

Health Effects of Air Quality Actions Across the Globe



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Accountability

- Goal of air quality regulations is to protect public health by implementing regulatory actions or by providing economic incentives that help reduce the public's exposure to air pollution (e.g. Clean Air Act)
 - Air pollution should be reduced
 - Indicators of public health should improve
- Evaluation of extent to which air quality regulations succeed in protecting public health is deemed “accountability research”



Chain of Accountability

D.Q. Rich / *Environment International* 100 (2017) 62–78

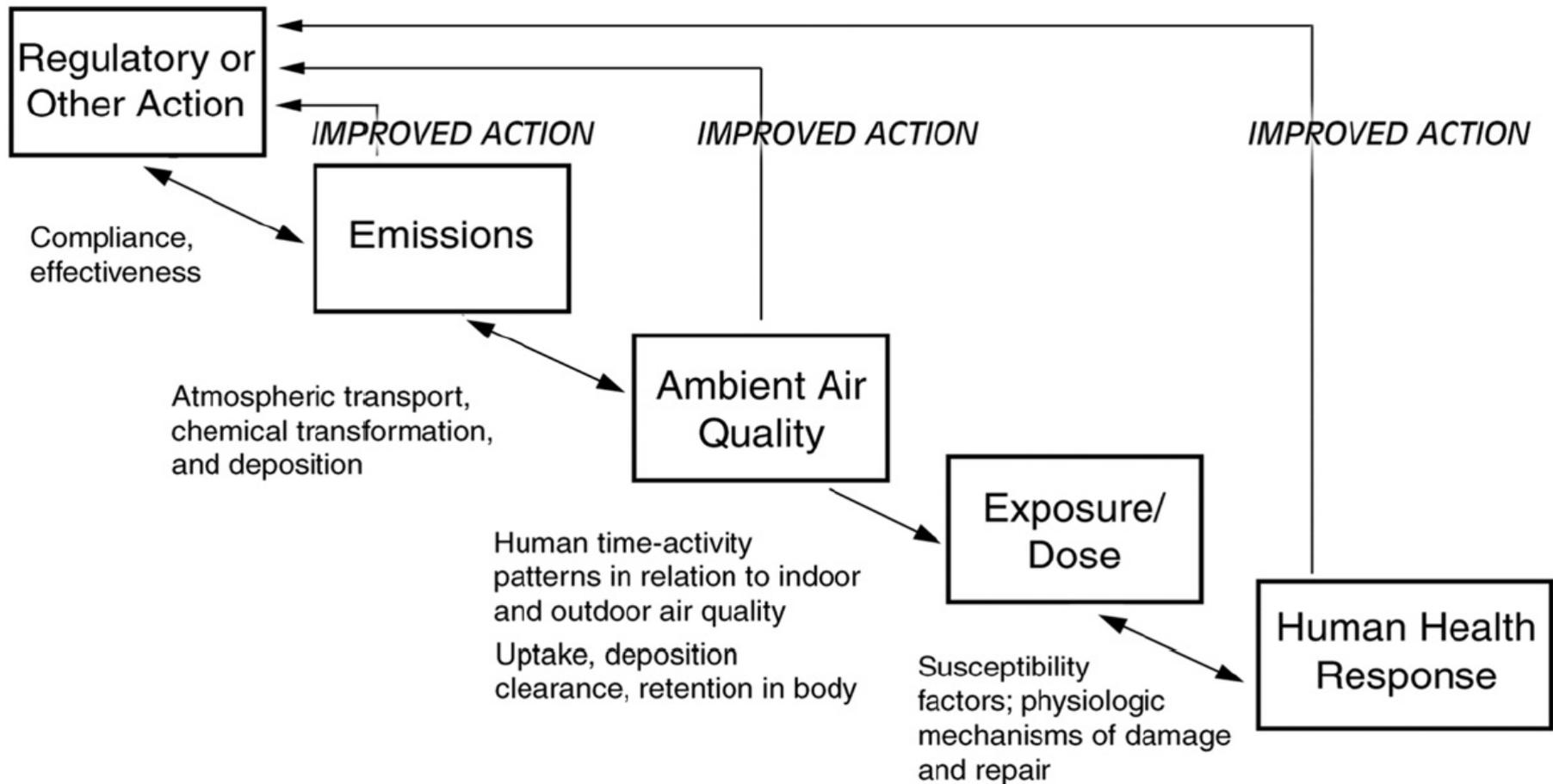


Fig. 1. Chain of accountability.

(Source: Health Effects Institute (Samet et al., 2003).)

Several Reviews



Public Health
England

Protecting and improving the nation's health

Review of interventions to improve outdoor air quality and public health



Contents lists available at [ScienceDirect](#)

Environment International

journal homepage: www.elsevier.com/locate/envint

Interventions to reduce ambient air pollution and their effects on health: An abridged Cochrane systematic review

J. Burns^{a,b,*}, H. Boogaard^c, S. Polus^{a,b}, L.M. Pfadenhauer^{a,b}, A.C. Rohwer^d, A.M. van Erp^c, R. Turley^e, E.A. Rehfuss^{a,b}

Environment International 100 (2017) 62–78



Contents lists available at [ScienceDirect](#)

Environment International

journal homepage: www.elsevier.com/locate/envint

Review article

Accountability studies of air pollution and health effects: lessons learned and recommendations for future natural experiment opportunities

