

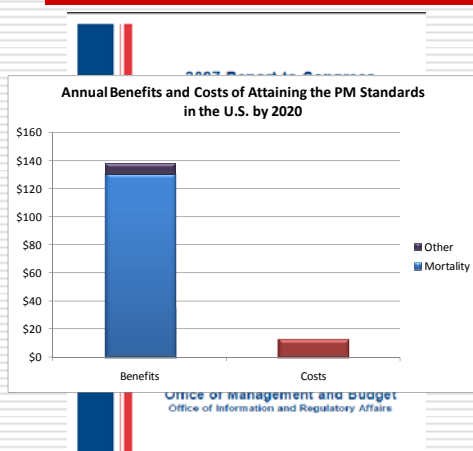
Health Implications of Energy Policy

*Sixth Annual Public Health Leadership Forum
Clearing the Air: Energy Practices & Human Health*

Massachusetts Medical Society
April 28, 2010

Douglas W. Dockery
Professor of Environmental Epidemiology
Harvard School of Public Health

Benefits and Costs of Federal Regulations



□ Largest estimated benefits of ALL Federal Regulations attributable to the reduction in public exposure to a single air pollutant: *fine particulate matter*.

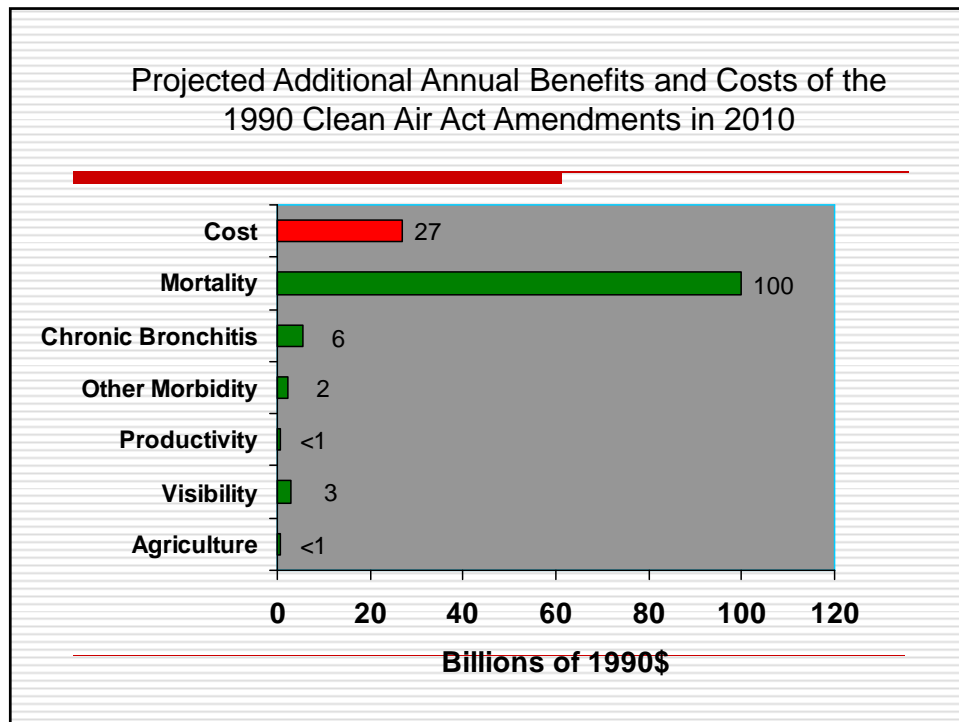
□ Clean Air Fine Particulate Implementation

■ Benefits (\$ Millions/year)

□ \$18,833 to \$167,408

■ Costs (\$ Millions/year)

□ \$ 7,324

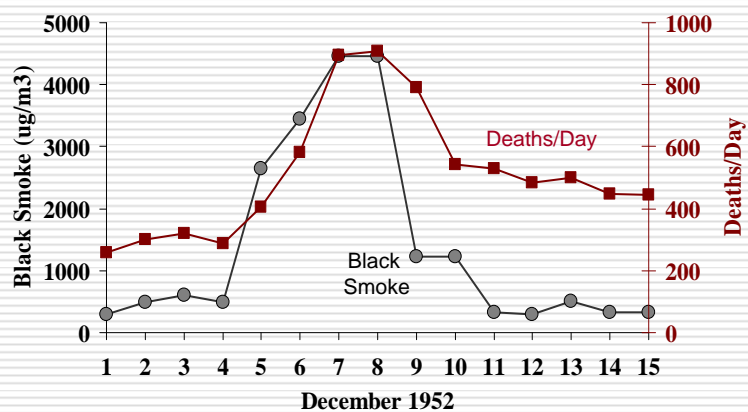


What is evidence for effects of PM on mortality?

