Air Pollution and Effects on Respiratory Health

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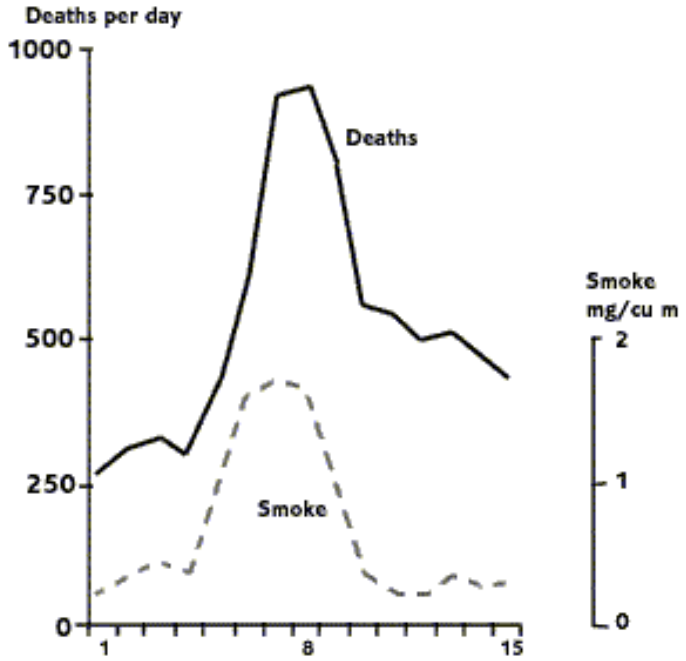
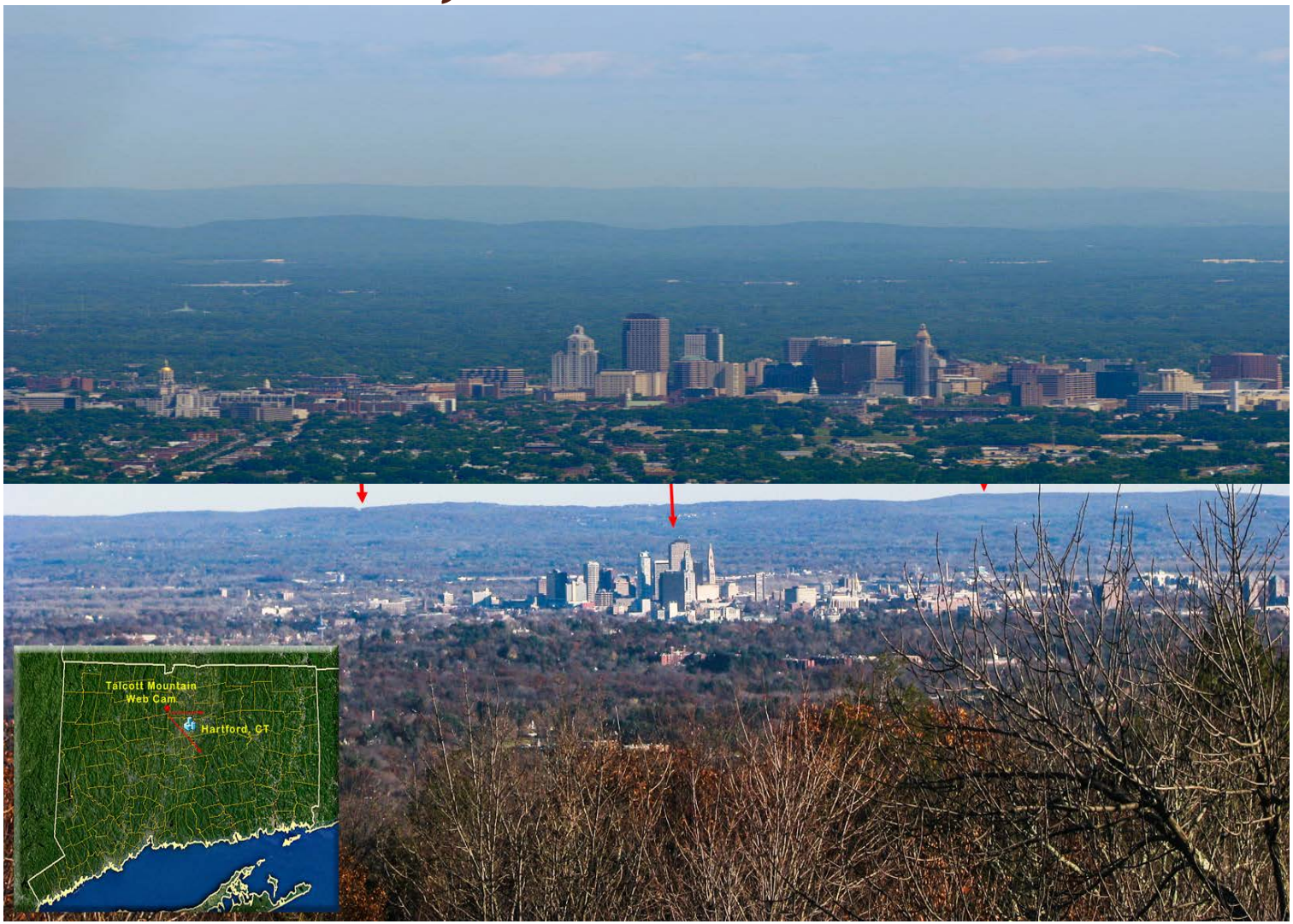
London Winter, 1952



In the Past 25 years,

- Ambient air pollution levels in the US have decreased significantly
- This is a major public health success of the Clean Air Act
- The question is:
  - Have we reached a point at which further reductions in ambient air pollution levels will result in no further health benefits?

Hartford, CT



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Sources of Air Pollution

- Vehicle exhaust
- Industry
- Power generation plants
- Background contamination

What Pollutant is Responsible?

