Vulnerable populations and the social dimensions of air pollution

Raphael E Arku, ScD

PATHWAYS TO EQUITABLE HEALTHY CITIES

www.equitablehealthycities.org

How to choose your battles

Unmodifiable Parameters

(1) Everyone is born

(2) Everyone dies

Modifiable Parameters

(3) Time between birth and death

(4) Quality of life

Pick battles big enough to matter,
small enough to win.

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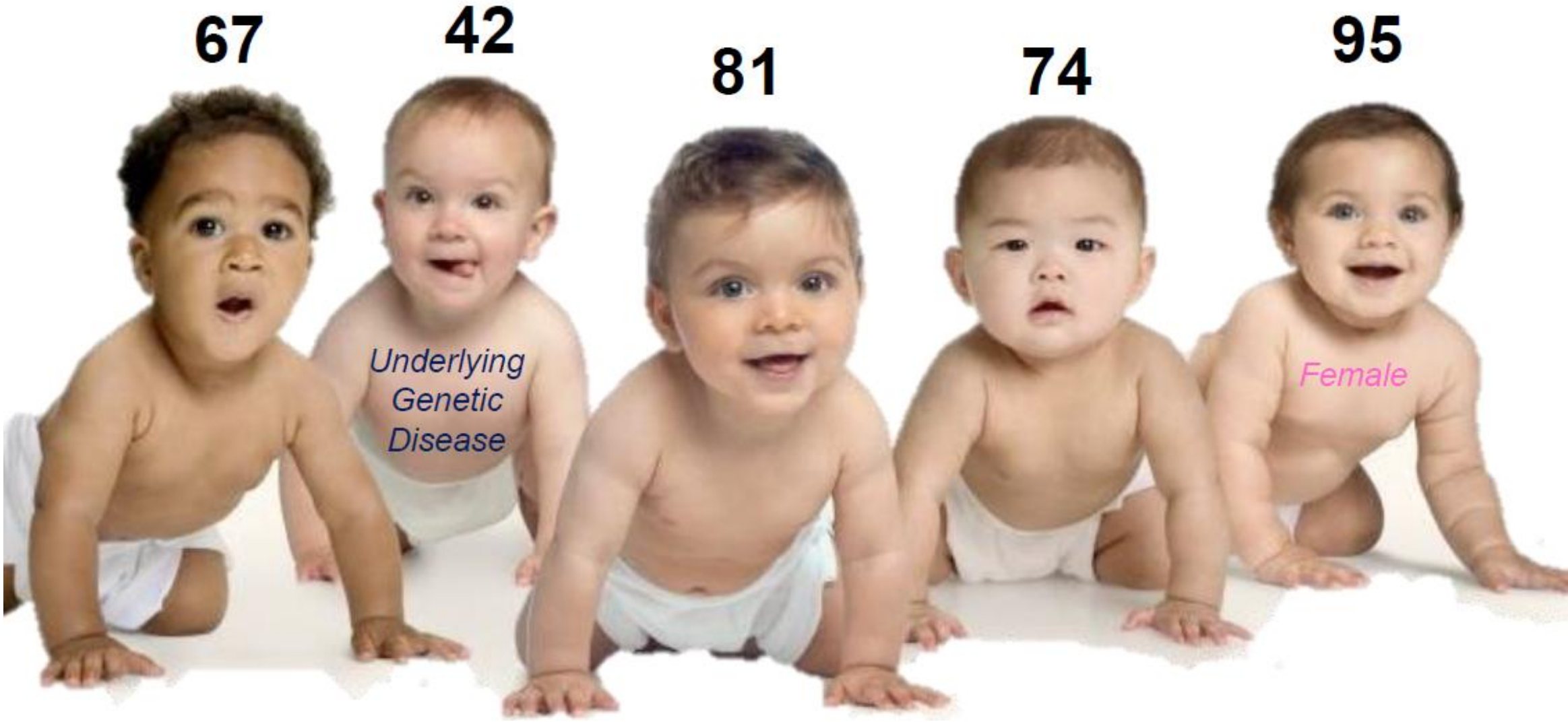
Spectrum of Life Expectancies



Spectrum of Life Expectancies

Effect of living here on life expectancy?

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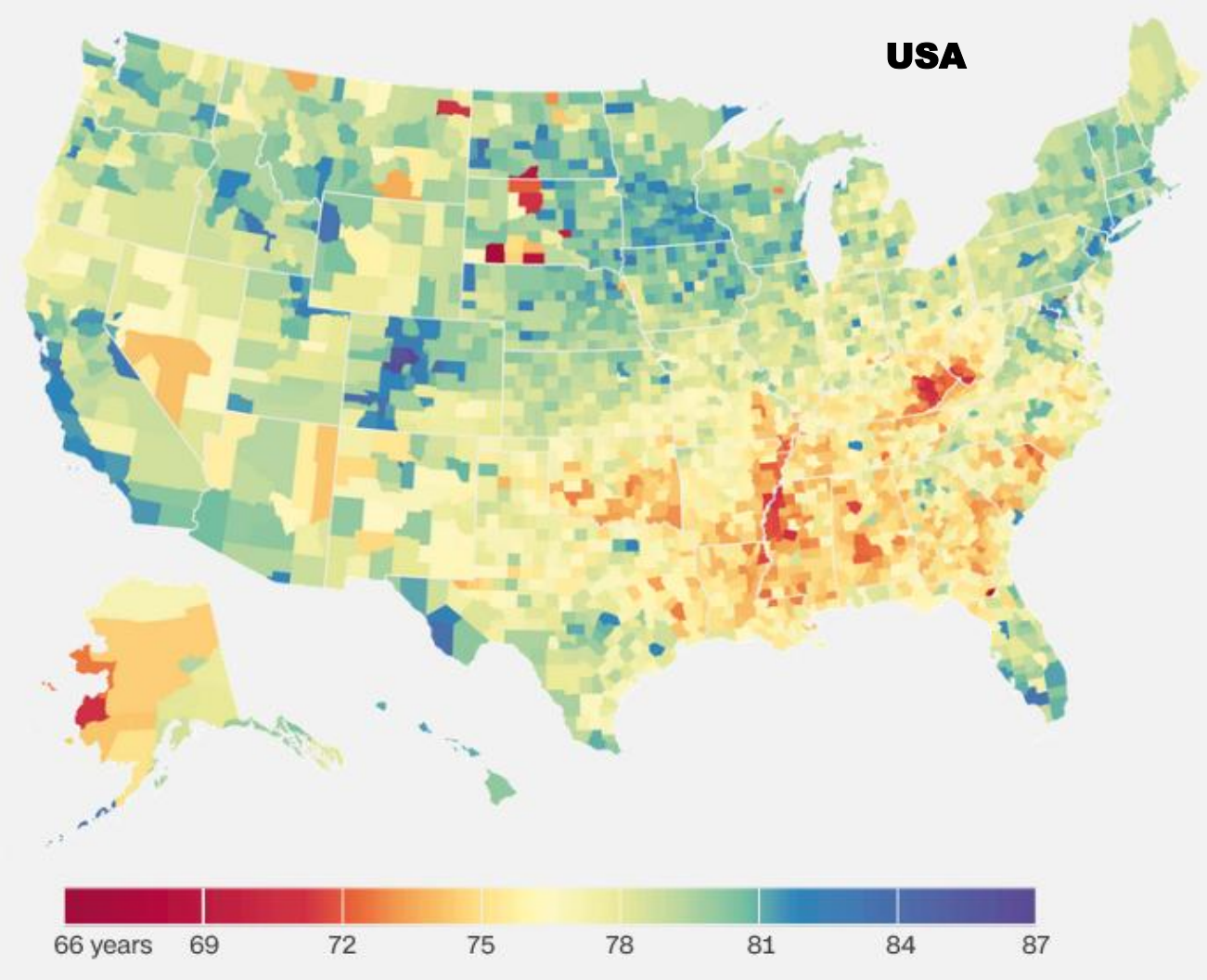
...versus growing up here?