David Q. Rich^{*}

JOURNAL OF THE AIR & WASTE MANAGEMENT ASSOCIATION 
2017, VOL. 67, NO. 2, 144–172
<http://dx.doi.org/10.1080/10962247.2016.1242518>



Taylor & Francis
Taylor & Francis Group

REVIEW PAPER

Evaluating the effectiveness of air quality regulations: A review of accountability studies and frameworks

Lucas R.F. Henneman ^a, Cong Liu^b, James A. Mulholland^a, and Armistead G. Russell^a

Curr Envir Health Rpt
DOI 10.1007/s40572-017-0161-0

AIR POLLUTION AND HEALTH (S ADAR AND B HOFFMANN, SECTION EDITORS)

Accountability Studies on Air Pollution and Health: the HEI Experience

Hanna Boogaard¹ · Annemoon M. van Erp¹ · Katherine D. Walker¹ · Rashid Shaikh¹



Cochrane
Library

Cochrane Database of Systematic Reviews

Interventions to reduce ambient particulate matter air pollution and their effect on health (Review)

Burns J, Boogaard H, Polus S, Pfadenhauer LM, Rohwer AC, van Erp AM, Turley R, Rehfuss E



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Interventions

- Short and Long term time scales
- Different pollutant sources and mixtures
- Different spatial scales
- Numerous health outcomes
- Retrospective versus Prospective Designs



