



STATEMENT

Synopsis of Research Report 93

HEALTH
EFFECTS
INSTITUTE

Effects of Concentrated Ambient Particles in Rats and Hamsters: An Exploratory Study

INTRODUCTION

Particulate matter (PM) is the term used to define the complex mixture of small particles in the atmosphere. The size, chemical components (such as metal, organic, and salt content), and other physical and biological properties of these particles are highly variable from place to place and from season to season. Particle properties are also influenced by their source (which may be either natural processes or human activities such as driving vehicles) as well as by changes the particles undergo in the atmosphere. Epidemiologic studies have indicated that exposure to PM is associated with increases in morbidity and mortality, particularly in individuals with compromised cardiopulmonary function. A plausible mechanism linking particles and pathophysiologic effects has not been established, however. Thus, toxicologic studies in appropriate animal models and in humans are critical in trying to establish how PM may exert its adverse health effects.

The Health Effects Institute funded the study described in this Research Report as part of a program intended to identify critically needed information.

APPROACH

Dr Terry Gordon and colleagues at the New York University School of Medicine conducted an exploratory study to test the effects of exposure to PM derived from New York City air on the rodent cardiopulmonary system. They hypothesized that PM would have greater, possibly fatal, effects in animals with compromised cardiopulmonary function than in normal animals. To maximize possible effects, they concentrated particles up to 10 times their level in ambient air, using for the first time in an exposure study an instrument known as the *Gerber concentrator*, which concentrates particles of 0.2 to 2.5 μm in diameter. Gordon and colleagues exposed animals

for up to 6 hours to these particles in concentrations that ranged from approximately 150 to 900 $\mu\text{g}/\text{m}^3$. They exposed normal rats and hamsters, rats injected with monocrotaline to induce right-heart hypertrophy and pulmonary hypertension, and hamsters with a genetic cardiomyopathy. The investigators evaluated changes in heart rate and electrocardiogram intervals, mechanical pulmonary function, and inflammatory parameters. The majority of experiments involved normal and monocrotaline-injected young rats.

RESULTS AND INTERPRETATION

The investigators found little or no effect of concentrated ambient PM exposure on cardiac, mechanical pulmonary, or inflammatory measures in the rats and hamsters they studied. One of the few significant effects of concentrated PM was a small increase in heart rate of young rats in the 6 hours after exposure, but this increase was not found on all exposure days. Similar small effects were occasionally noted in monocrotaline-injected animals. Thus, the results indicated that the compromised rats and hamsters appeared no more sensitive to PM effects than age-matched control animals.

Previous studies have demonstrated that some types of PM can induce cardiac effects that may be fatal in monocrotaline-injected rats, but the effects reported in the current study were not life threatening. The current study used concentrated ambient particles, which might be expected to increase the likelihood of observing effects, but the study also used small numbers of animals (6 maximum) and small numbers of experiments, factors expected to reduce the likelihood of observing effects of exposure. Differences between the chemical composition and dose of PM components (such as metals) in other studies also may explain the discrepant findings.

Continued

This Statement, prepared by the Health Effects Institute, is a summary of a research project conducted by Dr Terry Gordon and colleagues of the New York University Medical Center, Tuxedo, New York. The complete report, *Effects of Concentrated Ambient Particles in Rats and Hamsters: An Exploratory Study*, can be requested from HEI by phone, fax, or e-mail (see reverse side).

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A recent study reported cardiac effects of concentrated ambient PM from Boston air in dogs, and particularly in dogs with induced coronary occlusion. In addition to the different species and models of cardiac conditions, differences in the levels of various PM components at distinct geographic locations may explain the differences in results. Comparing the particles used in this study with those used in Boston is difficult because Gordon and colleagues determined particle mass and sulfate but

did not fully characterize the particles to which the rodents were exposed.

No firm conclusions can be reached from this study about the sensitivity of these rodent models to concentrated PM, and the appropriateness of using these models—right-heart failure and pulmonary hypertension in particular—to represent a high-risk subset in the human population is uncertain.