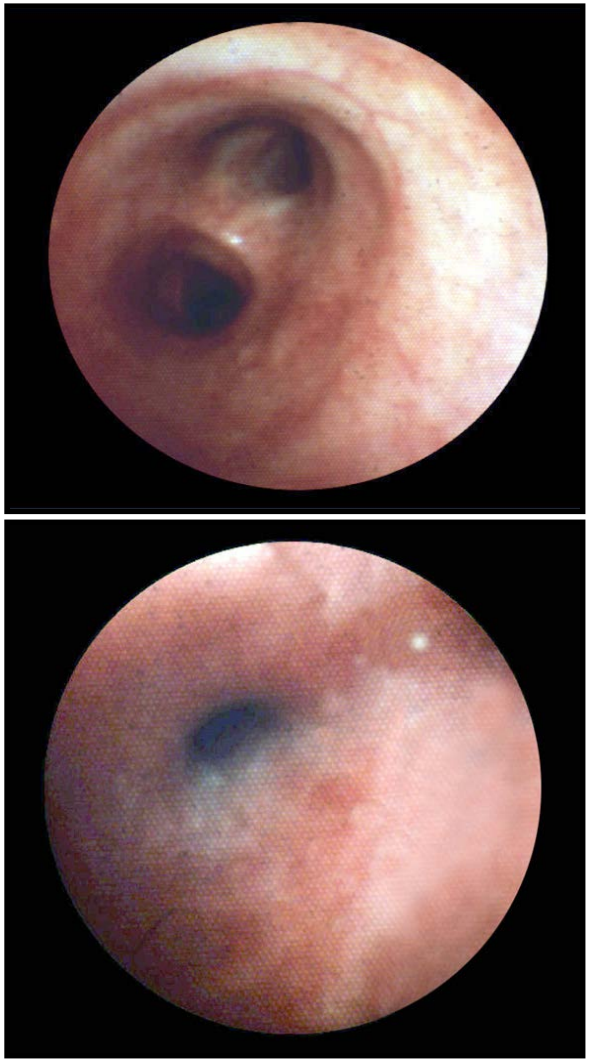
- Complex and complicated
- Problems with exposure misclassification
- Changes in many pollutants are associated with changes in other pollutants
- Major pollutants are ozone, nitrogen dioxide (NO_2) and particulate matter 2.5 μm (PM2.5)

Outline

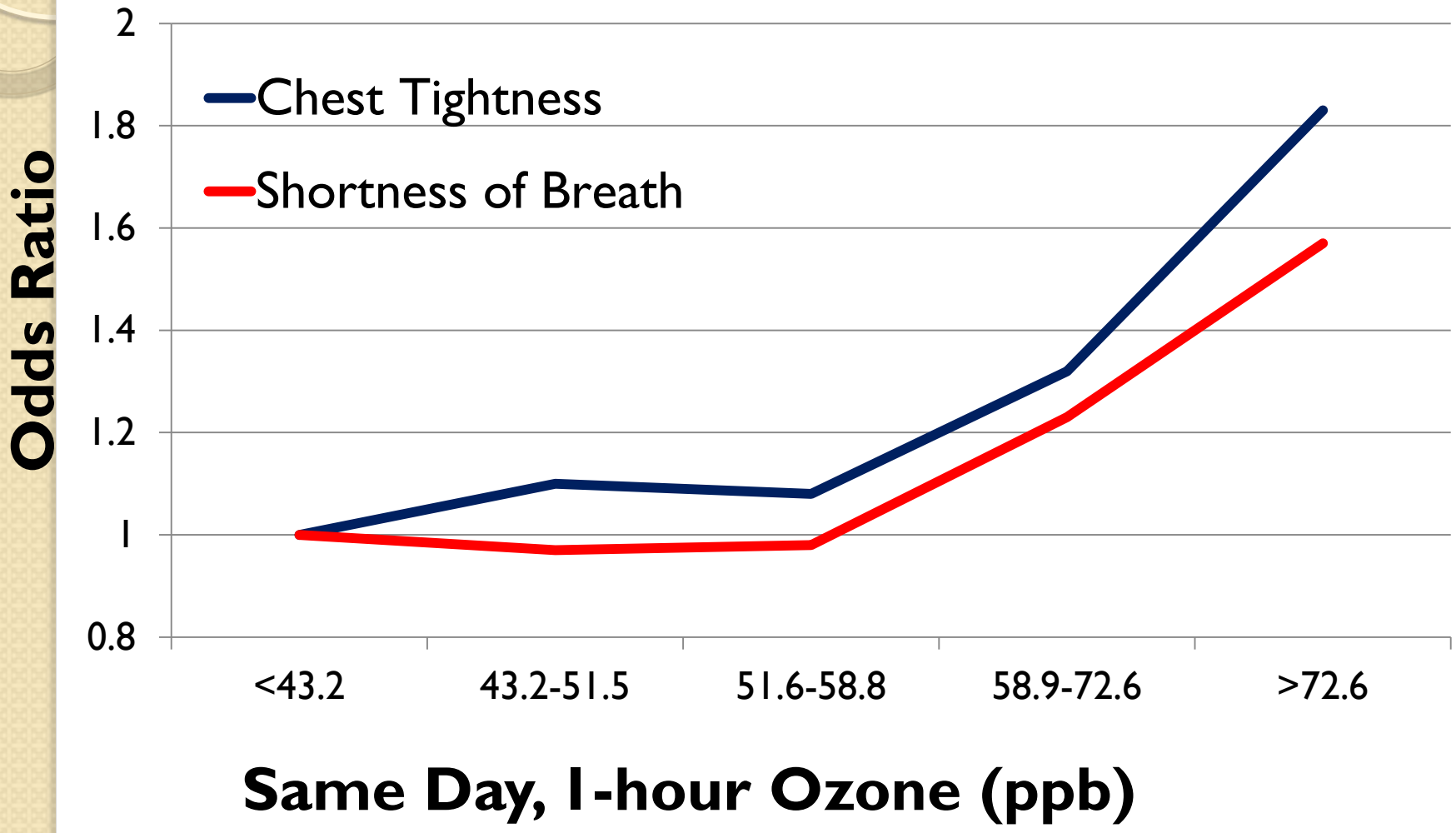
- The effects of air pollution in a vulnerable population, namely children with asthma
- The effects of air pollution on healthy individuals and the consequences:
  - Joggers
  - Healthy children
- Results from 2 "natural" experiments