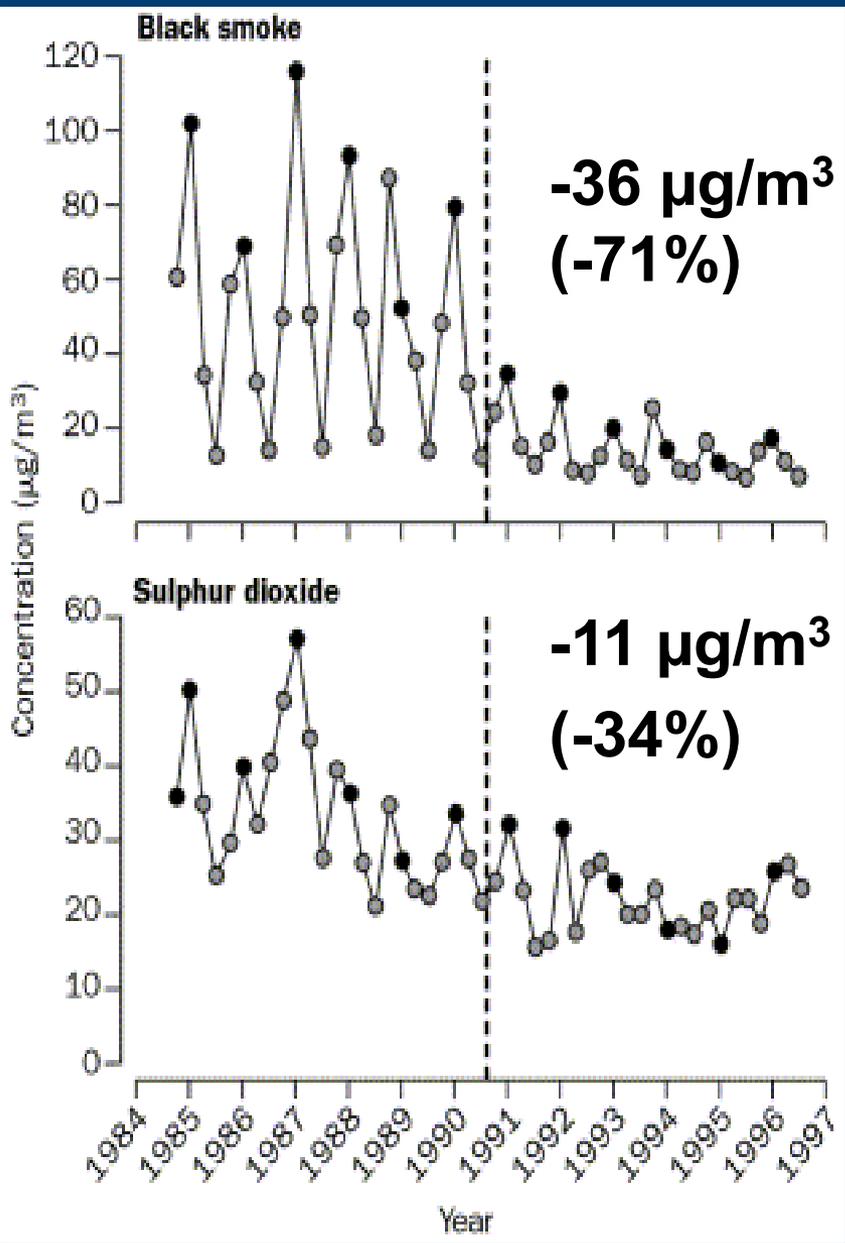
Dublin, Ireland – Coal Sale Bans

- 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

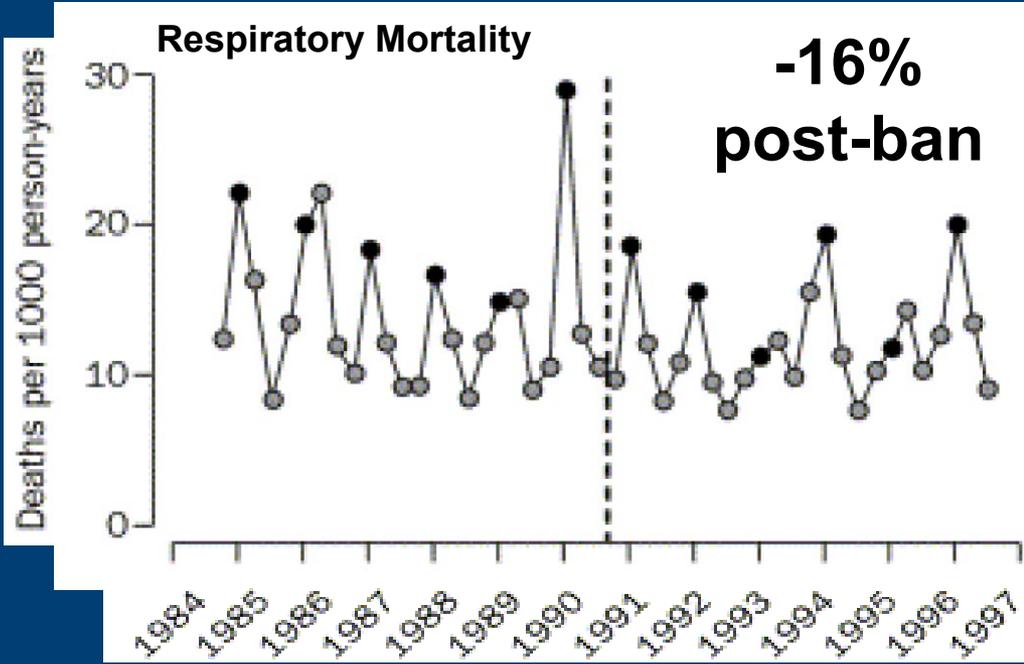


- Deterioration in air quality after switch to coal
(Flanagan, 1986)
- During winters of 1980's, Dublin experienced number of severe air pollution episodes.





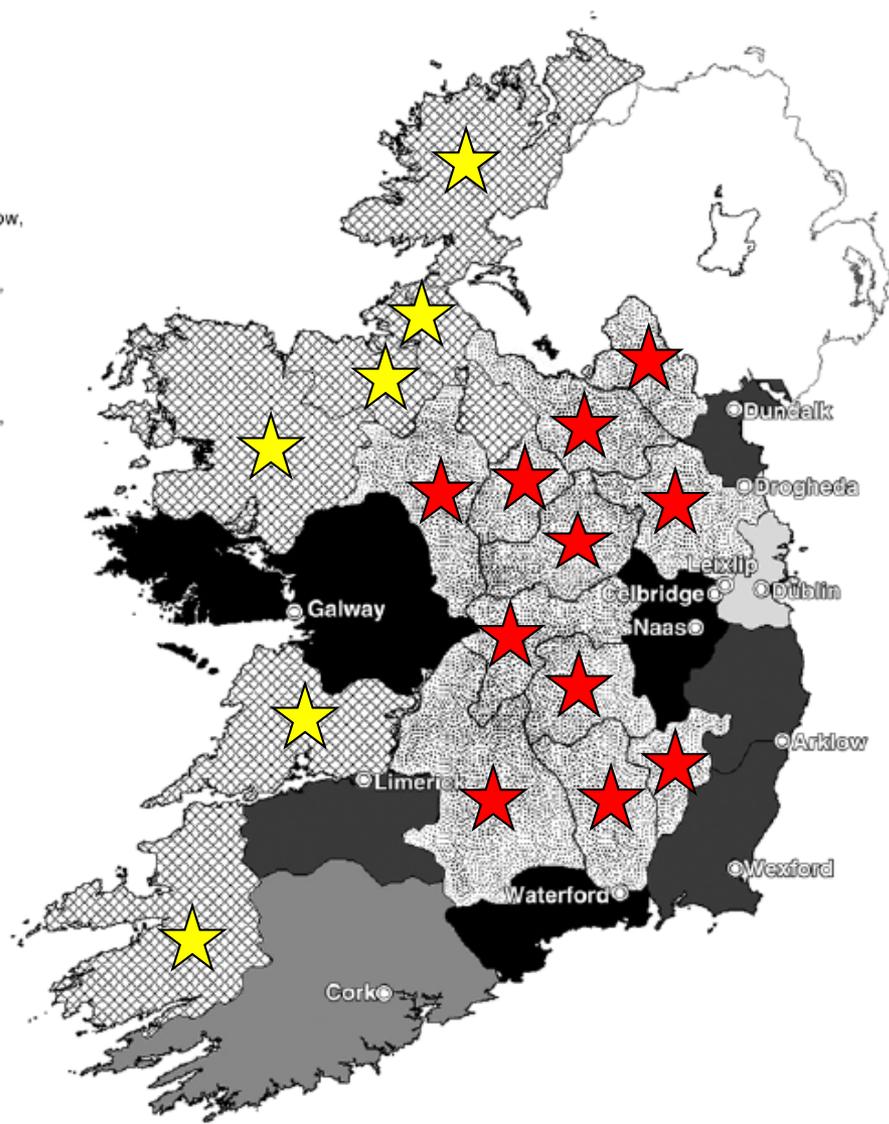
- September 1, 1990 - Irish gov't banned marketing, sale, and distribution of coal in Dublin
- Immediate reduction in monthly mean particle concentration
(Sinclair and Clancy, 1995)