Does air pollution impact life expectancy?



Exposures and their impacts can vary by

- Geographical location
- Urban/rural environment
- Lifestyle
- Socioeconomic status
- Occupation

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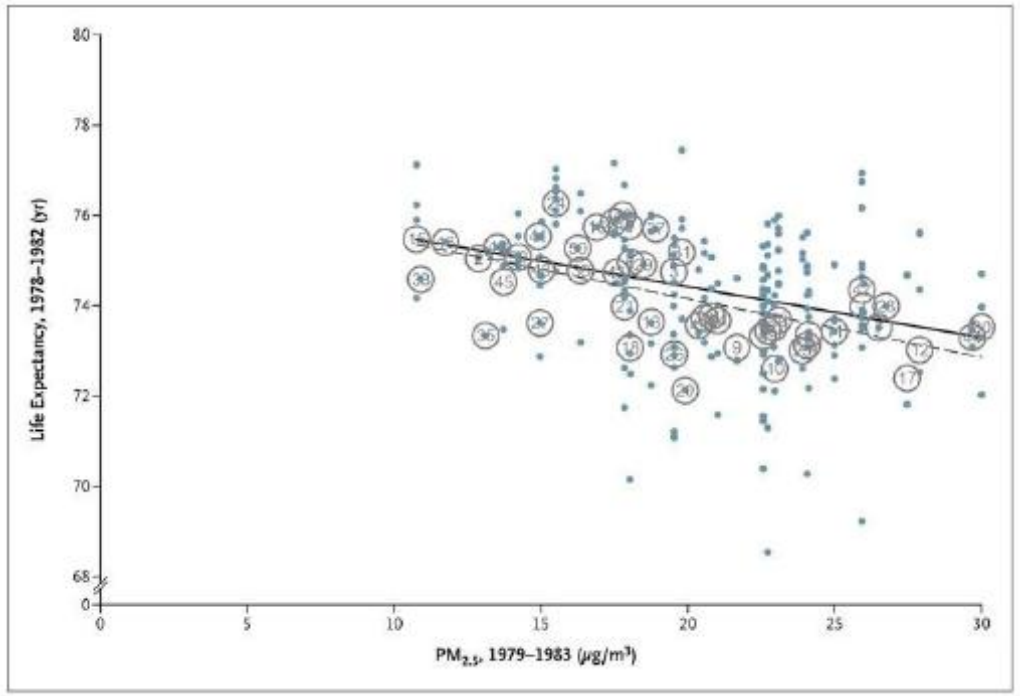
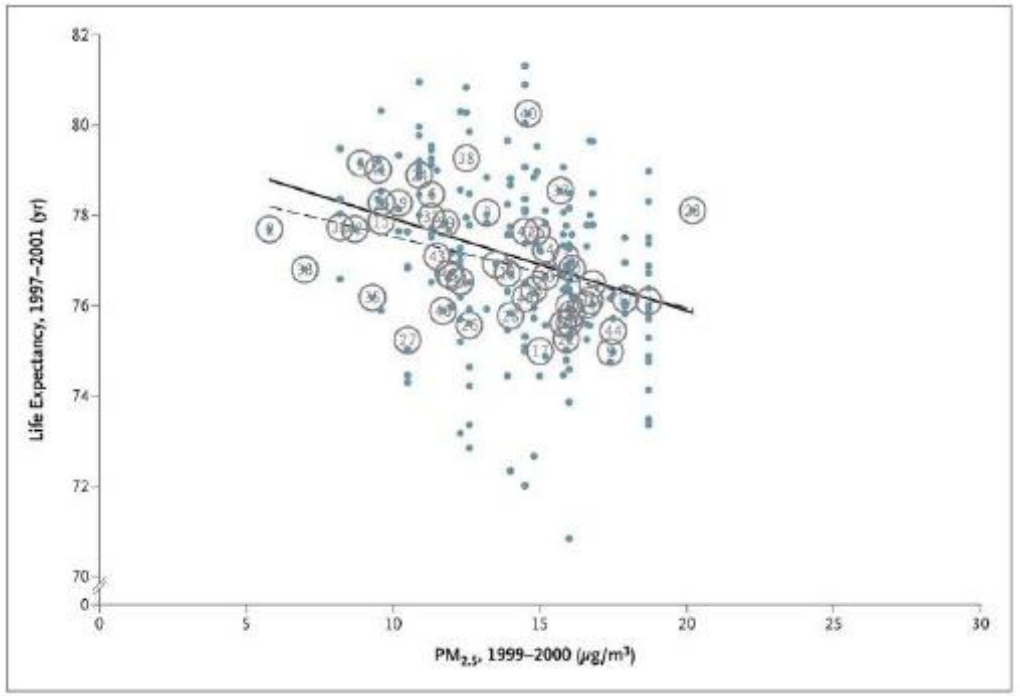
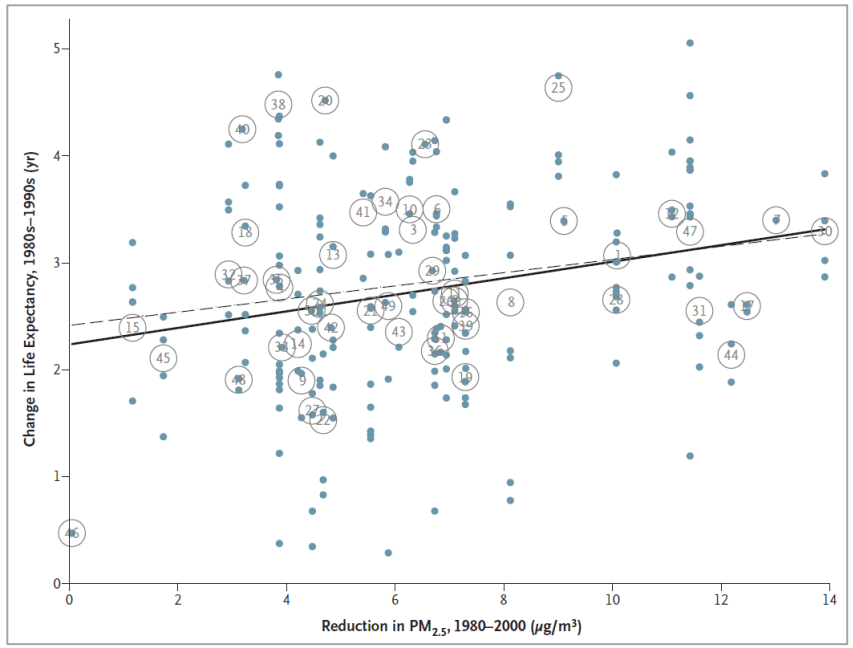