Asthma

- Chronic, inflammatory disease of the airways associated with reversible airway narrowing, airway swelling and increased mucus production
- Symptoms of asthma are cough, wheezing and chest tightness
- Asthma is the most common, chronic disease of children.
- In the United States, 6.9 million children have asthma (2014)

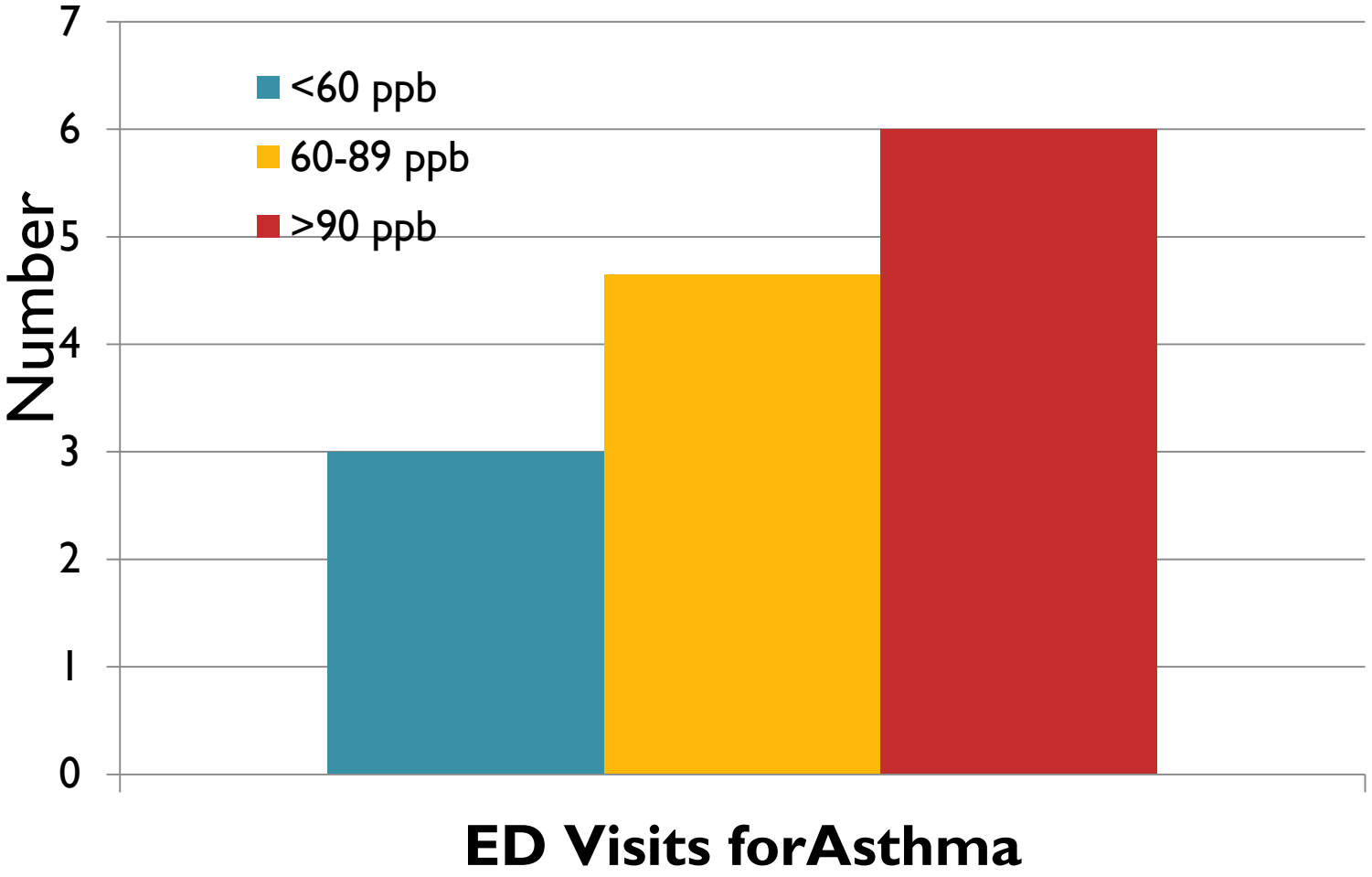


Effects of Ozone on Children with Asthma



Gent, JF et al JAMA 2003:290(14):1857-1867

Effects of Ozone are Dose Dependent



Friedman, MS JAMA 2001:285(7):897-905

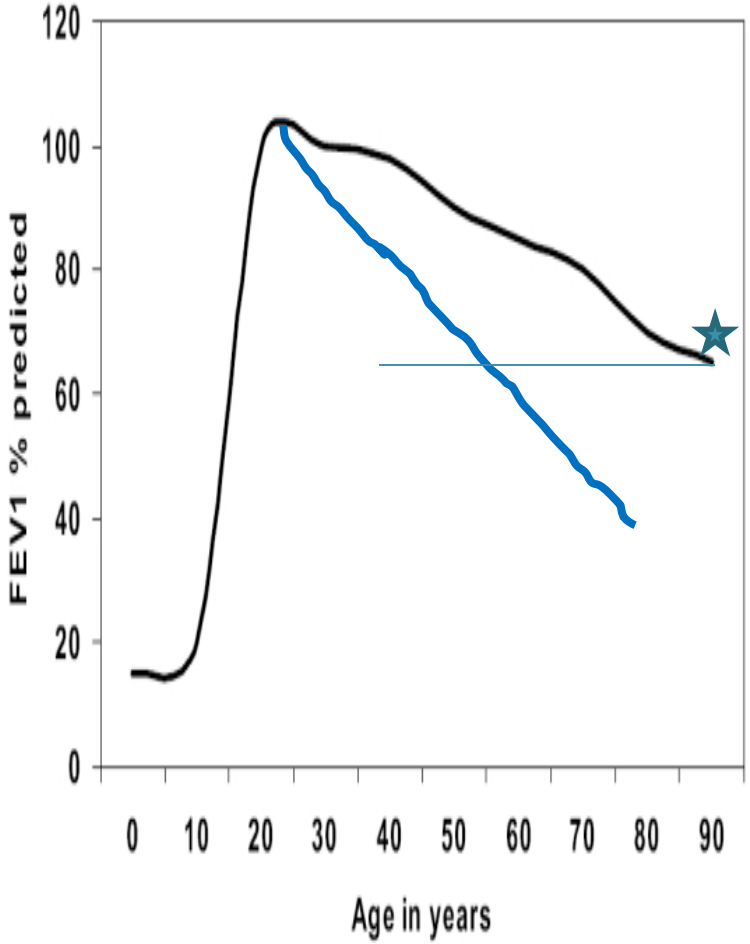