Dublin Re- analysis

- 1990 Ban in Dublin
- 1995 Ban in Cork County Borough
- 1998 Ban in Dundalk, Drogheda, Arklow, Wexford, Limerick
- 2000 Ban in Galway, Waterford, Naas, Leixlip, Celbridge
- Coastal counties (Clare, Donegal, Kerry, Leitrim, Mayo, and Sligo)
- Midlands counties (Cavan, Monaghan, Meath, Laois, Longford, Offaly, Westmeath, Tipperary [North and South], Carlow, Kilkenny, and Roscommon)
- Northern Ireland

0 25 50 Miles



RESEARCH REPORT

HEALTH
EFFECTS
INSTITUTE

Effect of Air Pollution Control on Mortality and Hospital Admissions in Ireland

Number 176
July 2013

Douglas W. Dockery, David Q. Rich,
Patrick G. Goodman, Luke Clancy,
Pamela Ohman-Strickland, Prethibha George,
and Tania Kotlov



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Dublin Re-analysis

- Longer study period
- Previous analysis used cause-specific death rates across the rest of Ireland to control for confounding by long term time trend
- Used mortality rates in Coastal Counties to control for confounding by long term time trend
- Used Midland Counties (unaffected by Coal Sale ban) as a comparison county
- **Change in mortality rates in Dublin**
 - **Respiratory Mortality: -17%**
 - **Cardiovascular Mortality: 0%**
 - **Total Mortality: -1%**

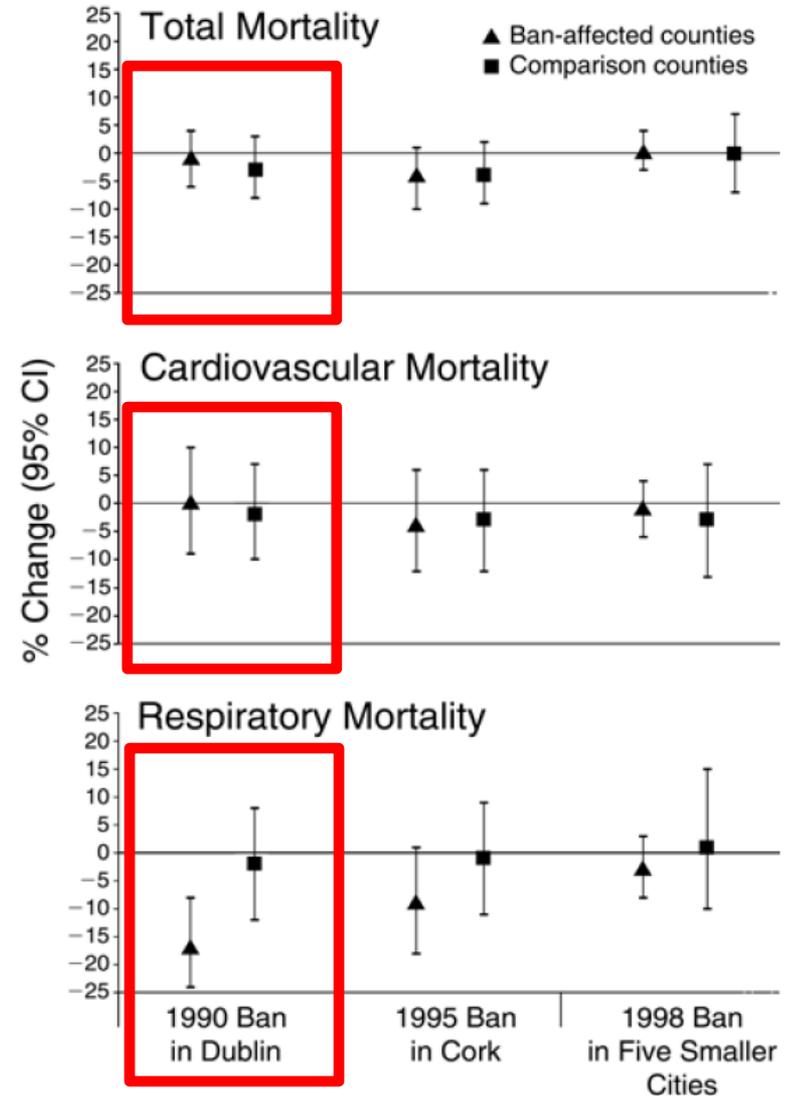


Figure. Percent change in cause-specific mortality for the ban-affected and comparison counties after the 1990, 1995, and 1998 coal bans. CI denotes confidence interval.

