



STATEMENT

Synopsis of Research Report 94, Part I

HEALTH
EFFECTS
INSTITUTE

The National Morbidity, Mortality, and Air Pollution Study: Methods and Methodologic Issues

BACKGROUND

Epidemiologic time-series studies conducted in a number of cities have found, in general, an association between daily changes in particulate matter (PM) and daily mortality counts. These studies, which have raised concerns about public health effects of particulate air pollution, have contributed significantly to decisions about regulating PM in the US. However, scientists have pointed out a number of limitations in these studies that raise questions about the interpretation of the results. They have questioned whether PM actually causes increased mortality, pointing to differences in results among studies in different locations; inadequate consideration of other variables, such as other pollutants, that might account for such an association; and the use of different analytic methods, yielding different results. Others have also pointed to the fact that the time-series epidemiologic studies do not include measurements of each individual's exposure to air pollutants, and concentration data from area monitors in the city are used as an approximation instead. This use of a surrogate may introduce error in exposure measurement that could account for observed associations.

Scientists have also suggested that the PM-mortality association represents premature mortality by only a few days among those near death. Advancing of death by only a few days has been referred to as harvesting or mortality displacement. If associations between increased mortality and PM reflect solely short-term mortality displacement, the daily time-series studies may be showing an effect of limited public health impact.

As the US Environmental Protection Agency (EPA) prepares to reevaluate the ambient air standards for PM in the US, and as other countries are similarly reviewing the evidence for associations between PM and mortality, it is important to understand

whether any observed associations might be accounted for by other pollutants, whether bias in exposure measurements leads to the association, or whether mortality displacement underlies the association.

APPROACH

In an effort to address the uncertainties regarding the association between PM and daily mortality, and to determine the effects of other pollutants on this association, HEI funded the National Morbidity, Mortality, and Air Pollution Study (NMMAPS). Dr Jonathan Samet and his colleagues at Johns Hopkins University, in collaboration with investigators at Harvard University, conducted this time-series study in large cities across the US where levels of PM and gaseous pollutants were varied. To conduct such a study and to begin to address issues of exposure measurement error and mortality displacement, new analytic methods were needed. This first report includes 5 separate sections that describe such methods; a second report will describe the results from applying these methods.

RESULTS AND IMPLICATIONS

Exposure Measurement Error

Dr Samet and his colleagues have advanced our understanding of the effects of error in measuring pollution in time-series studies. They use a theoretical model to test systematically what effect the relationship between personal exposure and ambient exposure might have on the observed increase in mortality associated with PM. The application of this model for correction requires using both ambient monitoring data and some personal exposure measurement data in the same area. Such availability of both types of data is currently limited to a few locations. The investigators were able to apply

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one such set of personal and ambient exposure data as an example. The theoretical and actual analyses generally appear to refute the criticisms that exposure measurement error could explain the associations between PM and adverse health effects. The general absence of measured exposure data, however, precludes making firm conclusions as to the specific effects of the errors. HEI, EPA, and other organizations are currently funding research to obtain more exposure data that should lead to more confident specific conclusions regarding the effect of any exposure measurement error.

Mortality Displacement

The investigators' examination of the role of mortality displacement using 2 different but related statistical approaches is original and suggests that more than a short-term displacement of mortality is occurring. It

remains unclear, however, which component(s) of the air pollution mix are actually responsible for any longer-term effect and, given our inexperience with the methods that focus on the longer time scales, how the estimates of effect based on these methods should be interpreted. Broader application of these methods and the development of new methods are needed to understand the public health implications more clearly.

Multicity Analysis Methods

The analytic methods developed to examine multicity mortality are flexible and comprehensive, allowing a combination of mortality effects across cities and an exploration of factors that might account for differences in effects seen among individual cities. These methods also set the stage for further analyses and for addressing questions that might follow from initial results.