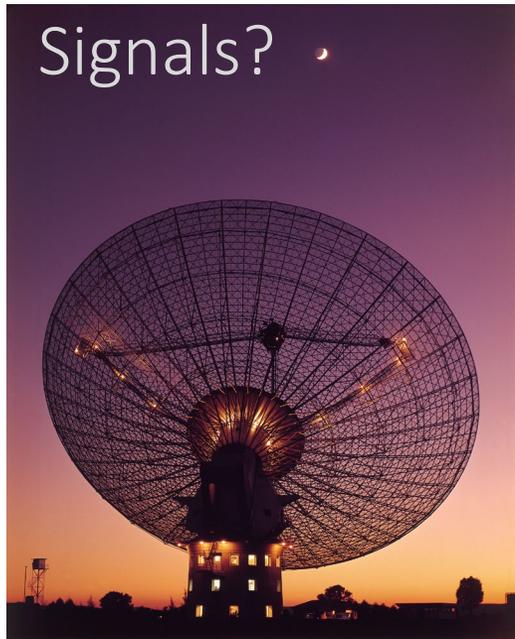


Might the recent observations of supralinearity at low ambient concentrations be indicative of relatively more toxic species/types of PM that have been resistant to, or not targeted in, past and current pollution reduction policies and regulations?

- Perhaps these longstanding policies targeting industrial and vehicle exhaust emissions have been successful in lowering PM_{2.5} ambient concentrations overall but not non-tailpipe emissions (e.g., tire wear, brake wear, domestic woodsmoke, new roadway surface components) or other novel components that persist after those 'traditional' PM sources are lowered.

Fig. 2 Hazard functions for CPS II (left hand panel) and CanCHEC (right hand panel). Optimal hazard function (black solid line) with uncertainty bounds (dashed black lines). Ensemble hazard function (blue solid line) with uncertainty bounds (gray-shaded area)





Are the persistent findings of regional heterogeneity in cross-sectional epidemiological studies also indicative of varying levels of toxicity among PM components?



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Original Contribution

Long-Term PM_{2.5} Exposure and Respiratory, Cancer, and Cardiovascular Mortality in Older US Adults

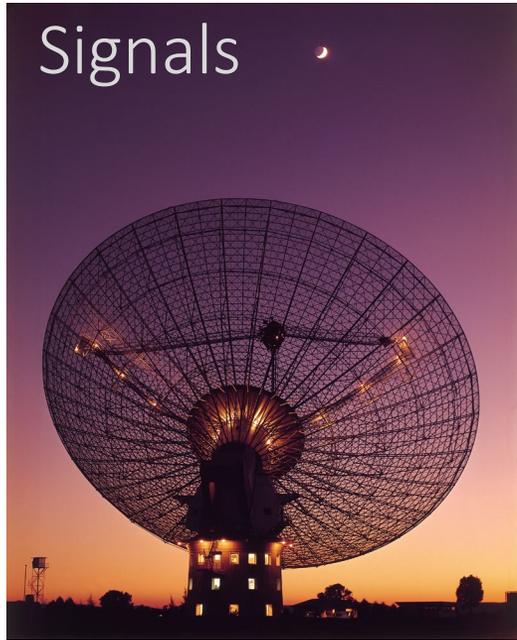
Vivian C. Pun, Fatemeh Kazemiparkouhi, Justin Manjourides, and Helen H. Suh*

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Table 2. Mortality Risk Associated With a 10- $\mu\text{g}/\text{m}^3$ Increase in 12-Month Moving Average PM_{2.5} Concentration, Nationwide and by Region, United States, 2000–2008

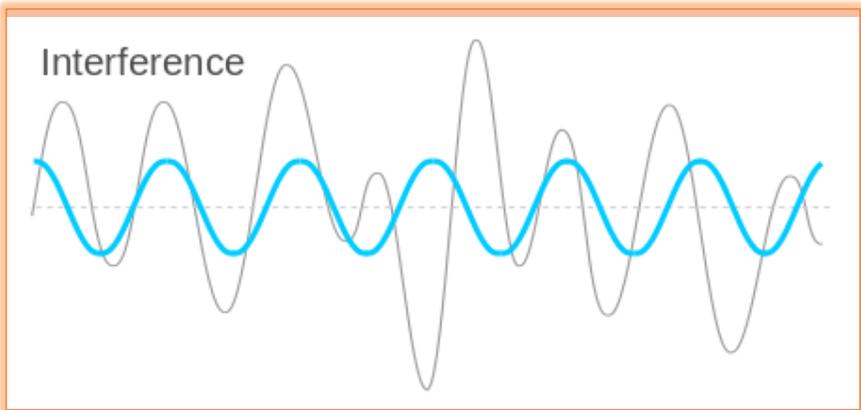
Cause of Death and Region	Nonadjusted Model		BRFSS-Adjusted Model ^a	
	RR	95% CI	RR	95% CI
All causes				
United States	1.223	1.215, 1.232	1.206	1.197, 1.214
West	1.163	1.152, 1.174	1.167	1.156, 1.178
Midwest	1.210	1.193, 1.228	1.172	1.155, 1.190
South	1.215	1.193, 1.239	1.151	1.129, 1.174
Northeast	1.471	1.447, 1.496	1.397	1.372, 1.422

Are current data sources and statistical methods still too limited to process these signals within a multi-pollutant world?



Analyses of time-activity patterns indicate that most people spend 85%-90% of their time indoors (even pre-COVID). In some areas/homes, concentrations of indoor-generated particles are higher than outdoor concentrations.

- *Might the signals from indoor PM be interfering with those from outdoor PM, thus partially obliterating potentially observable differences in particle species toxicity in epidemiology studies?*



Path Forward

- Abandon the particle mass-based search?
- Search on other characteristics, e.g., particle number, morphology, sizes, sources?
- Focus search on 'new' sources mentioned previously?
- Account for and isolate signals from indoor PM in future searches?
- Are the appropriate data sources (now inadequate) and analytical tools required for non-mass PM epidemiologic research available or being developed?