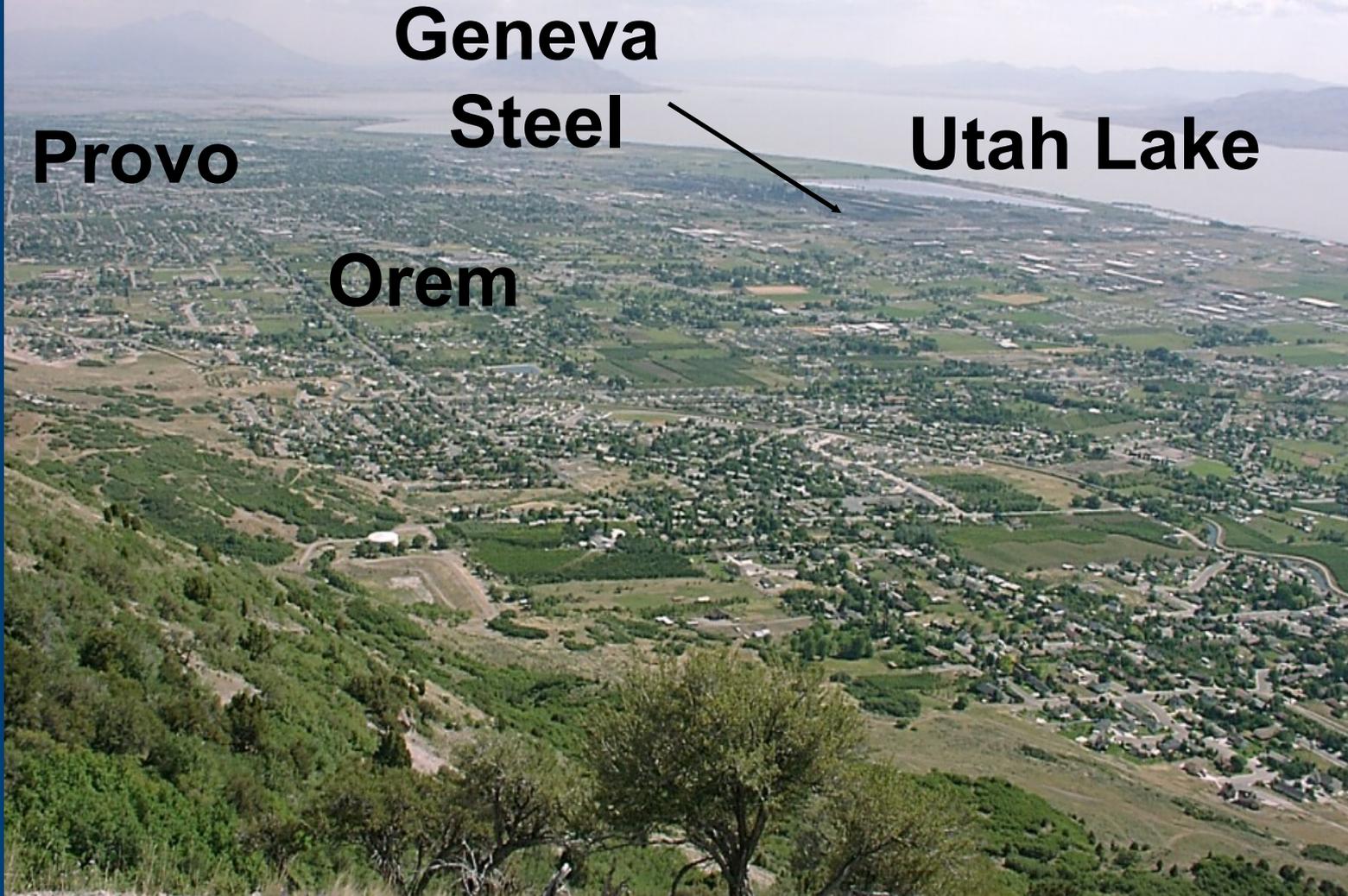


Other European Accountability Studies

- London Congestion Charging Scheme
- German Reunification
- German power plant scrubber installations