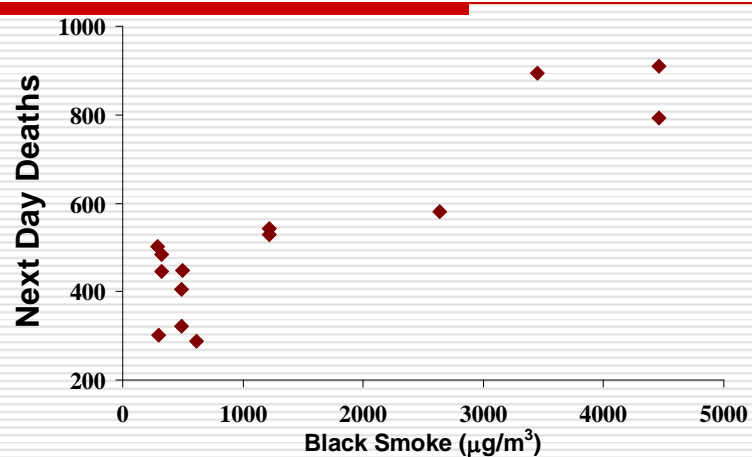
London Fog, December 1952



1952 London Fog Episode

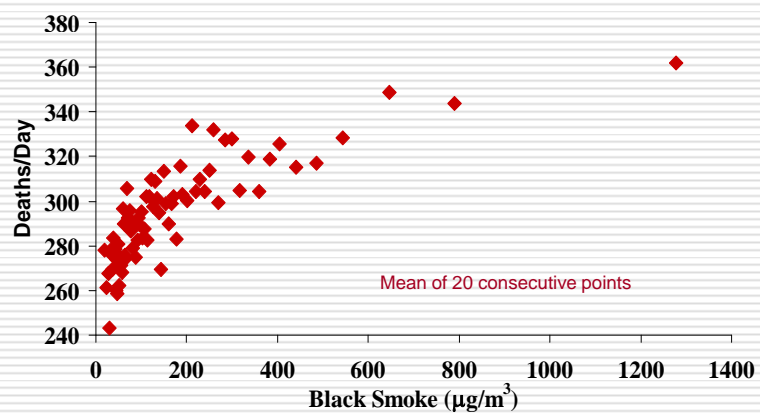


1952 London Fog Episode



London Mortality Time Series

Schwartz & Marcus, Am J Epi 1990

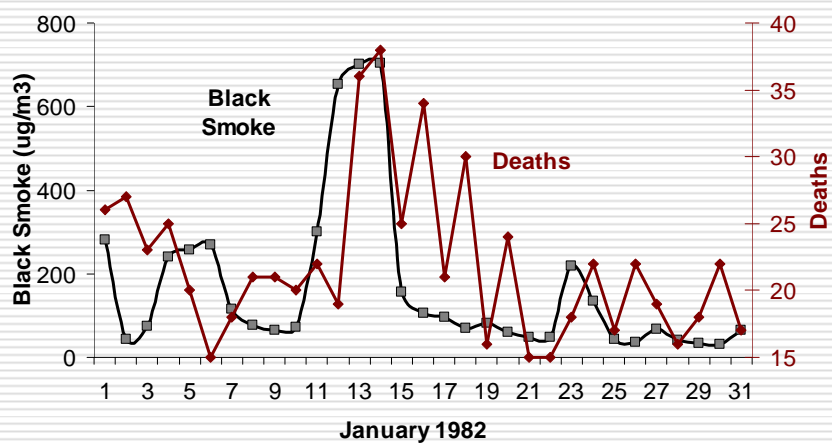


Experience in Dublin

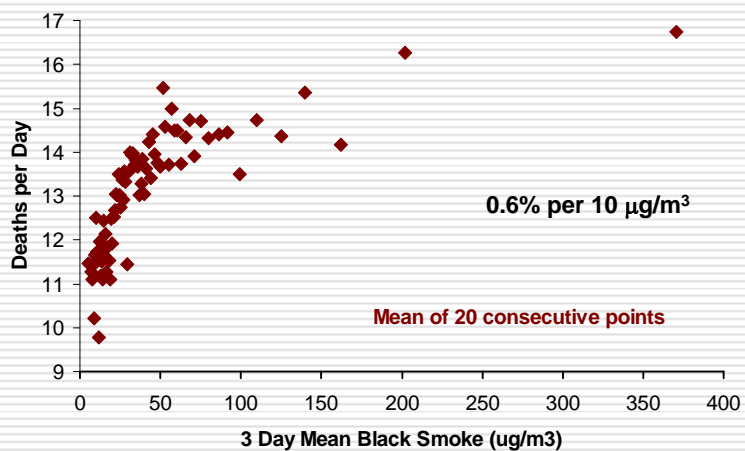
- ❑ Oil crisis in late 1970's led to programs to encourage use of solid fuels, primarily coal
- ❑ 1980's - switch from oil to coal
- ❑ Dominant source of air pollution in Dublin was smoke from domestic fires



