



CLEAN AIR RESEARCH PROGRAM

EXPOSURE SCIENCE IMPROVES RISK ASSESSMENTS OF AIR POLLUTANTS

Issue:

Exposure to air pollutants is known to cause discomfort, illness, and even death, particularly among susceptible individuals. Susceptible groups include those with pre-existing cardiovascular or respiratory problems as well as the very young and the elderly. Research funded in part by the U.S. Environmental Protection Agency has shown that cleaner air results in a longer life.

Exposure in the context of air pollution is typically defined as the concentration, frequency, and duration of time that a human comes into contact with an airborne pollutant. In the case of most air pollution, the primary concern is the concentration of the contaminant to be inhaled.

Exposures vary depending on an individual's location relative to the contaminant source (distance,

indoor/outdoor), the time of day, lifestyle, and other factors. But how do we determine the actual exposure?

Measuring the actual exposure of an individual requires researchers to provide a measurement device to the person and record the amount of the contaminant he/she encounters throughout some defined period. Measuring exposure over a day is often a useful measure.

However, performing these studies is very expensive and time-consuming; therefore, it would be helpful to have better ways to estimate exposure. As a result, theoretical and experimental models based on study data are used to predict exposures.

Typically, the measured outdoor concentration of a contaminant is used as the estimate of exposure,

but for various contaminants it is not a good measure of the actual exposure. For this reason, the Clean Air Research Program in EPA's Office of Research and Development is dedicated to improving measurement capabilities and is developing and improving models that will provide more accurate estimates of exposure.

Science Objective:

Scientists in the Clean Air Research Program are characterizing exposure of humans through direct measurements of outdoor contaminant concentrations and direct measurements of personal exposure. As part of this effort, they are investigating the role human exposure plays in observed relationships between air quality and human health.

The information from exposure measurements is then being used

continued on back



CLEAN AIR RESEARCH PROGRAM

continued from front

to develop computer modeling tools to provide health scientists and risk assessors with more accurate exposure estimates.

Key scientific questions include:

- What is the relationship between (outdoor) ambient air concentration and actual human exposures to air pollutants?
- How does proximity to sources impact human exposures?
- How can exposure modeling approaches be applied to strengthen studies investigating relationships between air quality and human health?

Application and Impact:

Important information and tools are being provided to better understand how we come into contact with air pollutants and what effect they may have on the risk we experience from air pollution in our day-to-day lives. With this information, state air quality managers and federal

regulators like EPA's Office of Air and Radiation can work to reduce the public health risk posed from air pollution.

Exposure science at EPA has made significant contributions toward advancing our understanding of exposure to air pollution. The document, "*2004 NRC Report on Research Priorities for Airborne Particulate Matter*," noted that substantial progress had been made in understanding relationships between outdoor measures of PM and actual human exposures. In particular, findings from the PM Exposure Panel Studies (Williams 2000) demonstrated that a community air monitor could be considered a reasonable surrogate for personal human exposure to fine particles of ambient origin, thereby supporting the epidemiological findings that were instrumental in the development of PM standards.

In addition, the value of exposure assessments has been demonstrated in specific health studies. Two examples include findings that show in-vehicle exposure measurements,

associated cardiovascular health outcomes (Riediker 2004), and differential health impacts associated with community and personal monitoring (Brook and Williams 2008).

References:

National Research Council (2004) Research Priorities for Airborne Particulate Matter IV – Continuing Research Progress. Washington DC: National Academies Press.

Williams, et al The 1998 Baltimore Particulate Matter Epidemiology-Exposure Study: Part 1. Comparison of ambient, residential outdoor, indoor, and apartment particulate matter monitoring. *Journal of Exposure Analysis and Environmental Epidemiology*. 10, 518-532 (2000)

Riediker, M., et al. Particulate matter exposure in cars is associated with cardiovascular effects in healthy, young men. *American Journal of Respiratory and Critical Care Medicine*. 169: 934-940 (2004).

Brook and Williams. Vest monitors show air pollution is dangerous indoors and out. *American Heart Association Press Release*. (Nov 12, 2008)

CONTACT

David Kryak, Ph.D., National Exposure Research Laboratory, EPA's Office of Research and Development, 919-541-1457, kryak.davidd@epa.gov

APRIL 2009