Cross-Sectional and changes in Life Expectancies plotted against $PM_{2.5}$ Concentrations



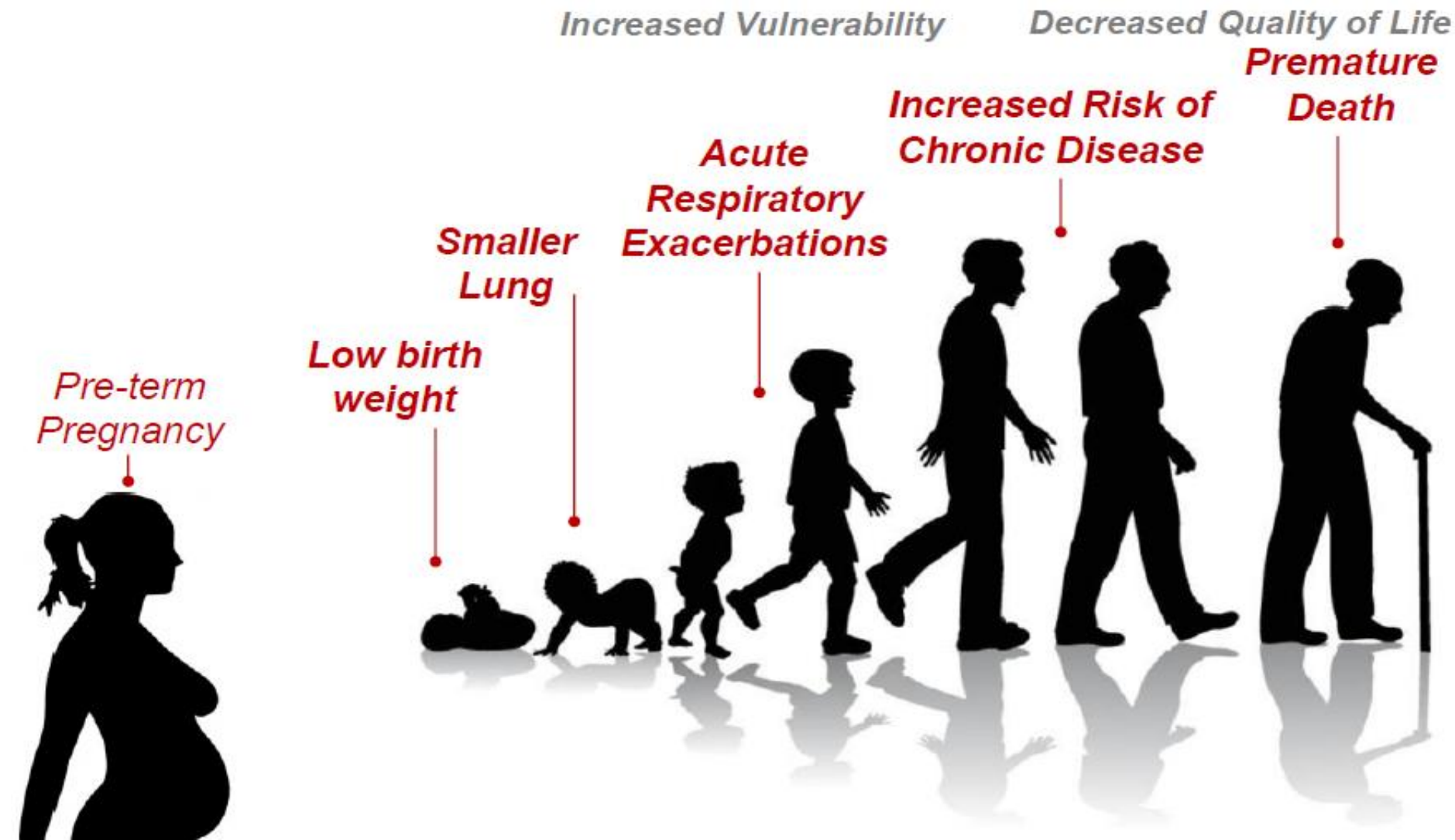
Pollutants can interact with our biology over time and can influence our heath

The NEW ENGLAND JOURNAL of MEDICINE

Fine-Particulate Air Pollution and Life Expectancy in the United States

C. Arden Pope III, Ph.D., Majid Ezzati, Ph.D., and Douglas W. Dockery, Sc.D.

Impacts of air pollution over a life course



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Who is most susceptible to air pollution?