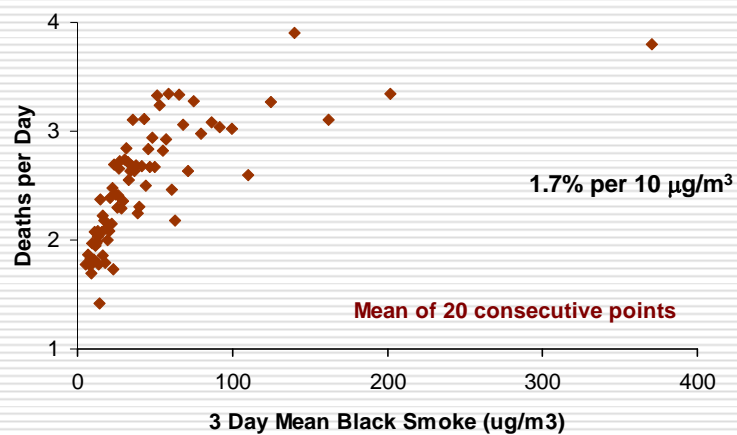
Dublin County Borough



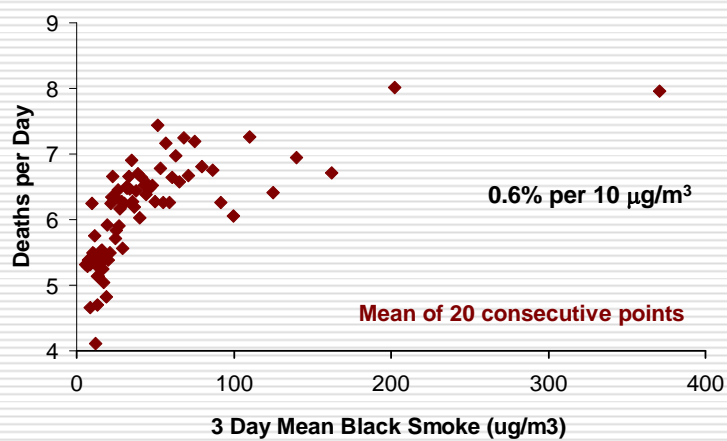
Dublin 1980-1990



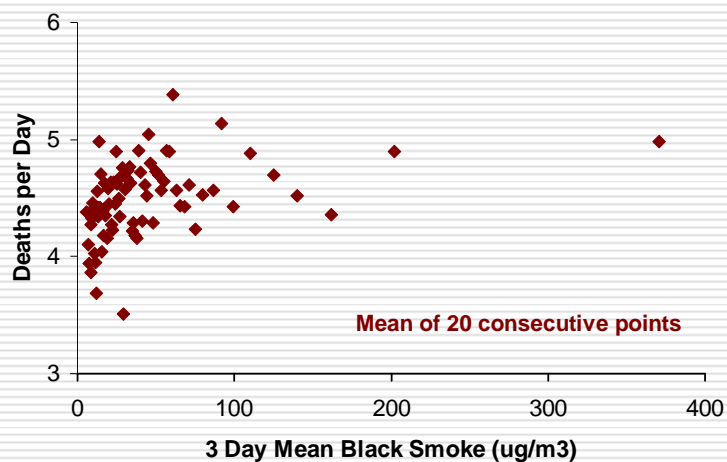
Respiratory Deaths: Dublin 1980-1990



Cardiovascular Deaths: Dublin 1980-1990

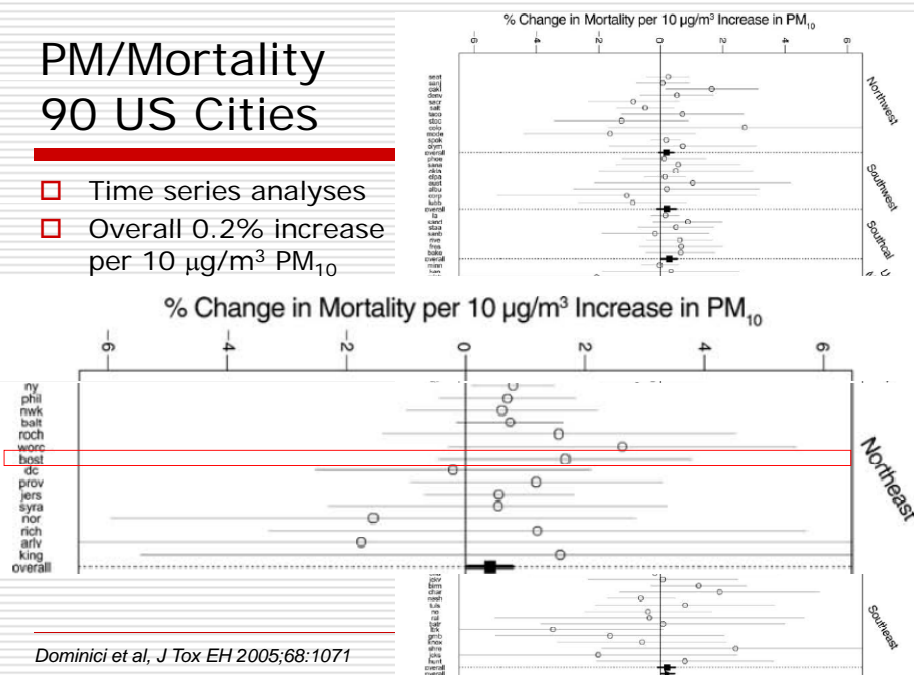


Other Deaths: Non-Cardiovascular, Non-Respiratory Dublin 1980-1990



PM/Mortality 90 US Cities

- Time series analyses
- Overall 0.2% increase per $10 \mu\text{g}/\text{m}^3$ PM_{10}

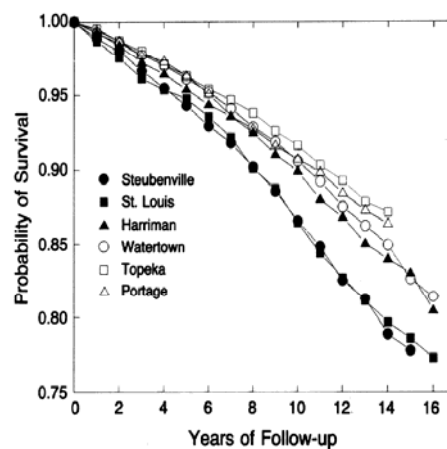


Mortality Effects of Chronic PM Exposures

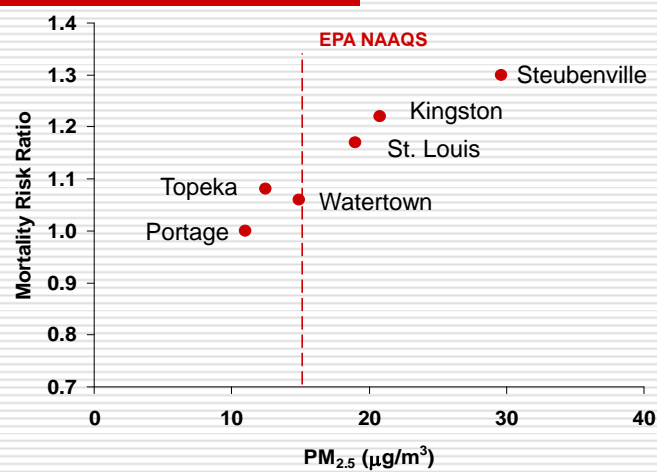
Six Cities Adult Mortality Study

Dockery et al, NEJM 1993; 329: 1753

- 8411 adults in 6 cities
 - Dirty: *Steubenville & St. Louis*
 - Moderate: *Watertown & Kinston/Harriman*
 - Clean: *Topeka & Portage*
- Enrolled starting in 1974
- 14-16 years of mortality follow-up