Joggers and Ozone

- Lung inflammation was present in individuals who
  - Jogged 3 or more times per week for ~2.5 miles on Governor's Island
- Mean ozone levels were 58-69 ppb

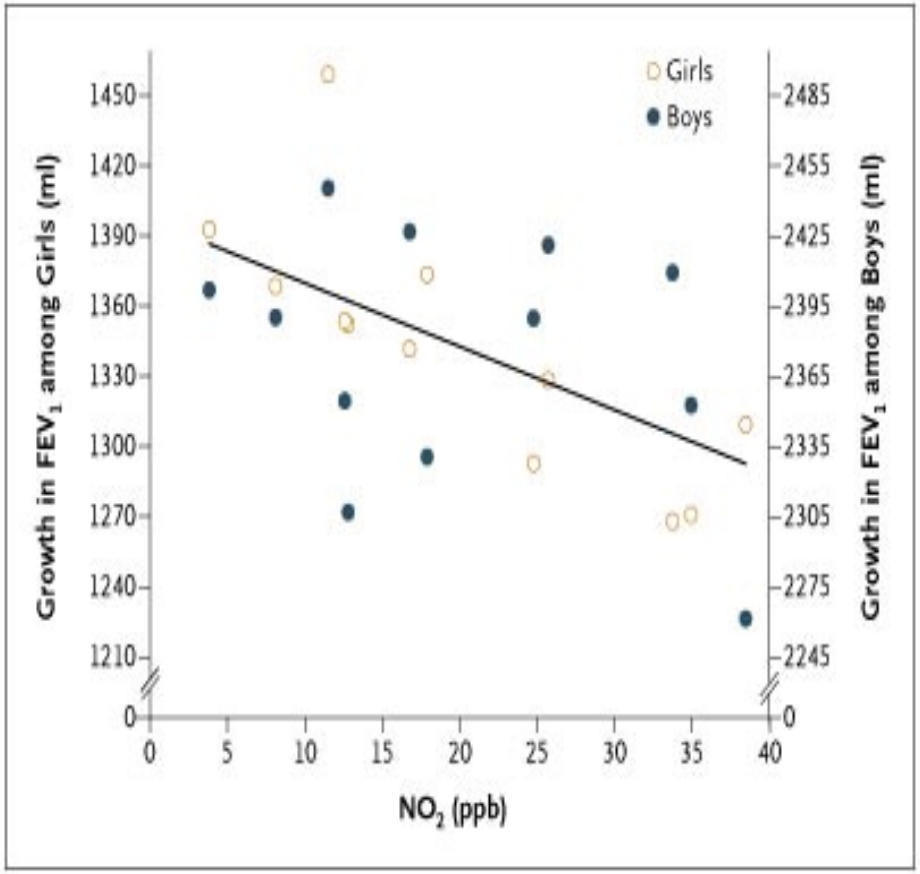
Kinney et al Am J Respir Crit Care Med 1996:154:1430-1435

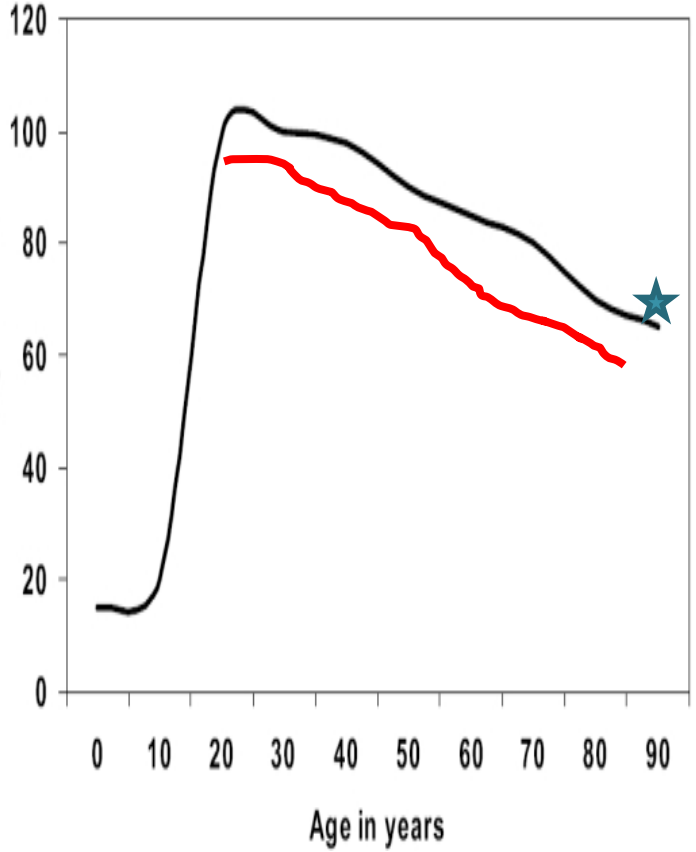
Lung Growth in Healthy Children

- The lungs of children grow until ~ 18 years in girls and 20 years in boys.
- Lung function then declines with age and in otherwise healthy individuals becomes "limiting" around 90 years



