

## **Adverse Health Effects of Particulate Matter: New Science Shows Effects Below Current Standards**



**More than 2,000 peer-reviewed studies** have been published since 1996 when the EPA last reviewed the standards for particle pollution. The new studies validate earlier research showing the strong relationship between particle pollution, illness, hospitalization and premature death. Furthermore, the recent studies show that the health effects of particle pollution may be more far reaching than was previously understood.

Particulate air pollution can affect the cardiovascular system as well as the lungs, triggering heart attacks and strokes. Lives are shortened not just by days or weeks, but by months or years. Air pollution targets not just the elderly, but also fetuses, infants, children and adolescents. People most at risk are not only those with asthma and COPD, but also those with heart conditions and diabetes. Effects are occurring at even lower concentrations than were previously believed to be harmful -- to levels below the current standards.

A few of the key studies that EPA relies on to recommend more stringent air quality standards are reviewed here.

### **LONG-TERM EXPOSURES**

**American Cancer Society Cohort Study:** This study of half a million people in 100 American cities over 16 years has been audited, replicated, re-analyzed, extended and ultimately reconfirmed. The latest results show that long-term exposure to fine particulate matter is associated with premature death from cardio-respiratory causes and *lung cancer*. Increased risk of premature death is evident at concentrations below current standards.<sup>1</sup>

**Harvard Six Cities Study:** This long-term cohort study has also been subject to an independent audit, review, and re-analysis and the original findings have been confirmed: long term exposure to fine particle pollution shortens lives and contributes to an increased risk of early death from heart and lung disease, even at air pollution levels far below the current standards.<sup>2</sup>

**Children's Health Study:** A study of school-age children in 12 southern California communities reported increased cough, bronchitis, and decreased lung function in children living in more polluted areas. The long-term mean fine particle concentration was at the level of the current standard.<sup>3,4</sup>

### **SHORT-TERM EXPOSURES**

Dozens of short-term community health studies from cities throughout the United States and around the world indicate that short-term increases in particle pollution are associated with adverse health effects ranging from increased respiratory symptoms such as coughing and wheezing to increased hospitalization, doctor visits and emergency room visits, to increased mortality from respiratory and cardiovascular disease. Here are a few of the dozens of studies upon which EPA is basing its recommendations:

**Air Pollution and Daily Mortality in Eight Canadian Cities:** Daily concentrations of PM<sub>2.5</sub> were well below the current air quality standards in this study of the eight largest Canadian cities. Daily increases in fine particle air pollution were linked to increases in daily deaths.<sup>5</sup>

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**Deaths from Cardiovascular Causes in Phoenix:** Phoenix is a city that meets current annual air quality standards, but a study has shown that short-term increases in fine particle pollution contribute to a rise in deaths from cardiovascular causes.<sup>6</sup>

**Daily Mortality in Santa Clara County:** A study of Santa Clara County, California found that the relationship between PM<sub>2.5</sub> pollution and daily mortality persisted even in an area that met current air quality standards.<sup>7</sup>

**Non-fatal Heart Attacks in Boston:** A Harvard University study found that high levels of particulate air pollution can trigger heart attacks in at-risk people exposed for even a short time. Researchers interviewed Boston area patients several days after their heart attacks and found that the onset of symptoms correlated with times of high daily air pollution.<sup>8</sup>

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<sup>1</sup> Pope CA, Burnett RT, Thun MJ, Calle EE, Krewski D, Ito K, Thurston GD. Lung Cancer, Cardiopulmonary Mortality, and Long-Term Exposure to Fine Particulate Air Pollution, *JAMA* 2002;287:9.

<sup>2</sup> Krewski D, Burnett RT, Goldberg MS, Hoover K, Siemiatycki J, Jerrett M, Abrahamowicz M, White WH. Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of particulate air pollution and mortality. 2000. Cambridge, MA: Health Effects Institute.

<sup>3</sup> Gauderman WJ, Gilliland GF, Vora H, Avol E, Stram D, McConnell R, Thomas D, Lurmann F, Margolis HG, Rappaport EB, Berhane K, Peters JM. Association between Air Pollution and Lung Function Growth in Southern California Children: results from a second cohort. *Am J Respir Crit Care Med* 2002;166:76-84.

<sup>4</sup> Gauderman WJ, Avol E, Gilliland F, Vora H, Thomas D, Berhane K, McConnell R, Kuenzli N, Lurmann F, Rappaport E, Margolis H, Bates D, Peters J. The effect of air pollution on lung development from 10 to 18 years of age. *NEJM* 2004;351:1057-67.

<sup>5</sup> Burnett RT, Brook J, Dann T, Delocla C, Philips O, Cakmak S, Vincent R, Goldberg MS, Krewski D. Association between particulate- and gas-phase components of urban air pollution and daily mortality in eight Canadian cities. *Inhal Toxicol* 2000;12 Suppl 4:15-39. Burnett RT Goldberg MS. Size-fractionated particulate mass and daily mortality in eight Canadian cities. In: Revised analyses of time-series studies of air pollution and health. Special report. 2003. Boston, MA: Health Effects Institute; pp. 85-90.

<sup>5</sup> Mar TF, Norris GA, Koenig JQ, Larson TV. Associations between air pollution and mortality in Phoenix, 1995-1997. *Environ Health Perspect* 2000;108:347-53. Mar TF, Norris GA, Larson TV, Wilson WE, Koenig JQ. Air pollution and cardiovascular mortality in Phoenix, 1995-1997. In: Revised analyses of time-series studies of air pollution and health. Special report. 2003. Boston, MA: Health Effects Institute; pp. 85-90.

<sup>5</sup> Fairley D. Daily mortality and air pollution in Santa Clara County, California: 1989-1996. *Environ Health Perspect* 1999;107:637-41. Fairley D. Mortality and air pollution for Santa Clara County, California, 1989-1996. In: Revised analyses of time-series studies of air pollution and health. Special report. 2003. Boston, MA: Health Effects Institute; pp. 85-90.

<sup>5</sup> Peters A, Dockery DW, Muller JE, Mittleman MA. Increased particulate air pollution and the triggering of myocardial infarction. *Circulation*. 2001;103:2810-2815.