Six Cities Adult Mortality

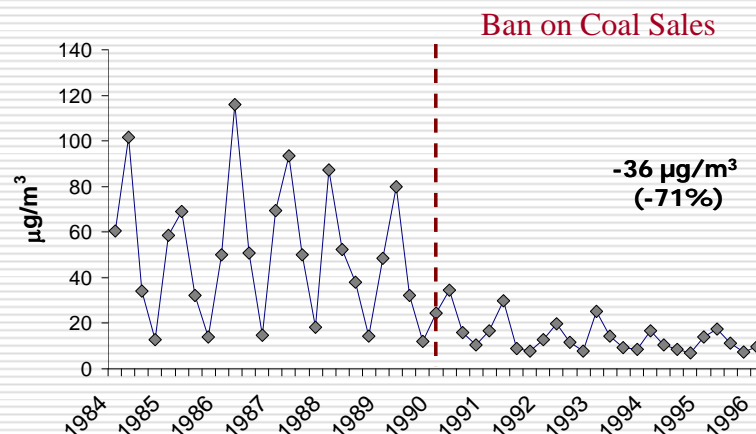


Evidence of effects of air
pollution control

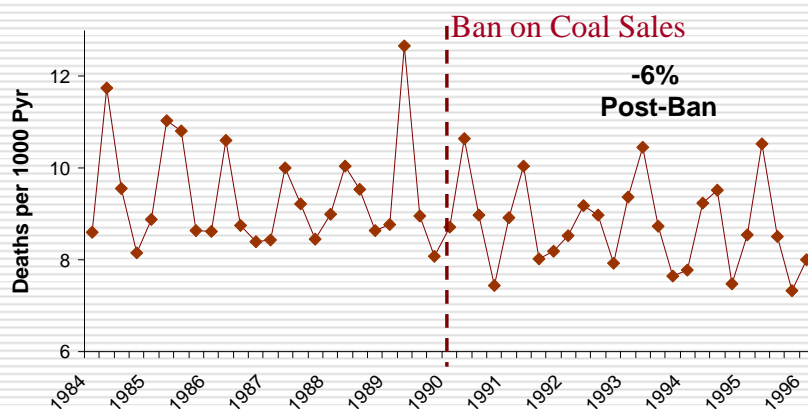
Dublin Coal Ban

- On September 1, 1990, the Irish Government banned the marketing, sale, and distribution of bituminous coals within Dublin County Borough, that is the city of Dublin (*Air Pollution Act, 1987*).

