

Follow-up to the
Harvard Six-Cities Study:
*Health Benefits of Reductions in Fine
Particulate Matter Air Pollution*

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Air Resources Board

California Environmental Protection Agency

Harvard Six-Cities Study: 1993 and 2006

- ◆ First study on long-term effects of exposure to low-to-moderate PM levels
- ◆ Dockery et al. (1993)* found an association between PM and premature death
- ◆ Over 8,000 adults in 6 cities in eastern U.S. followed for about 15 years
- ◆ Laden et al. (2006)** extended the follow-up for an additional 8 years (1990-1998)

*Dockery et al.: An association between air pollution and mortality in six US cities. N Engl J Med 1993; 329:1753-1759.

**Laden et al.: Reduction in fine particulate air pollution and mortality, extended follow-up of the Harvard Six Cities Study. Am J Resp Care Med 2006; 173:667-672.

Methodology Used and Trends Observed

- ◆ PM2.5 concentrations estimated based on visibility data and monitored PM10 data
 - Error of estimate not determined
- ◆ Study controlled for smoking, education, body mass index, sex and age
- ◆ PM2.5 decreased substantially between the two study periods
 - Correspondingly, death rates decreased in each city

Key Finding #1

- ◆ 16% increase in risk of overall premature death for each $10\text{-}\mu\text{g}/\text{m}^3$ increase in PM_{2.5} over entire follow-up period
 - Uncertainty range is 7% to 26%
- ◆ Results significant for deaths due heart-related disease, but of borderline significance for deaths due lung cancer
- ◆ Results are consistent with other chronic exposure studies
 - American Cancer Society (national and Los Angeles data)

Key Finding #2

- ◆ Between 2 periods, 27% lower risk of overall premature death for each 10- $\mu\text{g}/\text{m}^3$ decrease in mean PM_{2.5}
 - Uncertainty range is 5% to 43%
- ◆ Risk for deaths due to heart and lung disease decreased consistently as PM decreased, but not for lung cancer
 - Mortality effects of long-term PM pollution may be reversible
- ◆ Results are consistent with other evidence of air pollution reductions and health improvement
 - Ban of coal sales in Dublin, Ireland
 - Closure of steel mill in Utah Valley, Utah
 - Children's Health Study in southern California

Implications

- ◆ Supports association between PM exposure and premature death due to heart-related disease
- ◆ PM_{2.5}-associated deaths decreased in periods of decreased PM concentrations
- ◆ Supports need for reductions in PM exposure