Lung Function Growth in Children Exposed to Nitrogen Dioxide





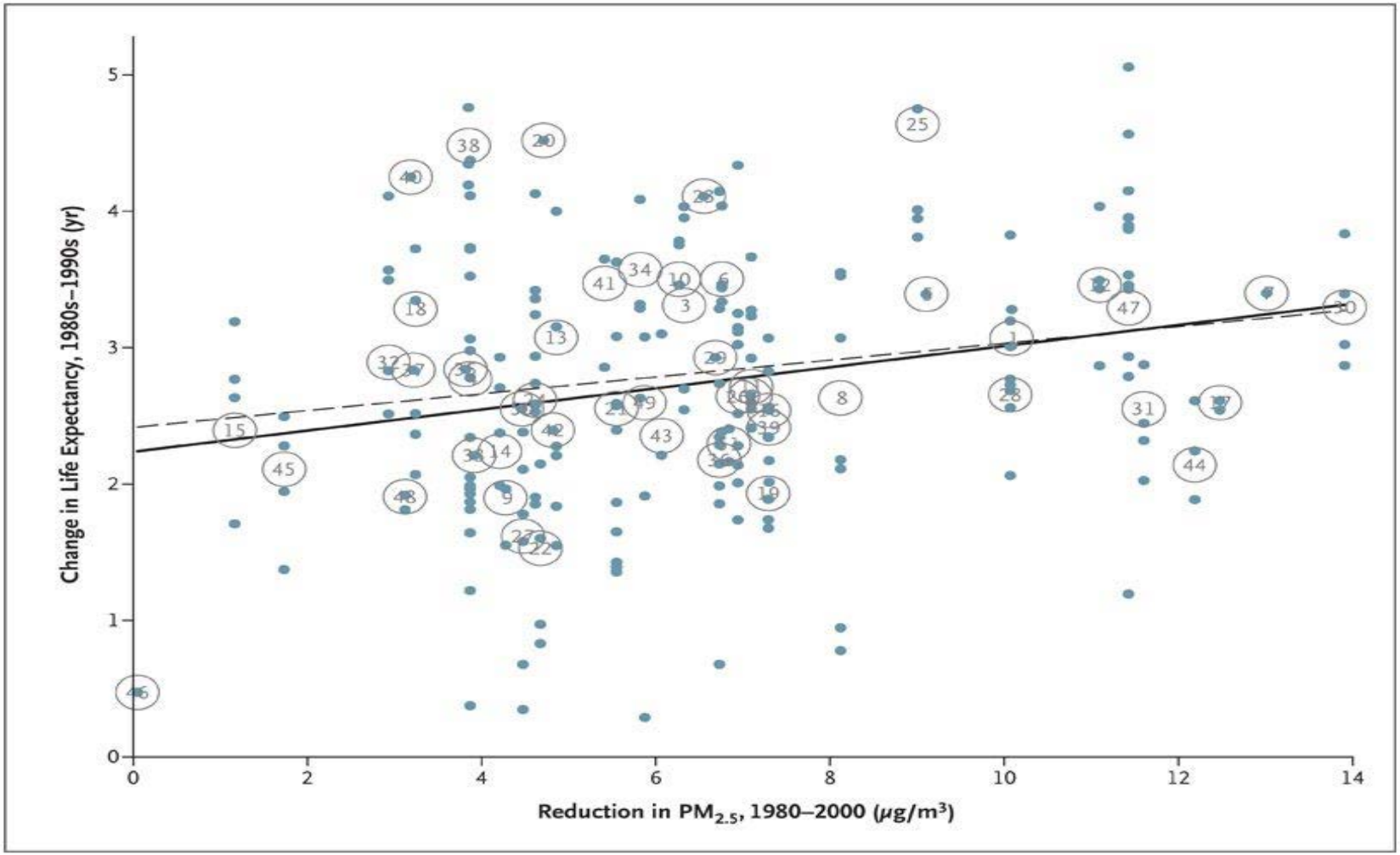
Children's Health Study in Southern California involving 1,759 children (10-18 years)