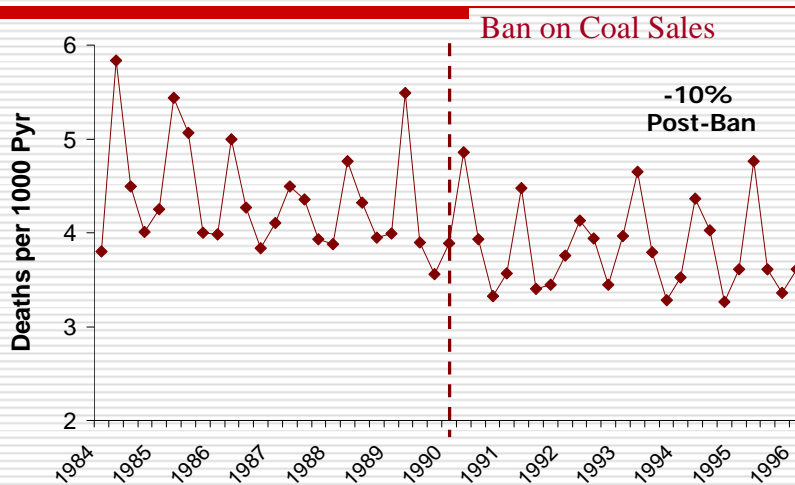
Dublin Black Smoke



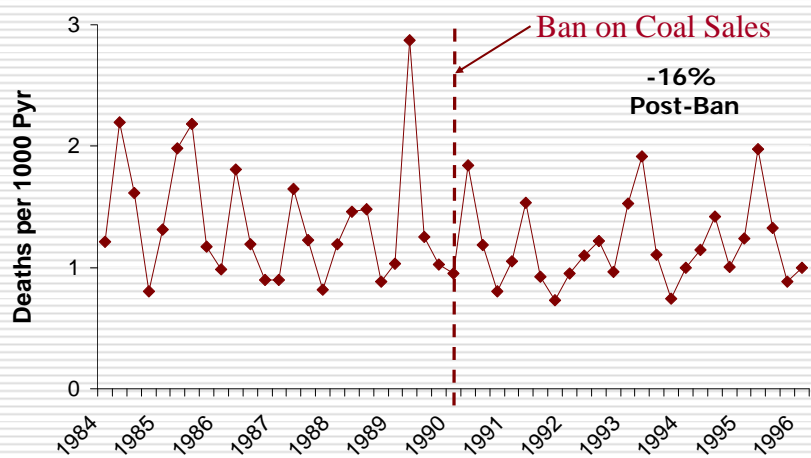
Dublin Total Mortality



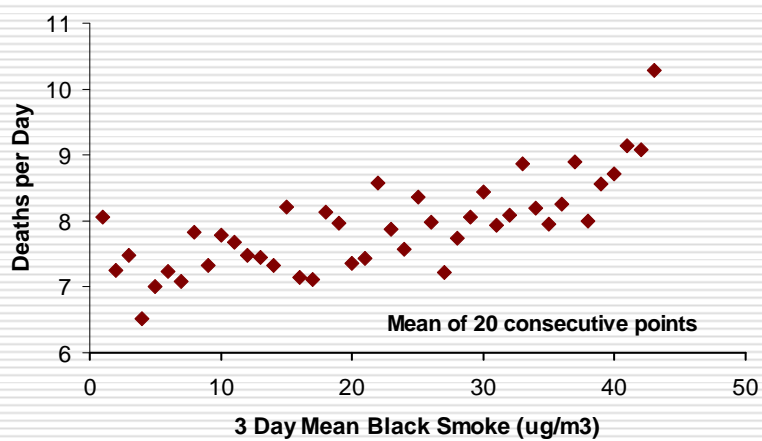
Dublin Cardiovascular



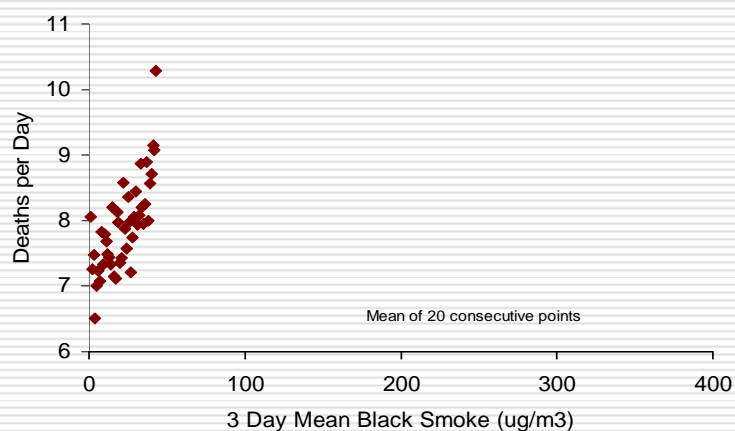
Dublin Respiratory Deaths



Dublin 1990-1996: Cardio-Respiratory Deaths



Dublin 1990-1996 Cardio-Respiratory Deaths

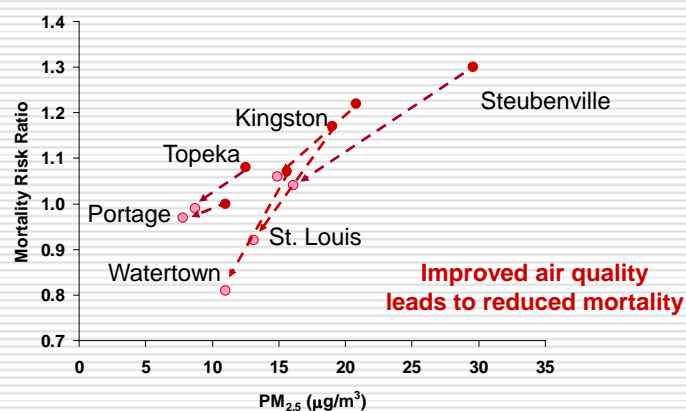


Six Cities Mortality Follow-up

- | | |
|---|---|
| <ul style="list-style-type: none"> □ 1974 to 1989 follow-up ■ Annual returned postcards and National Death Index ■ 1,364 deaths □ 104,243 person years ■ PM_{2.5} measurements 1979-1986 | <ul style="list-style-type: none"> □ 1990 to 1998 follow-up ■ National Death Index search ■ 1,368 deaths □ 54,735 person years ■ PM_{2.5} estimated from PM₁₀ 1990-1998 |
|---|---|