Children

0 - 14 years

Adults

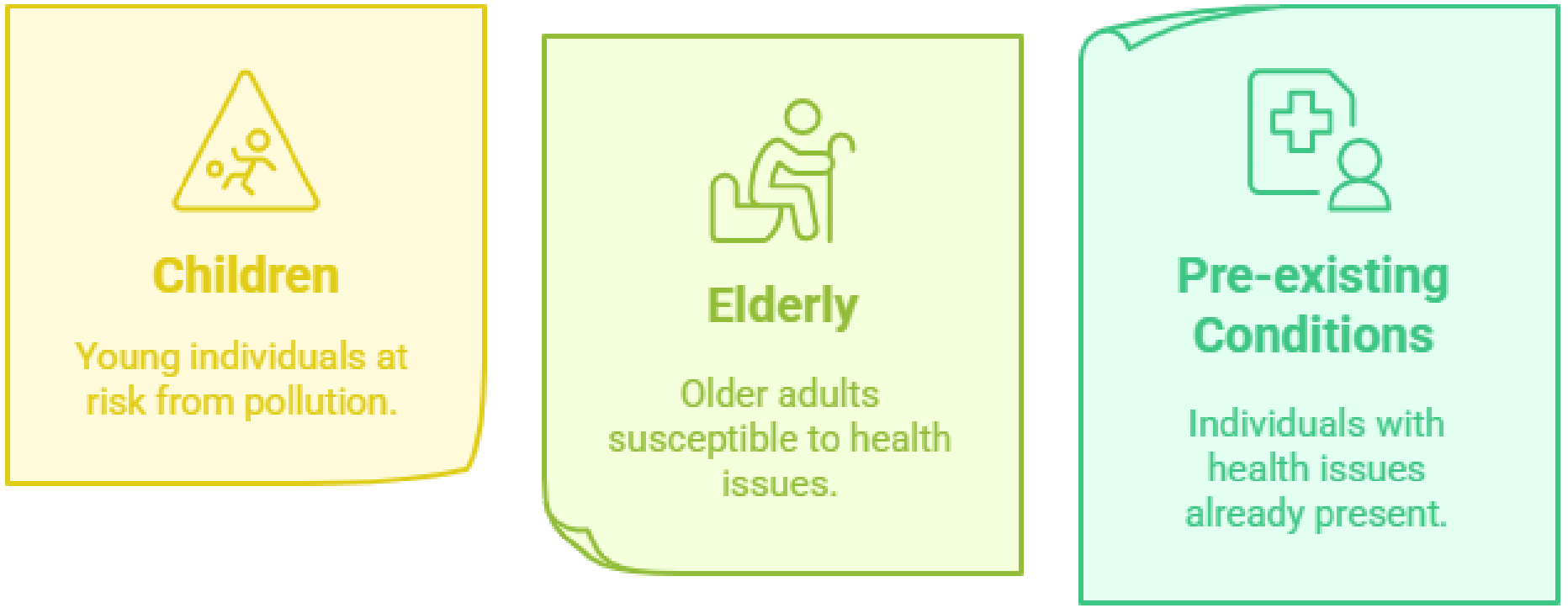
15 - 65 years

Elderly

65 - 74 years

75 years +

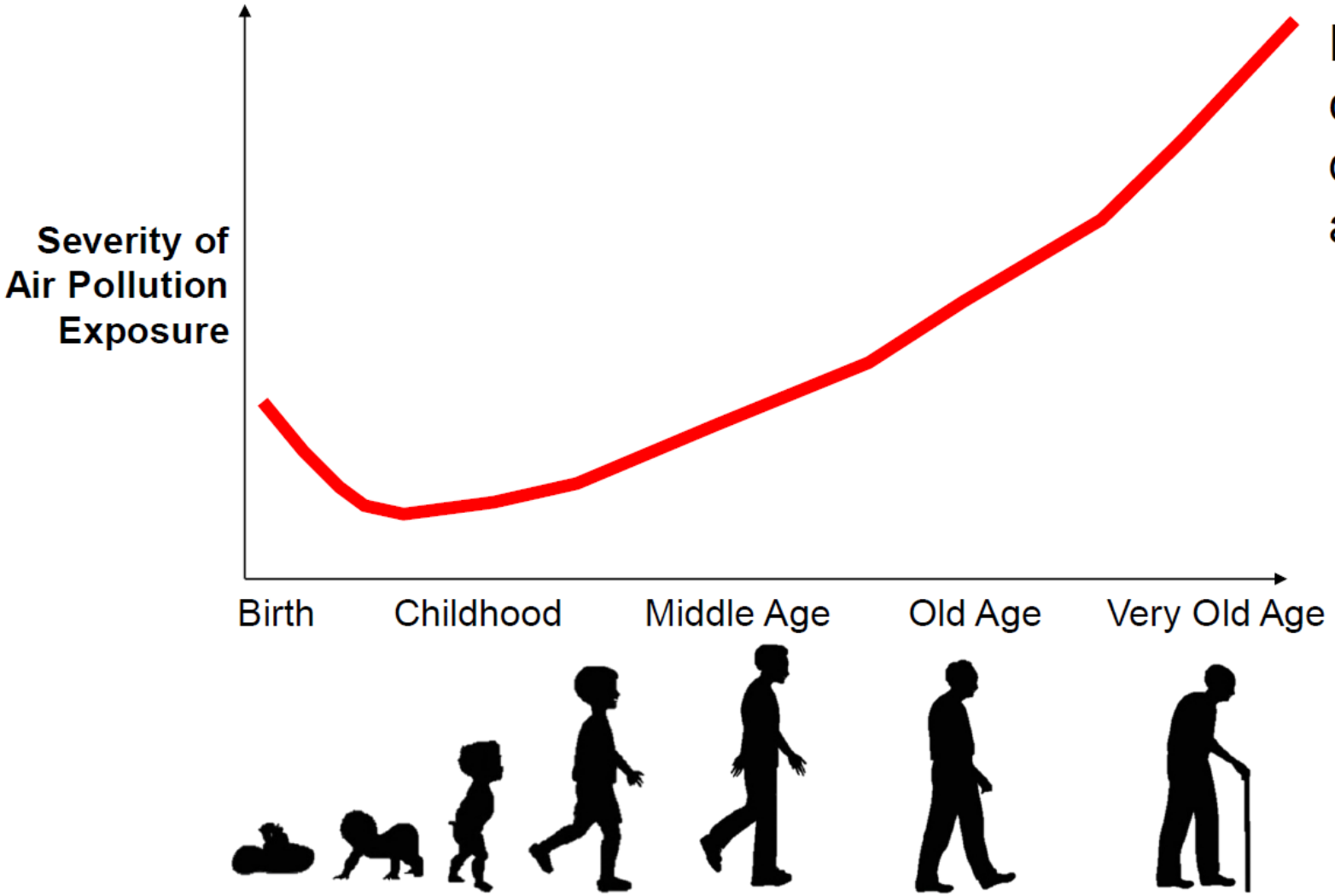
- Certain population are uniquely **vulnerable** to the adverse effects of air pollution due to one of combination of
  - Multiple and higher exposures
  - Social conditions
  - Underlying biological factors



