



# STATEMENT

Synopsis of Research Report 94, Part II

HEALTH  
EFFECTS  
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## The National Morbidity, Mortality, and Air Pollution Study: Morbidity and Mortality from Air Pollution in the United States

### BACKGROUND

Epidemiologic time-series studies conducted in a number of cities have identified, in general, an association between daily changes in concentration of ambient particulate matter (PM) and daily number of deaths (mortality). Increased hospitalization (a measure of morbidity) among the elderly for specific causes has also been associated with PM. These studies have raised concerns about public health effects of particulate air pollution and have contributed to regulatory decisions in the United States. However, scientists have pointed out uncertainties that raise questions about the interpretation of these studies.

One limitation to previous time-series studies of PM and adverse health effects is that the evidence for an association is derived from studies conducted in single locations using diverse analytic methods. Statistical procedures have been used to combine the results of these single location studies in order to produce a summary estimate of the health effects of PM. Difficulties with this approach include the process by which cities were selected to be studied, the different analytic methods applied to each single study, and the variety of methods used to measure or account for variables included in the analysis. These individual studies were also not able to account for the effects of gaseous air pollutants in a systematic manner.

### APPROACH

HEI funded the National Morbidity, Mortality, and Air Pollution Study (NMMAPS) to characterize the effects of airborne particles less than 10  $\mu\text{m}$  in aerodynamic diameter ( $\text{PM}_{10}$ ) alone and in combination with gaseous air pollutants in a consistent

way in a large number of cities. The study was designed to select multiple locations based on the specific criteria of population size and availability of  $\text{PM}_{10}$  data from the US Environmental Protection Agency's Aerometric Information Retrieval System (AIRS) database, and to apply the same statistical procedures to all locations. Dr Jonathan Samet and his colleagues at Johns Hopkins University conducted a time-series study of mortality effects in large US cities representing various levels of  $\text{PM}_{10}$  and gaseous pollutants. In their analysis, the investigators first estimated risk in each city using the same method and then combined these results systematically to draw more information than any single city could provide. The 20 and 90 largest cities were analyzed for effects of  $\text{PM}_{10}$  and other pollutants on mortality; the 90 largest cities were analyzed for possible modification of  $\text{PM}_{10}$  effects among cities by factors other than air pollutants. Dr Samet's coinvestigators at Harvard University also applied a unified statistical method, although different from the one used in the mortality analysis, to 14 cities with daily  $\text{PM}_{10}$  data to examine effects on hospitalization among those 65 years of age or older.

### RESULTS AND IMPLICATIONS

NMMAPS has made a substantial contribution in addressing major limitations of previous studies. The mortality analysis used one analytic approach to examine the  $\text{PM}_{10}$  effect in many cities that cover a wide geographic area and have varying levels of different air pollutants. The results of both the 20 cities and 90 cities analyses are generally consistent with an average approximate 0.5% increase in overall mortality for every 10  $\mu\text{g}/\text{m}^3$  increase in  $\text{PM}_{10}$  measured the day before death. This effect was

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This Statement, prepared by the Health Effects Institute, summarizes a research project conducted by Dr Jonathan M Samet of Johns Hopkins School of Public Health, Baltimore MD. The complete report, *The National Morbidity, Mortality, and Air Pollution Study, Part II: Morbidity and Mortality from Air Pollution in the United States*, can be requested by contacting HEI offices (see reverse side).

SAMET II 94

slightly greater for deaths due to heart and lung disease than for total deaths. Effects of PM<sub>10</sub> measured on the day of death or 2 days before did not vary substantially from one another for total or for heart and lung deaths. The PM<sub>10</sub> effect on mortality also did not appear to be affected by other pollutants in the model.

Although individual estimates for each of the 90 cities varied, as expected, the strength of the analysis was in its ability to combine data from nearby cities in a particular region to estimate a PM<sub>10</sub> effect. Combining the data in this systematic way provided additional statistical power to the analysis that is not available in single-city analyses. Some differences in PM<sub>10</sub> effect on mortality were seen by region of the US: for the 90 cities, the largest effect was evident in the Northeast. The investigators did not identify any factor or factors that might explain these differences. This analysis is an important first step, and further evaluation of the reasons for these regional differences will advance our understanding of the association between PM<sub>10</sub> and mortality. The heterogeneity of effect across cities offers the potential to identify factors that could influence the effects of PM<sub>10</sub> on health

and thus provide valuable insights into the mechanisms by which PM<sub>10</sub> causes adverse health effects.

The morbidity analysis also used a unified analytic method to examine the association of PM<sub>10</sub> with hospitalization of those 65 years of age or older in 14 cities with daily PM<sub>10</sub> measurements. The results were consistent with an approximate 1% increase in admissions for cardiovascular disease and about a 2% increase in admissions for pneumonia and chronic obstructive pulmonary disease for each 10 µg/m<sup>3</sup> increase in PM<sub>10</sub>. A greater estimate of effect on hospitalizations at lower concentrations (less than 50 µg/m<sup>3</sup>) was found for the three diagnoses considered, but the meaning of these findings should await completion of concentration-response analyses for mortality now under way using data from 20 cities.

NMMAAPS has made substantial contributions to our understanding of the relationship between exposure to PM<sub>10</sub> and health effects. Further analyses in these databases of regional differences, the effects on morbidity and mortality combined, and concentration-response relationships will enhance our understanding.

# The National Morbidity, Mortality, and Air Pollution Study Part II: Morbidity and Mortality from Air Pollution in the United States

## INVESTIGATORS' REPORT

Jonathan M Samet, Scott L Zeger, Francesca Dominici, Frank Curriero, Ivan Coursac, Douglas W Dockery, Joel Schwartz, and Antonella Zanobetti

### Overview

Project Objectives  
Introduction to NMMAPS Part II

### Background

#### Mortality

Methods  
Results

#### Hospitalization of Elderly

Methods  
Results

### Discussion

### References

#### Appendix A. Demographic and Pollution Data for 90-City Analysis

#### Appendix B. Distributed Lag Between Air Pollution and Daily Deaths

#### Appendix C. Comparison of Heterogeneity Models

#### Appendix D. Monitoring Sites, Base Model Characteristics, and Results

#### Appendix E. Averaging and Trimming Process

## COMMENTARY

Health Review Committee

### Introduction

### Overview of the National Morbidity, Mortality, and Air Pollution Study

### Key Results

### Technical Evaluation

### Suggestions for Future Analyses of NMMAPS Data

### Discussion of Study Findings

### Conclusions

### References