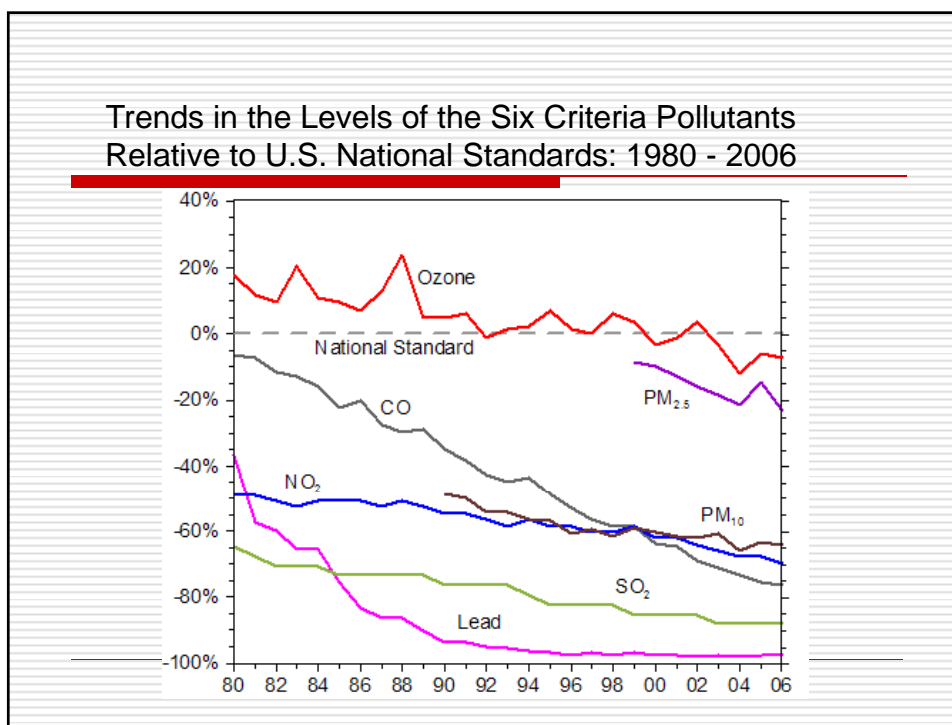
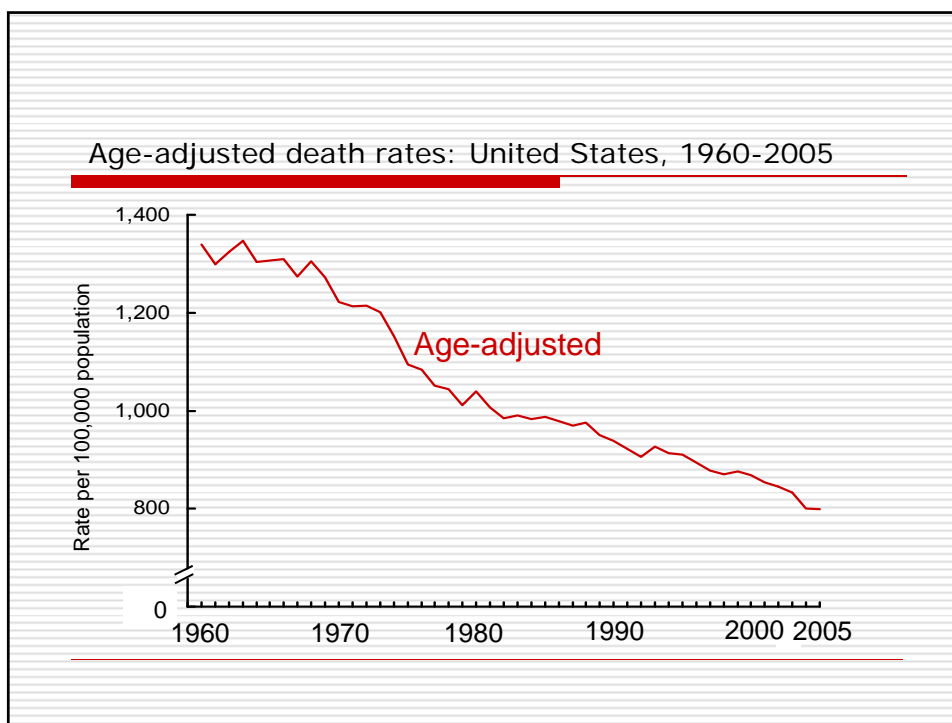
Laden et al, AJRCCM 2006;54:709

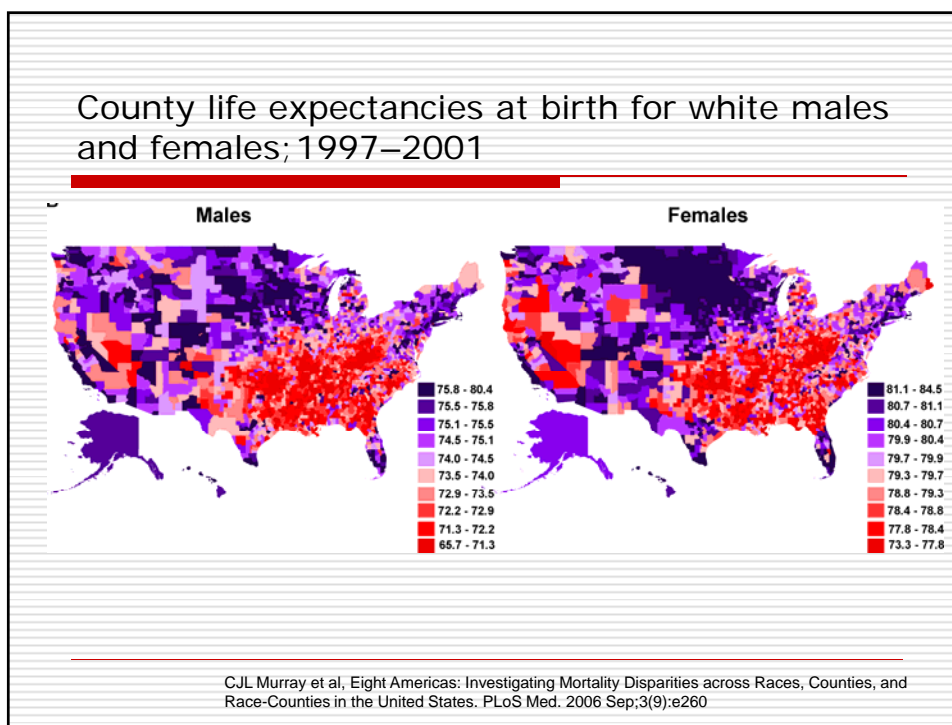
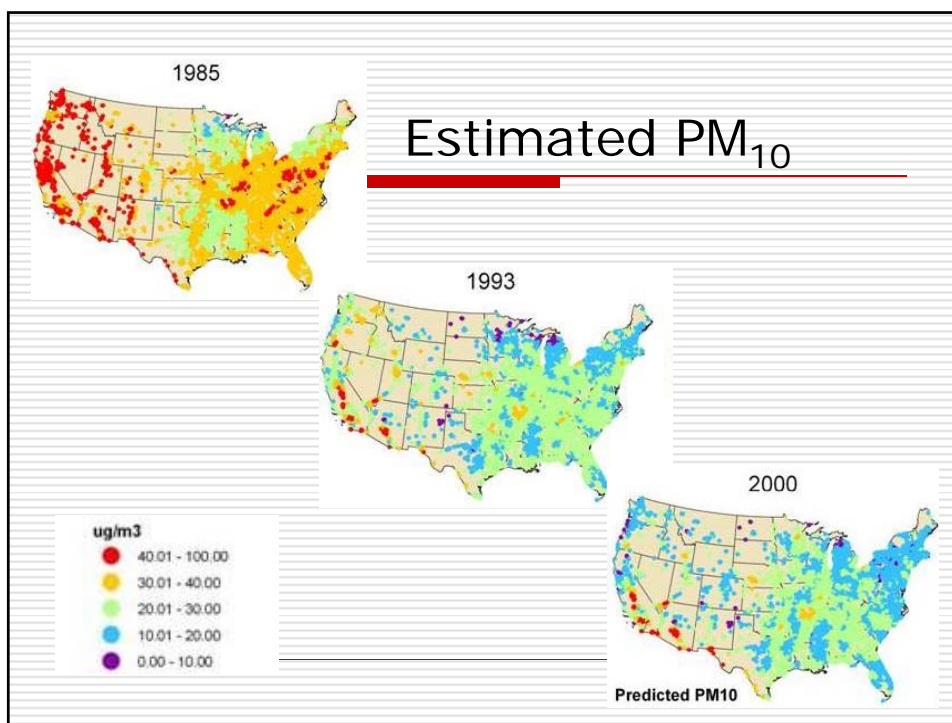
Six Cities Cohort Follow-up