Vulnerable groups include

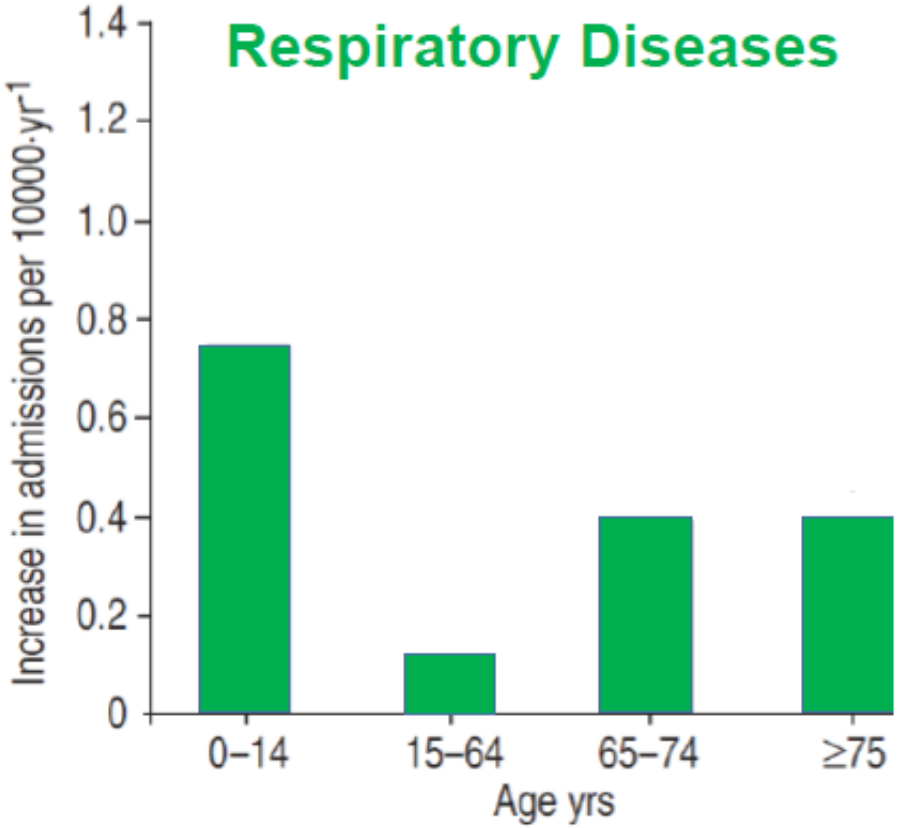
- Vulnerable groups include
  - Biologically determined susceptibility; disability; underlying health conditions
  - Poverty
- Children, pregnant women, the elderly, and people with heart and lung diseases, are more affected

(1) Increase vulnerability with age

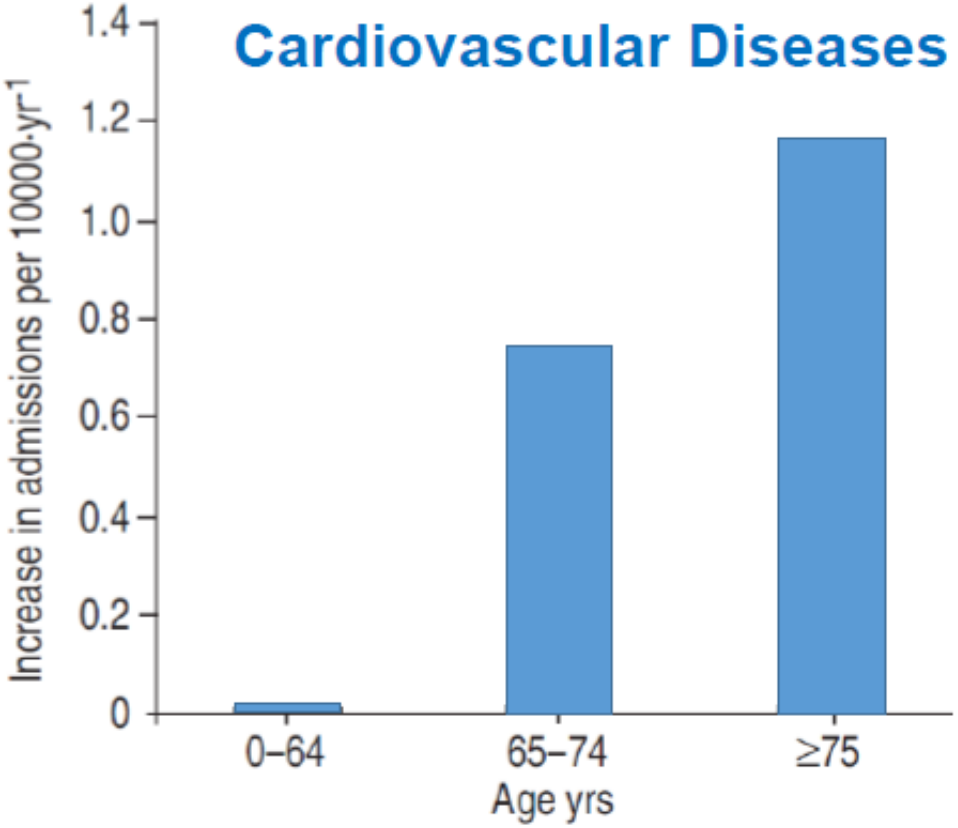


Exposure to air pollution can push forward the development of diseases and death.

Relative risk of hospital admissions associated with PM_{10}



Highest risk in children.
Lowest risk for adults.



Highest risk in the elderly which increases with age.