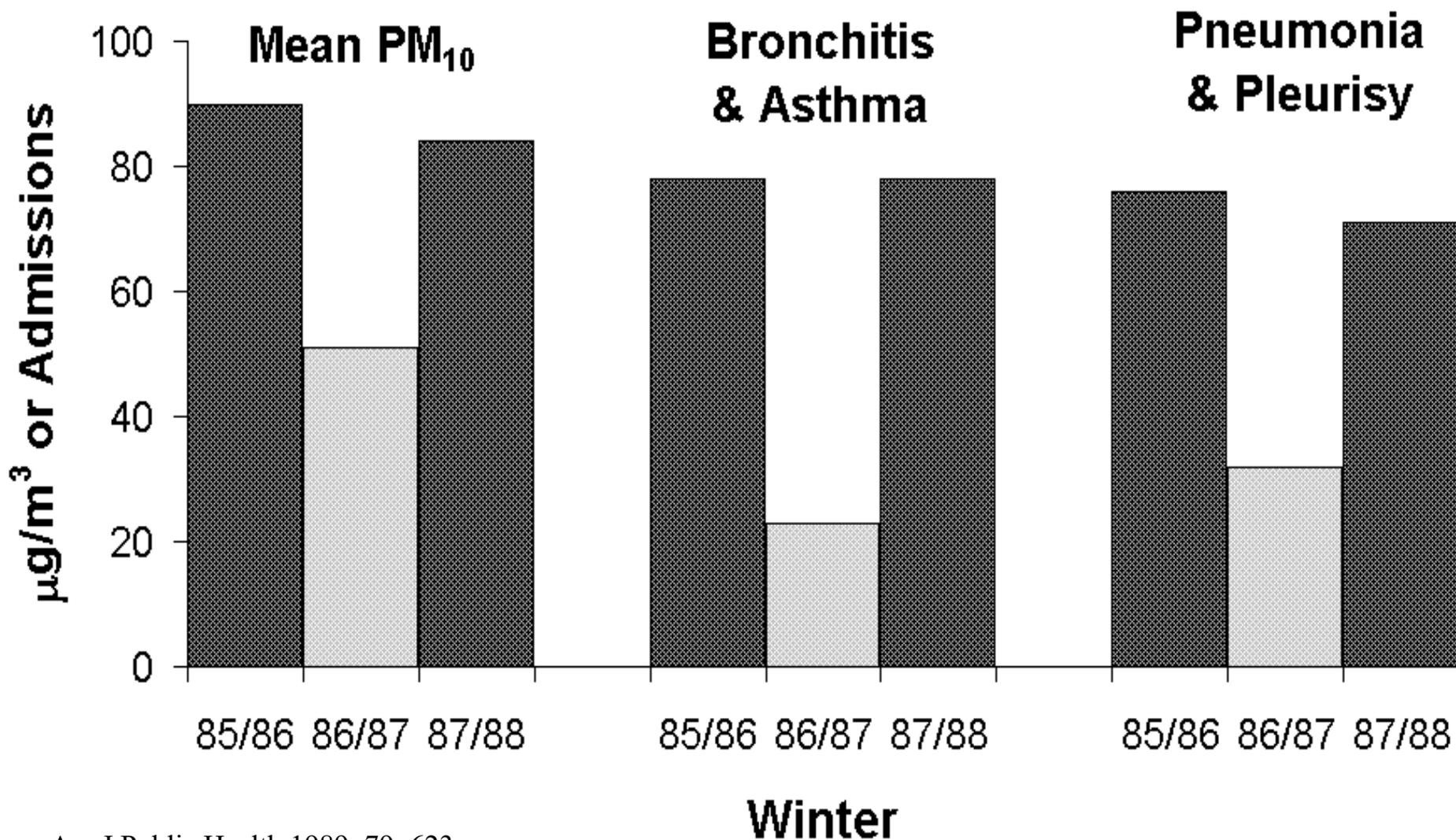
UTAH VALLEY, USA





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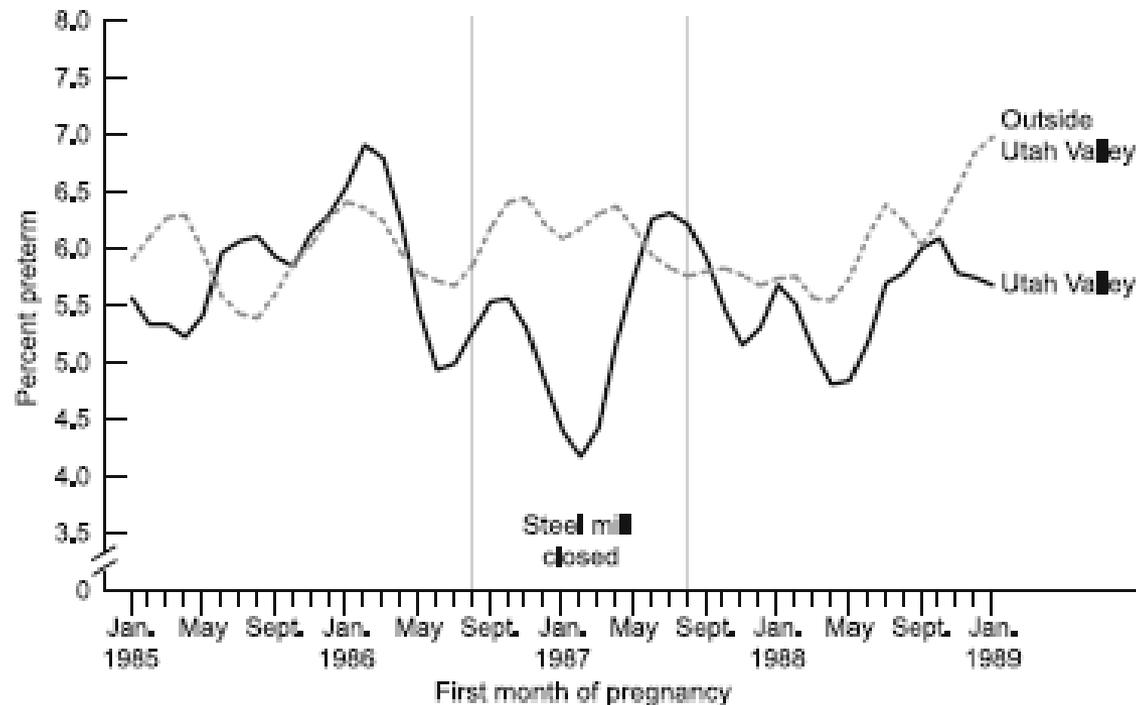
Utah Hospital Admissions Children 0-17 Year



Preterm Birth After the Utah Valley Steel Mill Closure

A Natural Experiment

Jennifer D. Parker,^a Pauline Mendola,^a and Tracey J. Woodruff^b



SOURCE: CDC/NCHS, Natality files.

FIGURE 1. Preterm birth* by first month of pregnancy (month of LMP) in the Utah Valley (solid line) and outside the Utah Valley (dashed line): Utah, January 1985–January 1989. *Smoothed percentages using a LOWESS smoother^{24–25} with a 10% bandwidth.