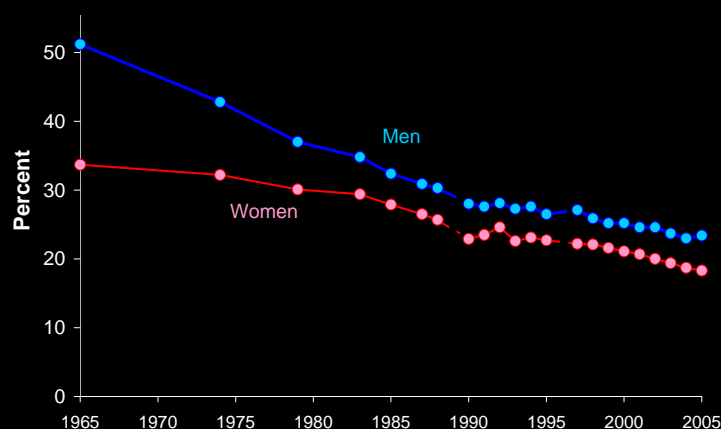
Laden et al, AJRCCM 2006;54:709

Can we see effect of air pollution controls in US?





Cigarette Smoking – United States



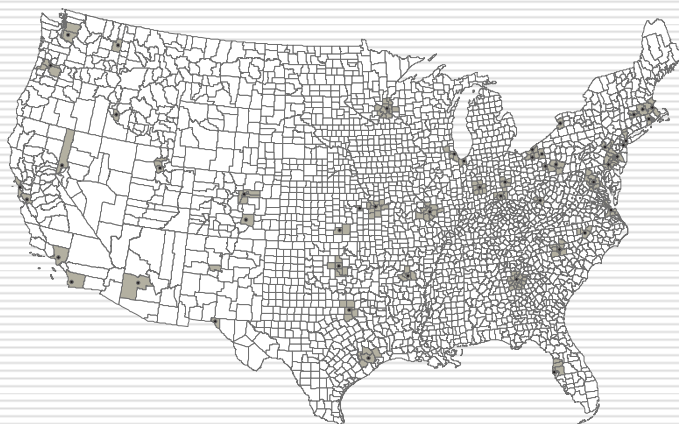
SOURCES: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health Interview Survey

Fine Particulate Air Pollution and US County Life Expectancies

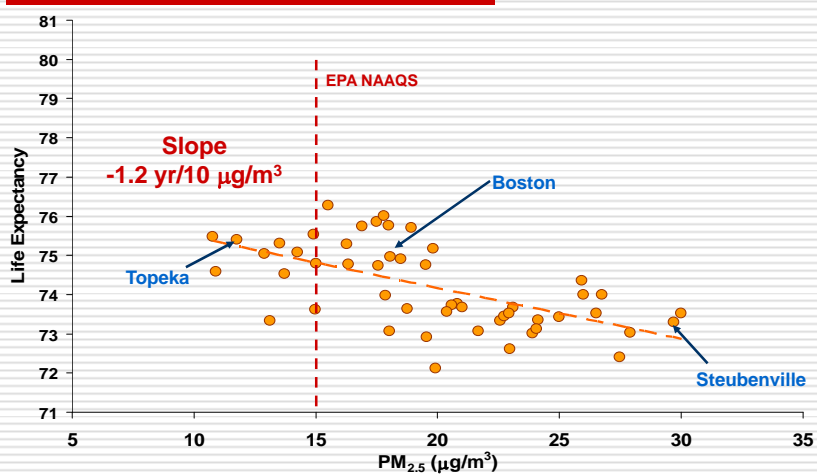
Pope, Ezzati, Dockery (NEJM 2009)

- Standardized life expectancy for each US County by year
- 51 U.S. metropolitan areas (217 counties)
 - PM_{2.5} data for ~1980 and ~2000
- Estimated association between reductions PM_{2.5} and change in life expectancy, controlling for
 - changes in socio-economic indicators
 - changes in demographic variables
 - proxy indicators of cigarette smoking (COPD and Lung Cancer mortality).