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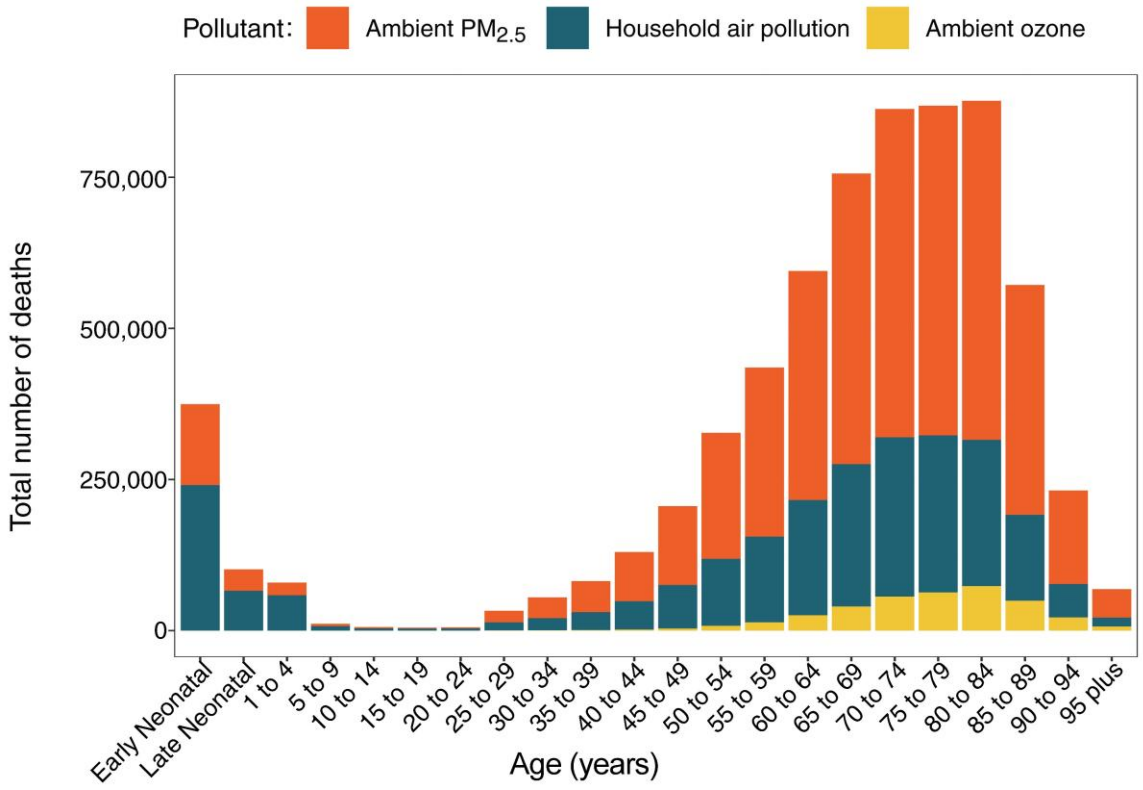
Children and the elderly at higher risk



https://www.stateofglobalair.org/health

(2) Underlying health conditions matters

Respiratory health in modern day London

$PM_{2.5} = 10\ \mu g\ m^{-3}$

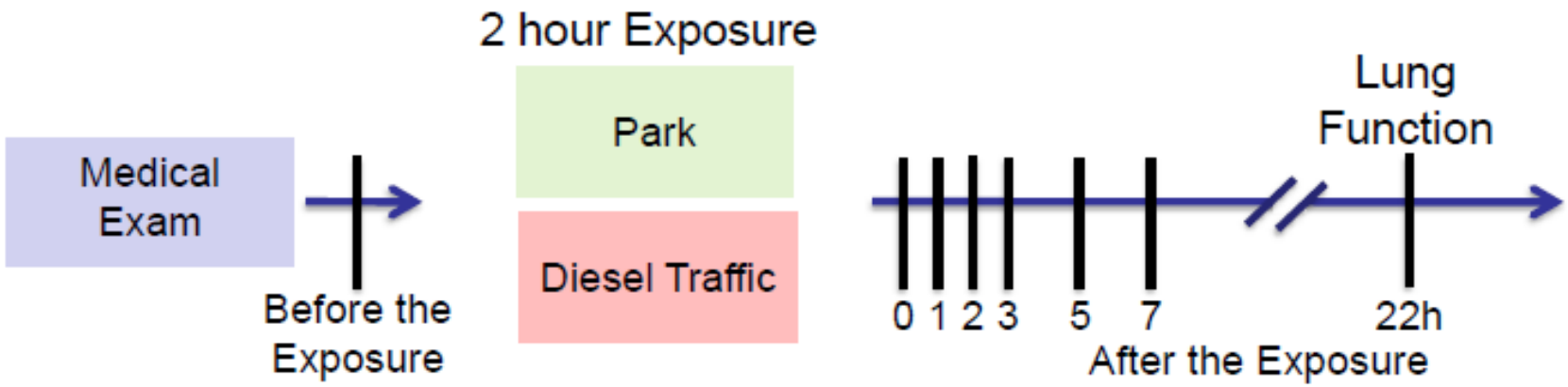
$PM_{2.5} = 30\ \mu g\ m^{-3}$

v Eng J Med. 2007 357: 2348-2358.

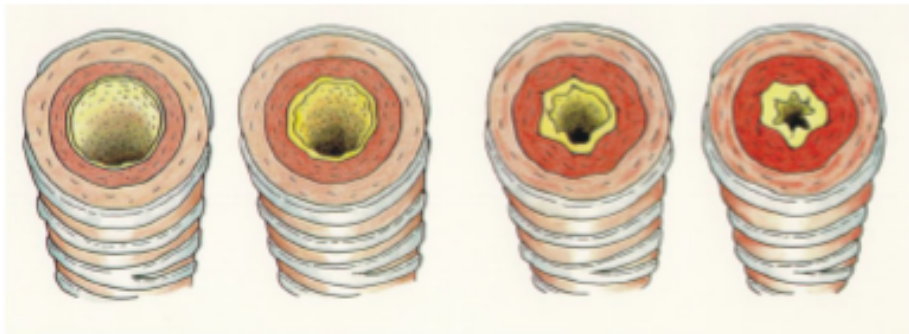
- 60 adults with either mild or moderate asthma
- Randomized, crossover study design
- Each participant walked for 2 hours along a London street (Oxford Street) and, on a separate occasion, through a nearby park (Hyde Park)
- Detailed real-time exposure, physiological, and immunologic measurements were conducted

A short shopping trip in London…

Do short term exposure to vehicle exhaust cause respiratory effects in asthmatics?