Gauderman, et al N Engl J Med 351:11:2004

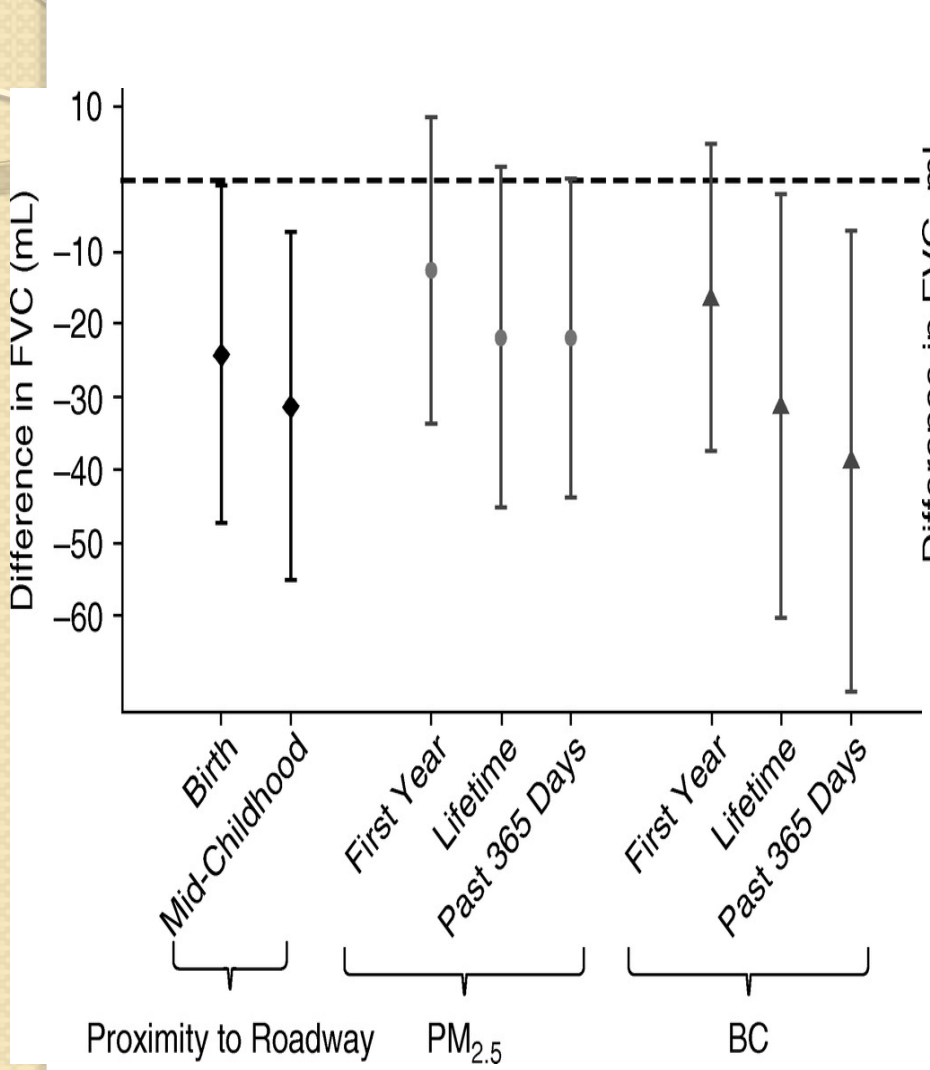
Consequences of Reduced Lung Function

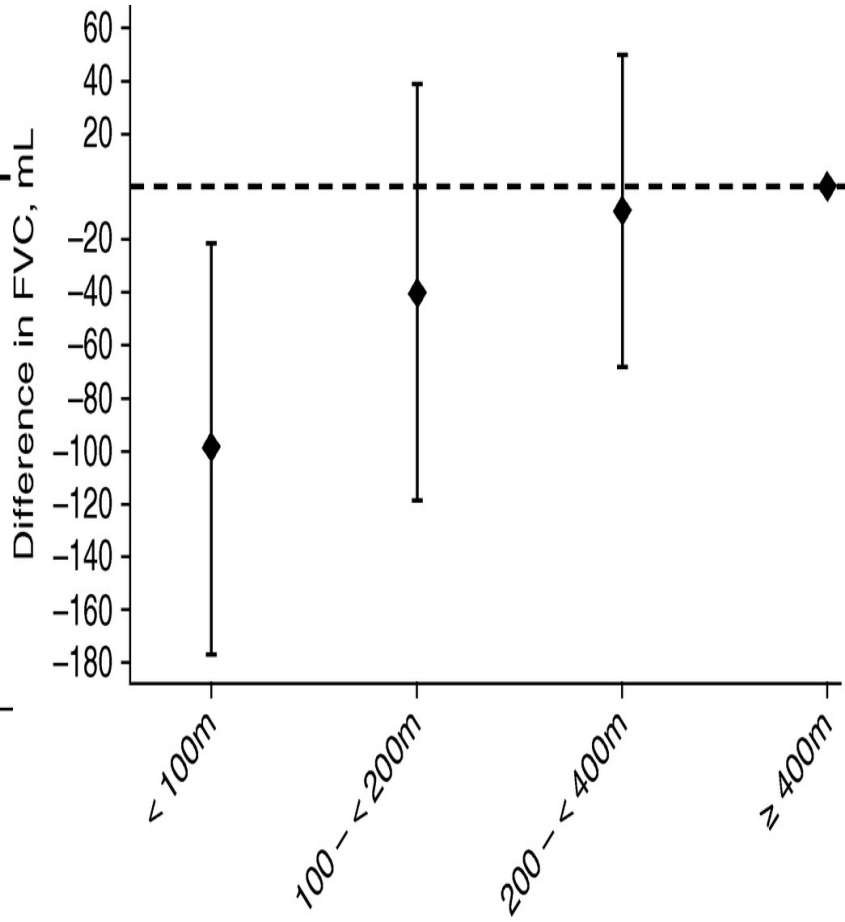
- An increased risk of asthma
- Increase risk of cardiovascular disease in adulthood (heart failure)
- Respiratory limitation at an earlier age
- Increased mortality