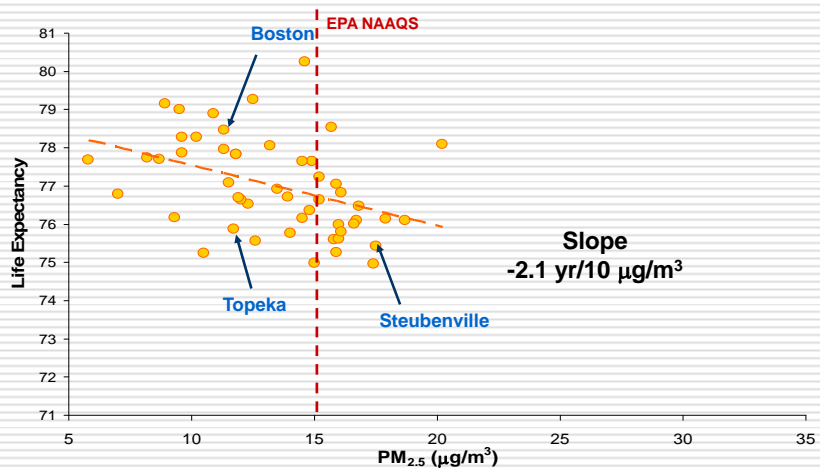
51 Metropolitan areas (dots); Study Counties (shaded gray)



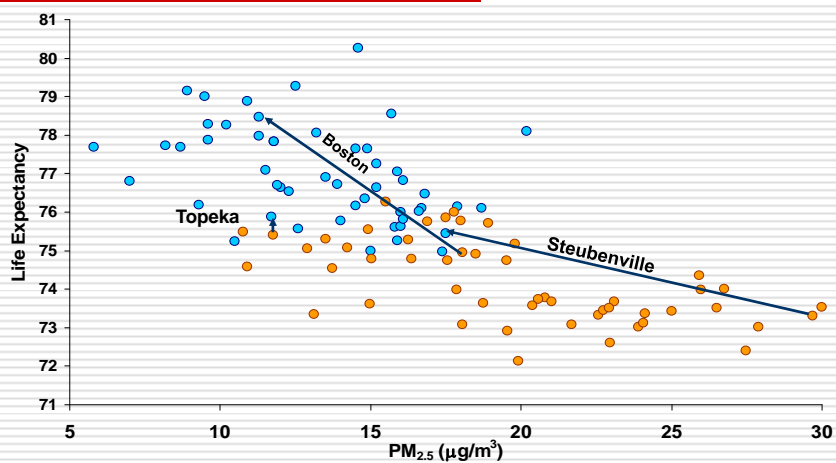
**Life Expectancy vs PM_{2.5}
1978-82**

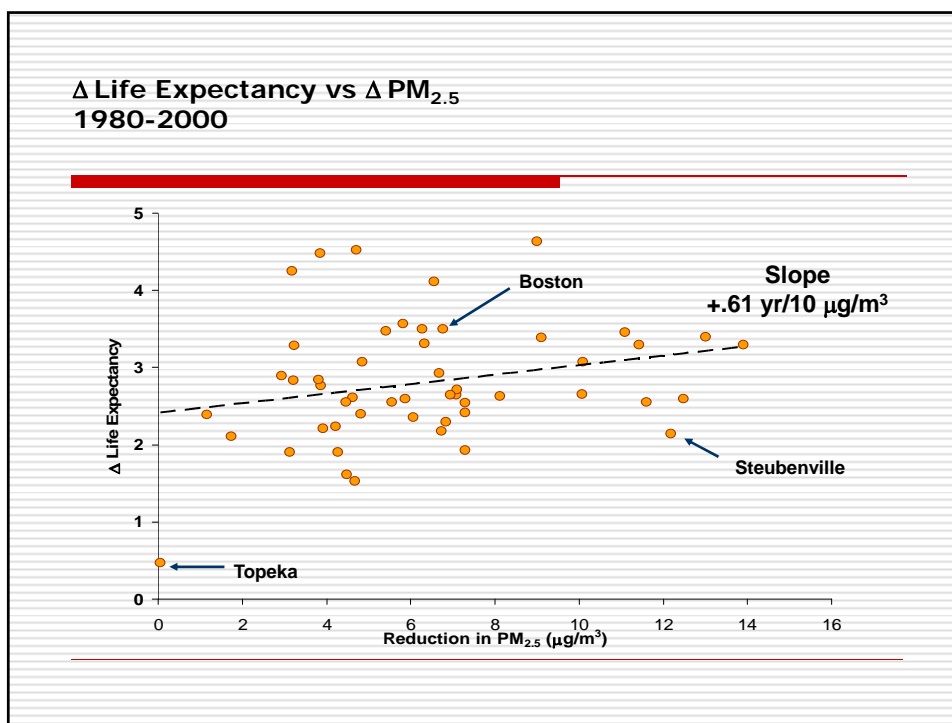


Life Expectancy vs PM_{2.5} 1997-2001



Life Expectancy vs PM_{2.5} 1980-2000





Fine Particulate Air Pollution and US County Life Expectancies

Pope, Ezzati, Dockery (NEJM 2009)

- 10 $\mu\text{g}/\text{m}^3$ decrease in PM_{2.5} associated with increase in life expectancy
0.61 (± 0.20) years
- Not sensitive to socio-economic, demographic, and proxy smoking variables
- Effect of reduced PM_{2.5} in these cities
15% overall increase in life expectancy

CONCLUSIONS

- ☐ Benefits of air pollution controls are measurable
 - ☐ Even in “clean” cities reduced air pollution leads to improved life expectancy
 - ☐ These benefits are substantial, that is year(s) of increased life expectancy
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