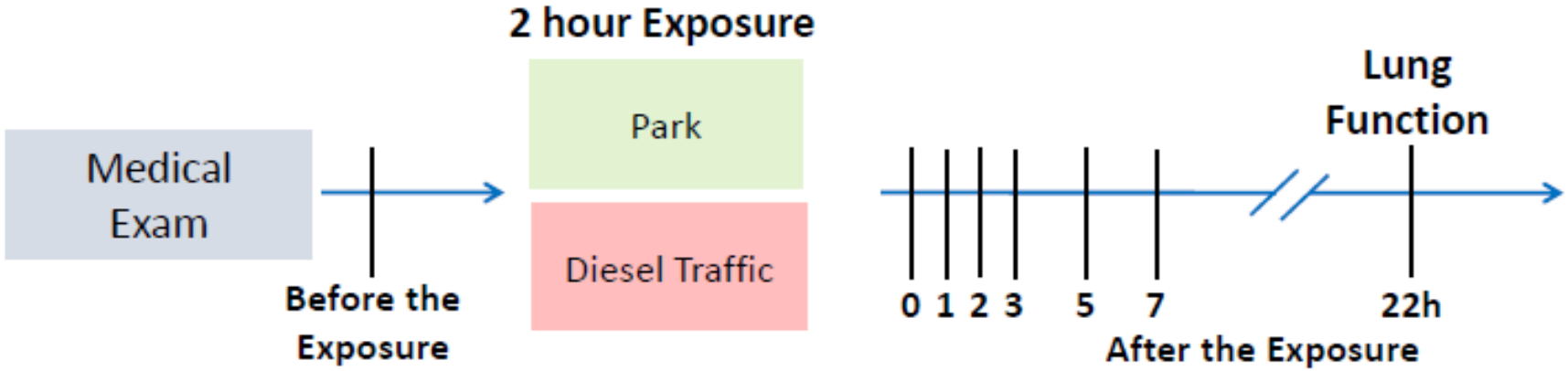


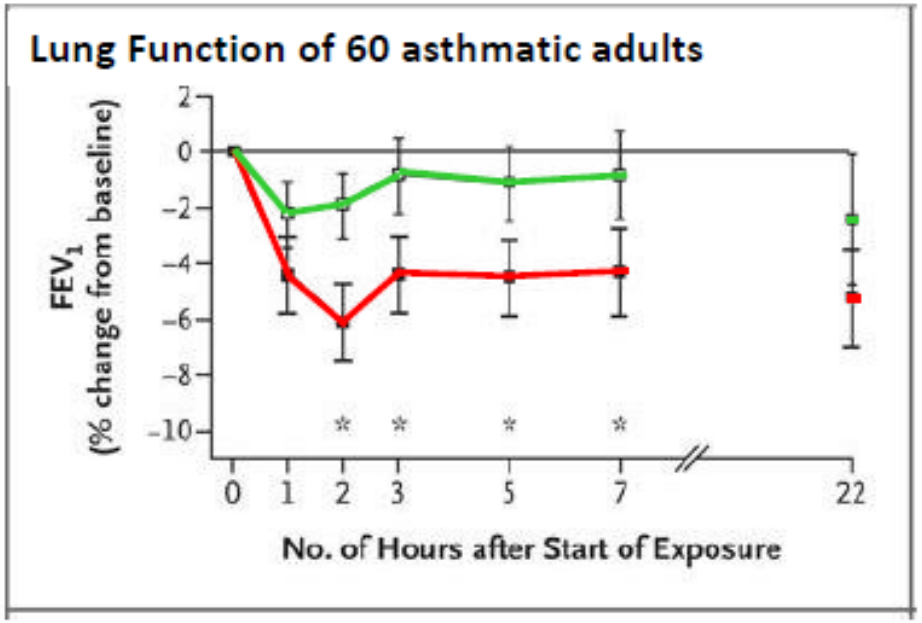
60 adults with asthma



McCreanor al. (2007) New Eng J Med 357: 2348-2358.

… could make it difficult to breathe.





- Traffic related pollution was found to worsen asthma. The effect was more pronounced for individuals with more severe asthma.

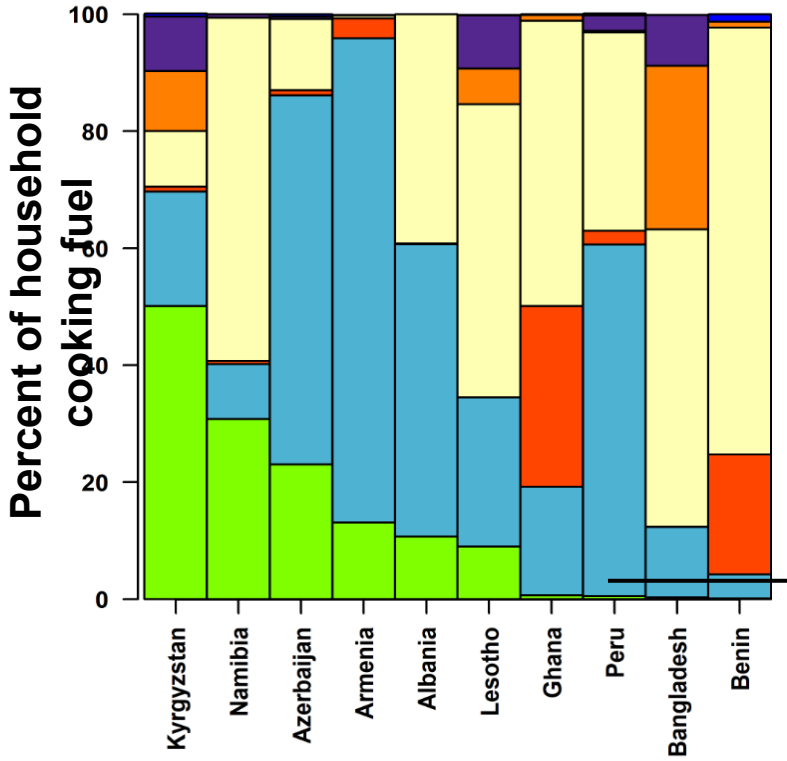
- Respiratory function decrease following diesel traffic exposure. Asthmatics also exhibited acidification of their lungs and higher levels of inflammation.

(3) Gender-defined roles in our context

Environmental Research
Volume 160, January 2018, Pages 499-505

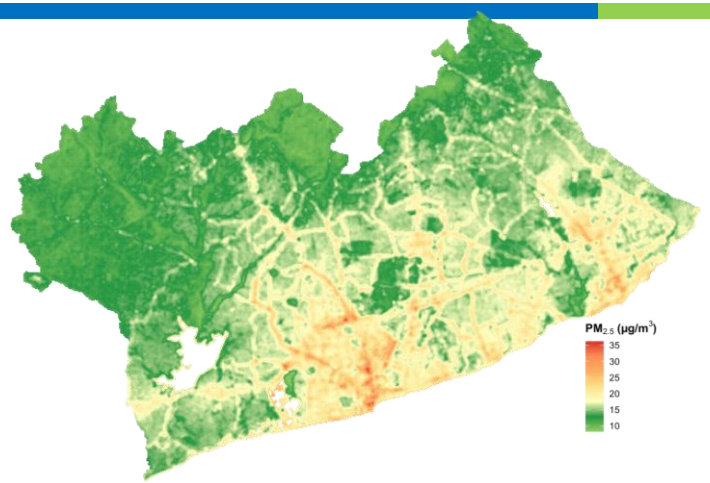
Elevated blood pressure and household solid fuel use in premenopausal women: Analysis of 12 Demographic and Health Surveys (DHS) from 10 countries