Epidemiology • Volume 19, Number 6, November 2008



2008 Beijing Summer Olympics

China promises to reduce air pollution levels to those of previous host cities during 47 day Olympics and Paralympics





RESEARCH REPORT

HEALTH
EFFECTS
INSTITUTE

Number 174
February 2013

Cardiorespiratory Biomarker Responses in Healthy Young Adults to Drastic Air Quality Changes Surrounding the 2008 Beijing Olympics

Junfeng Zhang, Tong Zhu, Howard Kipen, Guangfa Wang,
Wei Huang, David Rich, Ping Zhu, Yuedan Wang,
Shou-En Lu, Pamela Ohman-Strickland, Scott Diehl,
Min Hu, Jian Tong, Jicheng Gong, and Duncan Thomas

- 30-60% reductions in all pollutants (except O₃) during 47 day Olympic period
- Among health young medical residents
 - Improvements in cardiorespiratory biomarkers during Olympics, with returns to baseline levels after the Games





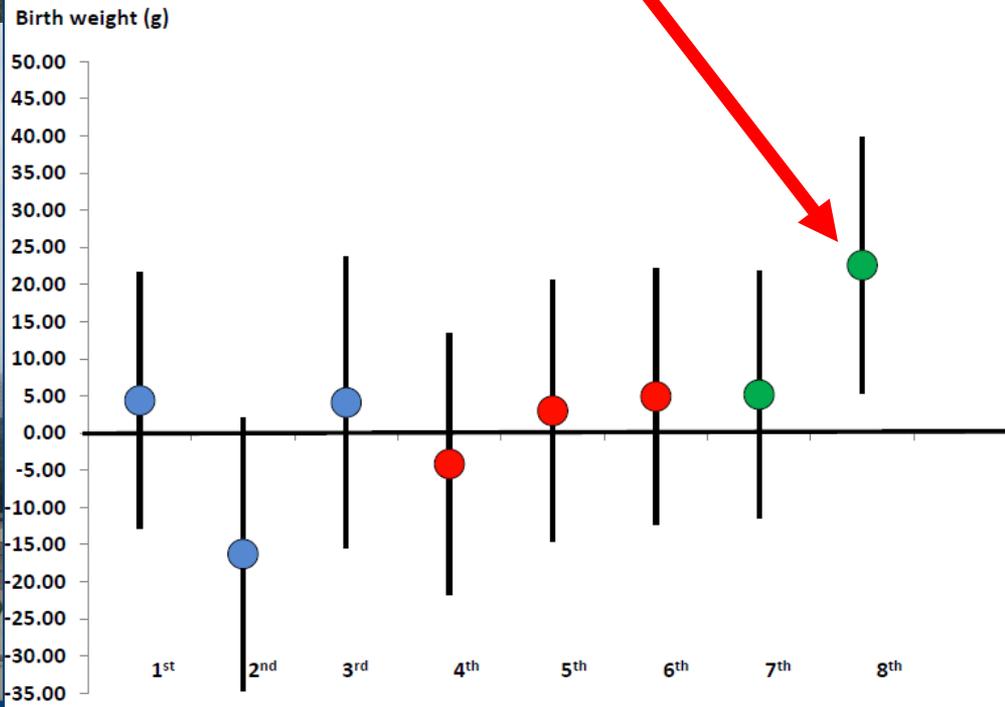
Pre-Olympics



During-Olympics

Air pollution and Fetal Growth

Pregnancies with 8th month of pregnancy during 2008 Olympics were, on average, 24 grams larger than pregnancies with 8th month of pregnancy during same calendar dates in 2007 or 2009



Evidence of health benefits from:

- Short term/temporary air quality improvements
 - Beijing, Utah Valley
- Long term air quality improvements
 - Ireland, Germany, Southern California

Summary

Several disease outcomes

- Mortality (Respiratory)
- Hospital Admissions (Cardiovascular, Respiratory)
- Cardiovascular Biomarkers
- Pregnancy Outcomes (Birth weight, Preterm birth)

Multiple Pollutant Sources (Industry, Traffic)