Mortality and Air Pollution



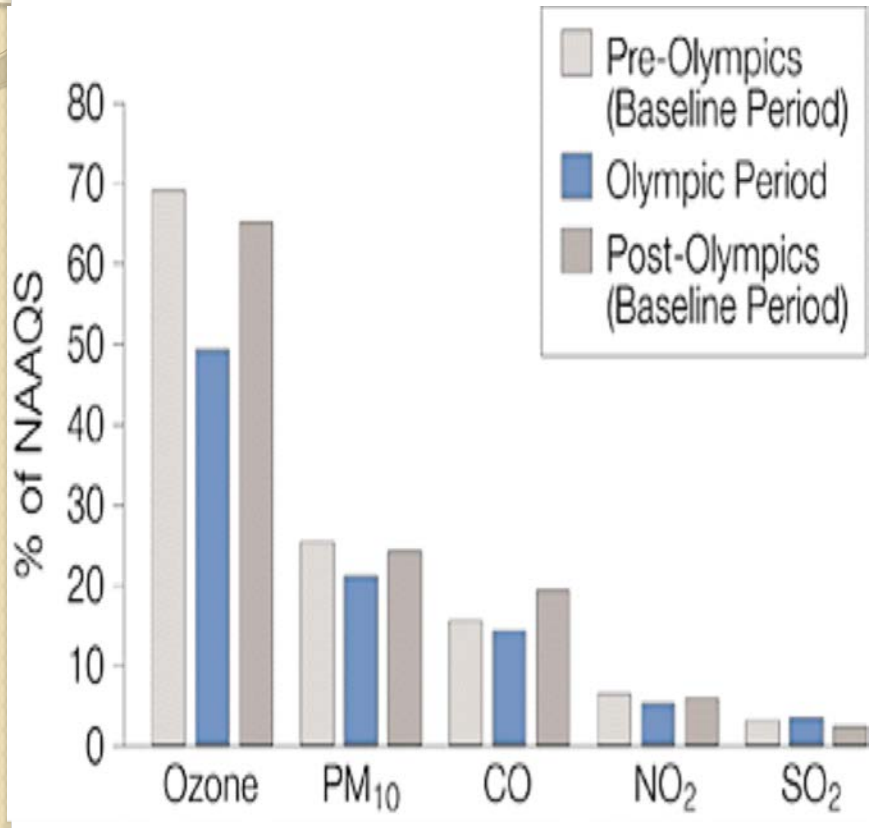
Lifetime Pollution and the Lungs



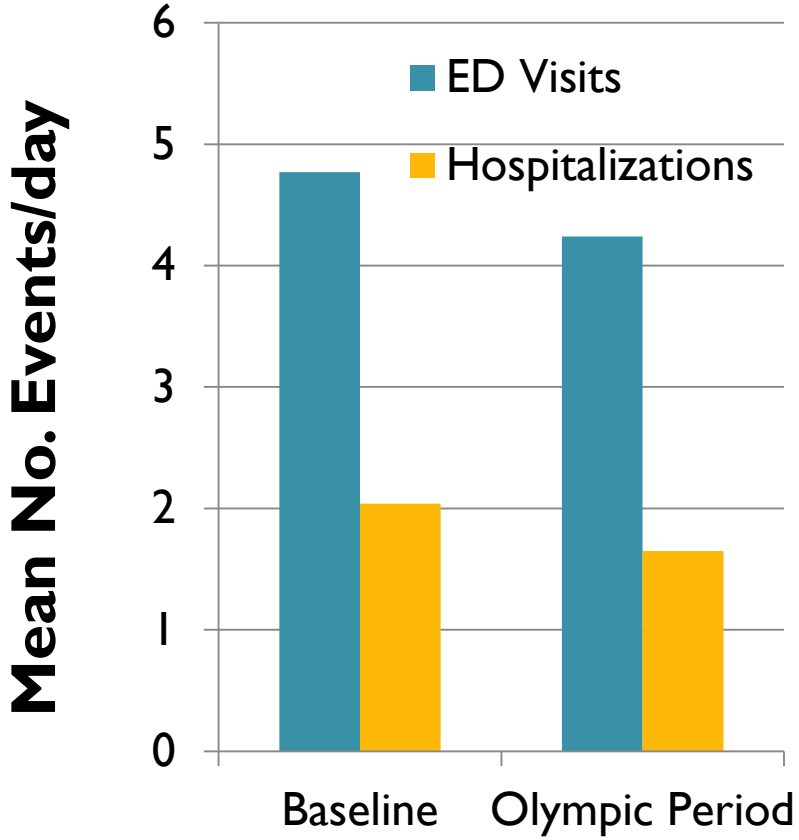


Rice MB, Am J Respir Crit Care Med 2016; 193 (8) 881-888

Air Pollutants and ED Visits: Atlanta 1996 Summer Olympics

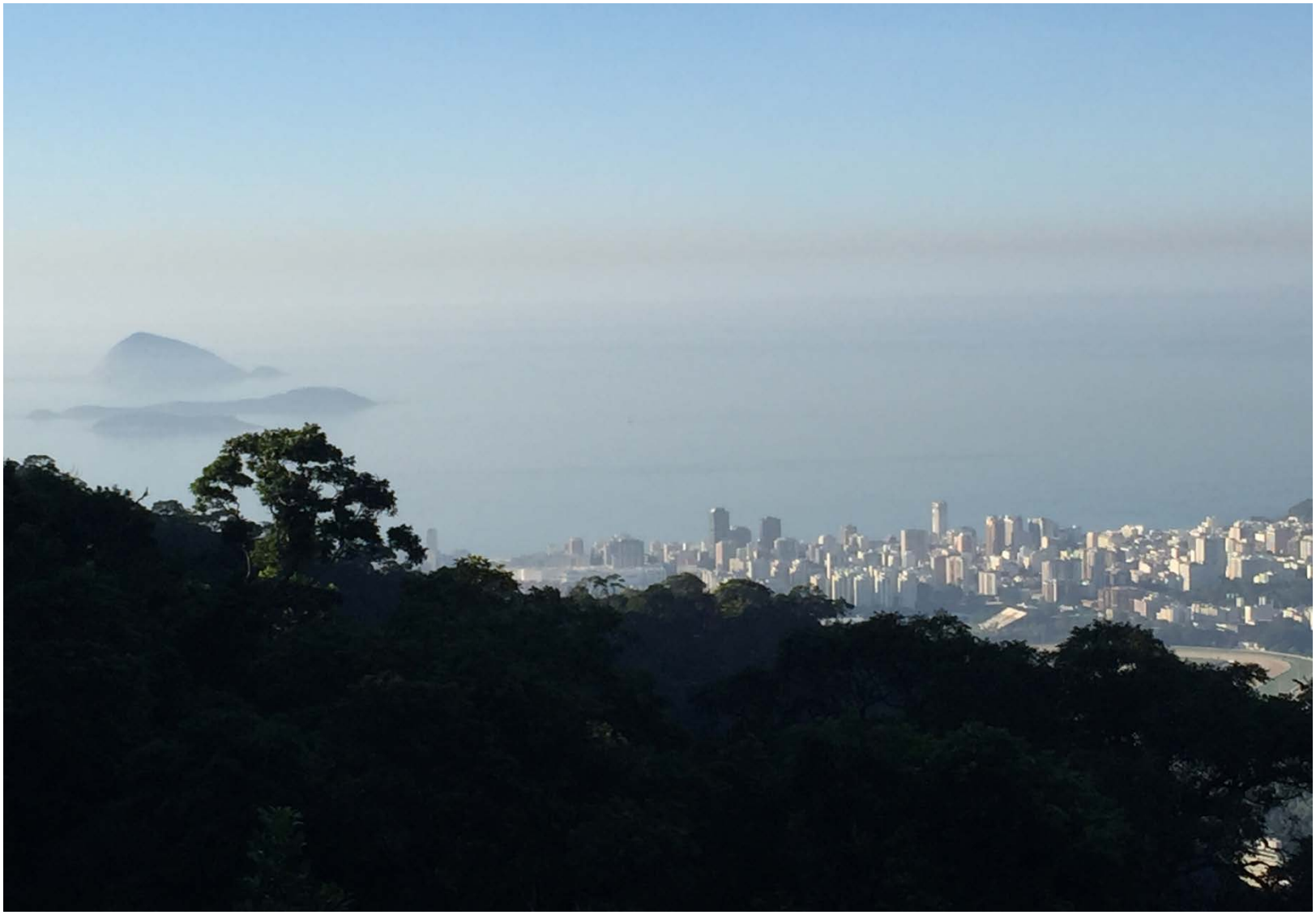


27.9% decrease in ozone



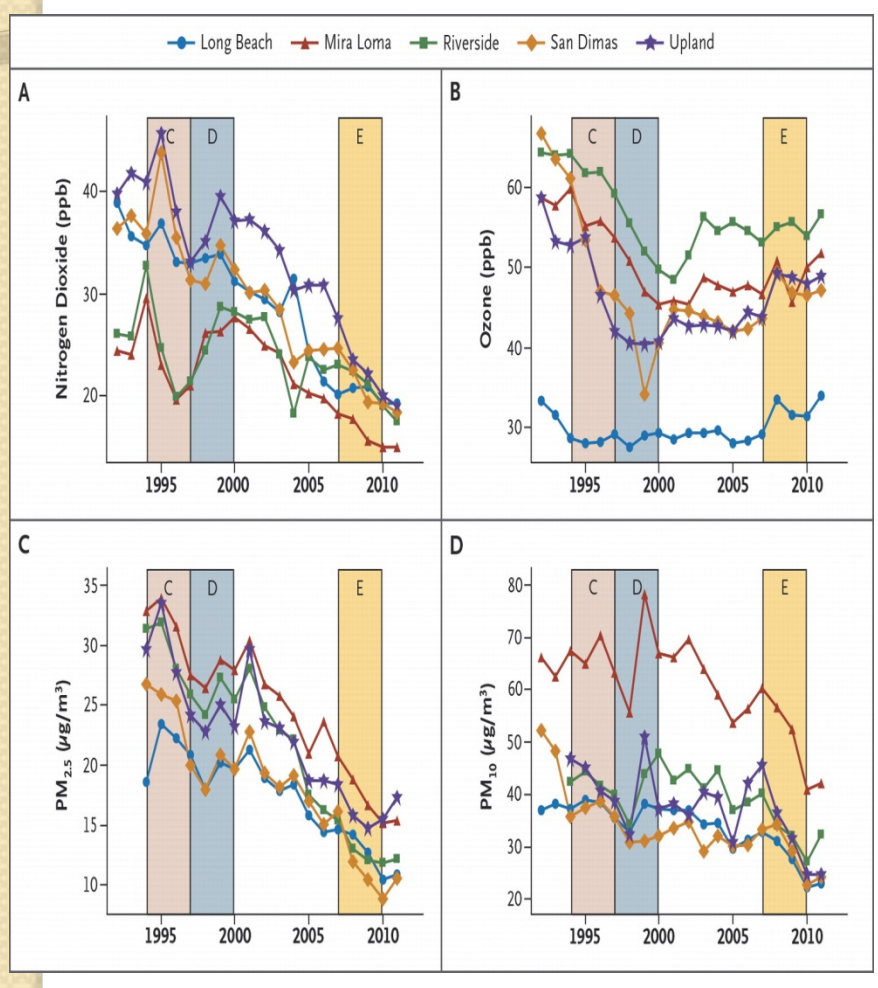
11.1% decrease in ED visits
19.1% decrease in Hospitalizations for asthma

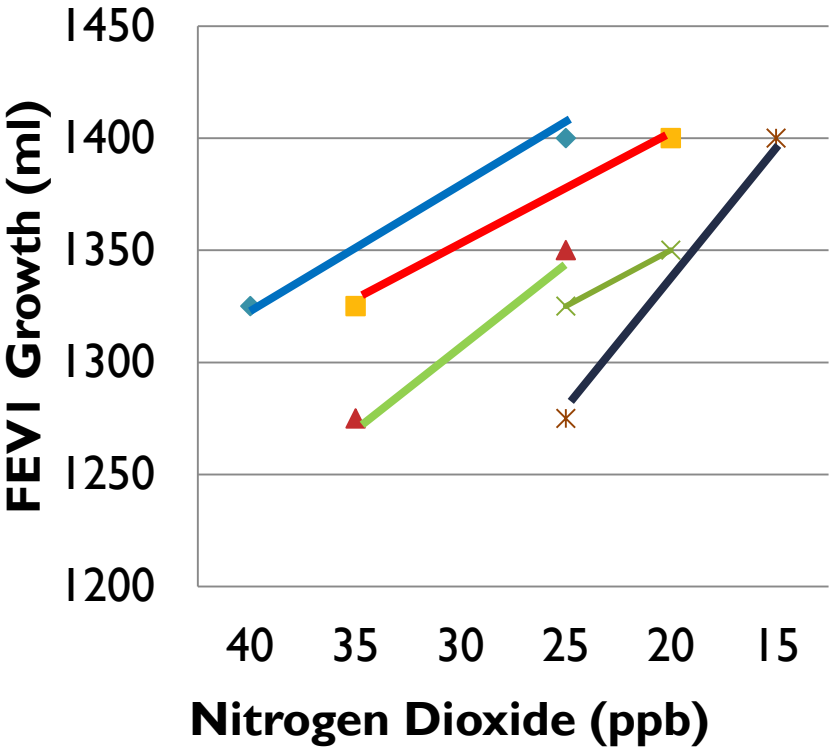
Olympics 2016: Rio de Janeiro



Improvements in Air Quality and Children's Lung Growth

NO2





From: Gauderman, WJ NEJM 2015

Summary

- Ozone at levels consistent with the EPA Standard affects asthma symptoms and medical service utilization in children in a dose dependent manner
- Ozone exposure causes airway inflammation even in otherwise healthy individuals
- Air pollution decreases lung growth in children
- Decreased lung growth is associated with asthma, cardiovascular disease and increased mortality
- Decreasing air pollution results in decreased morbidity in children with asthma and improvements in lung growth.