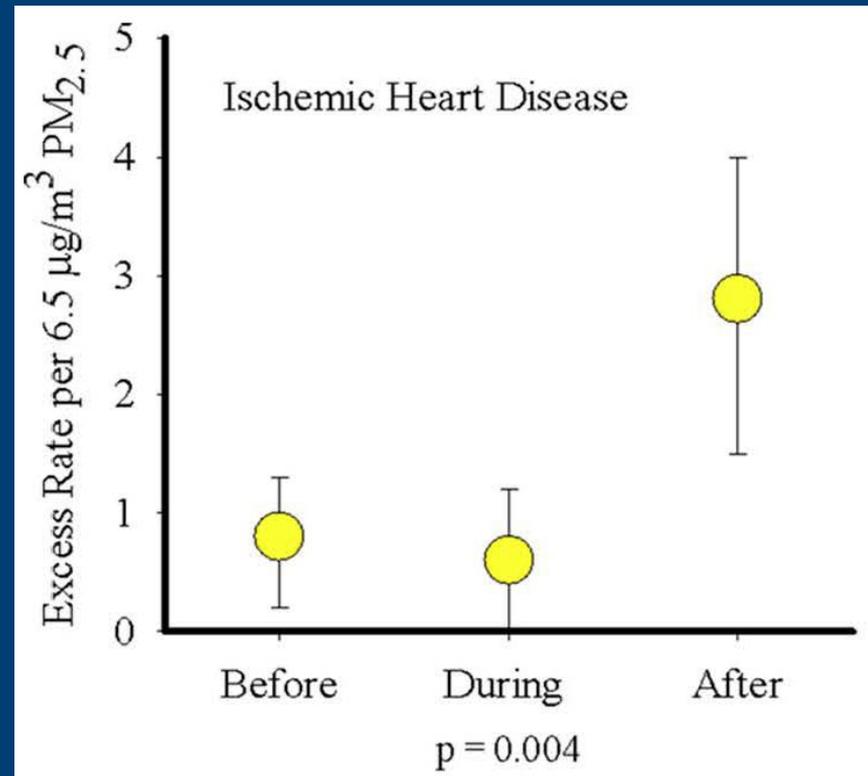
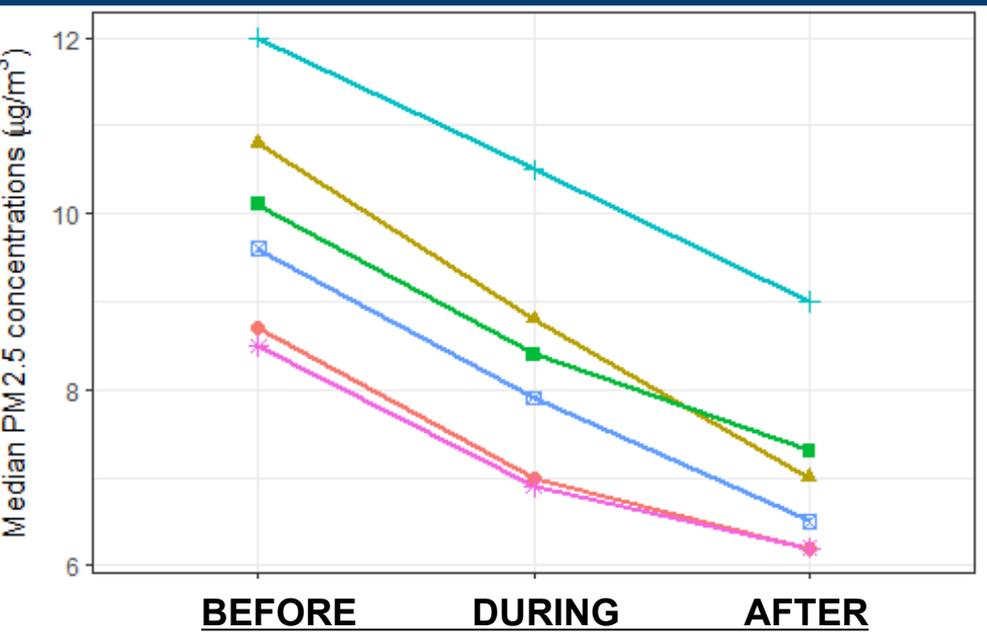
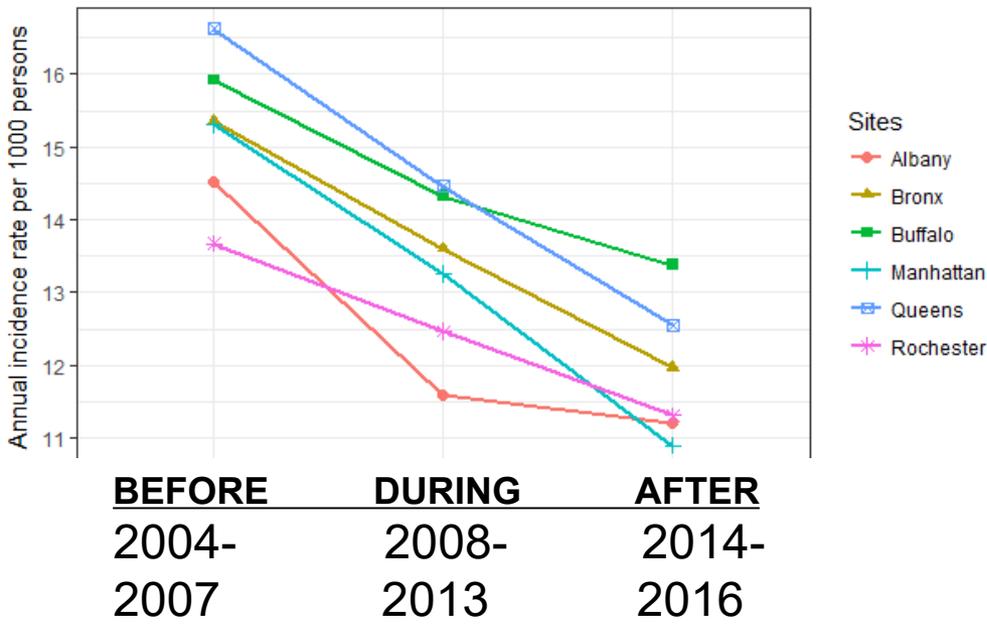
Multiple Spatial Scales (Urban, Regional, National)

Study design & statistical analysis difficulties are numerous



CAUTION: New York, US

- Increased PM toxicity AFTER air quality policies
- Air quality policies need to address PM composition and sources, not just total PM



Policy Impacts

- Using the “chain of accountability” provides a useful construct to assess the effectiveness of regulatory actions, but regulatory changes often overlap with (many) other changes and trends
- Overall, AQ actions have improved air quality in the US, Europe, and Asia, but it continues to be useful to examine what the health benefits have been, and how we might have done better
- Accountability studies should continue to be explored as a means to assess climate policies, working to solve methodological challenges
- Urban, Regional, and National level assessments needed

Thank you!