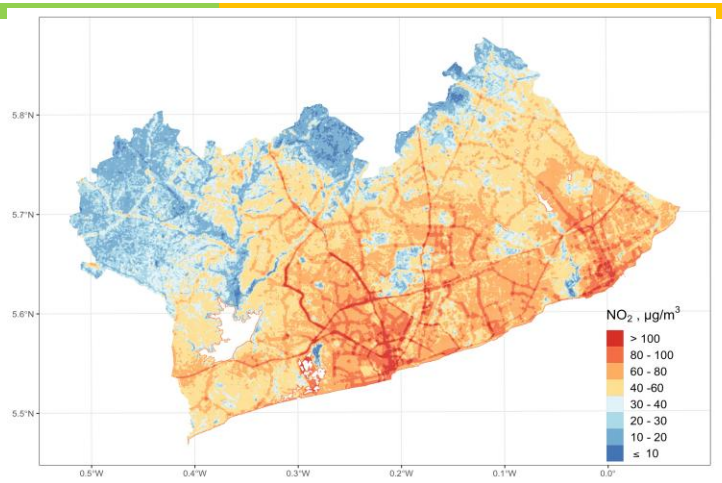
Raphael E. Arku [a, b], Majid Ezzati [c], Jill Baumgartner [d], Günther Fink [e, f], Bin Zhou [c], Perry Hystad [g], Michael Brauer [a]

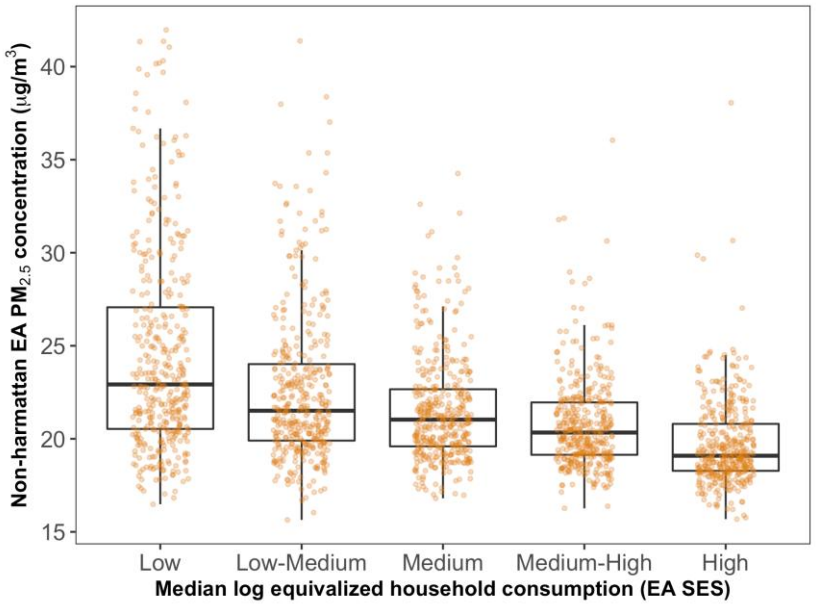


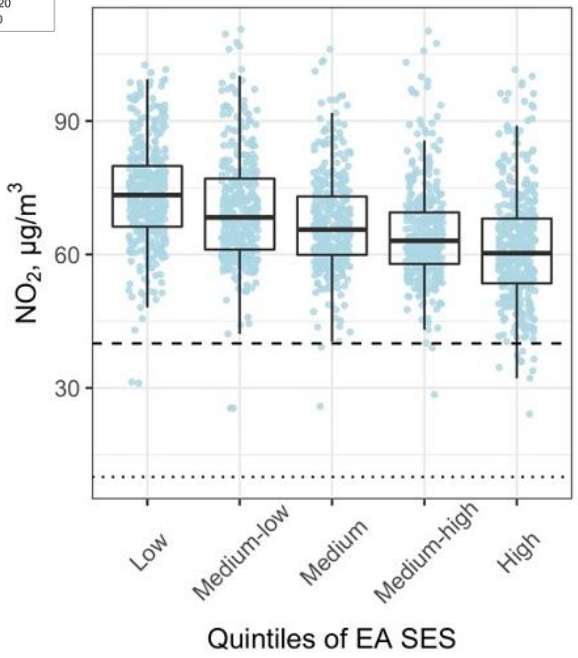
	N	Pooled effect estimates of BP (mmHg) (95% CI)		Pooled effect estimates for the odds of hypertension (95% CI)
		Systolic BP	Diastolic BP	OR
All countries	77 605	0.58 (0.23, 0.93)	0.30 (-0.12, 0.72)	1.07 (0.99, 1.16)
Rural	36 860	0.46 (-0.01, 0.93)	0.54 (-0.08, 1.15)	1.16 (1.01, 1.35)

(4) Socioeconomic disparities in exposure









Previous WHO annual AQG (40 µg/m^3)

2021 WHO annual AQG (10 µg/m^3)

Contrasting risks – the challenge of addressing air pollution

Large

Small

Small risk but cumulative 'exposure'

Some ways we can protect ourselves

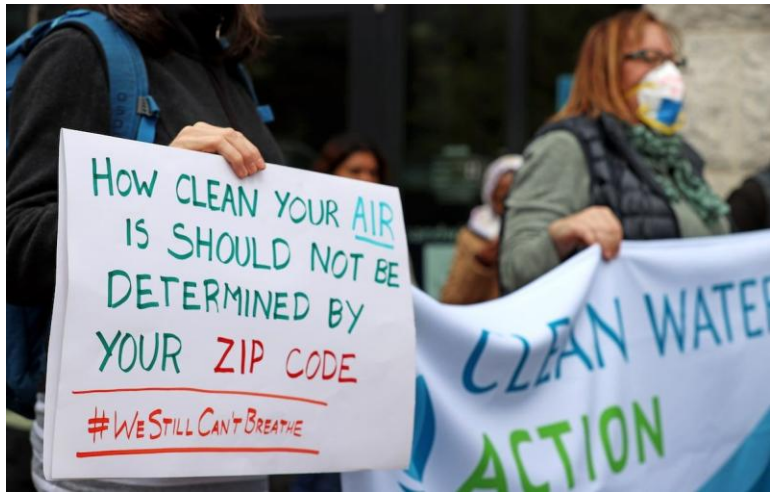
Behavioral Interventions

- Avoiding outdoor activity on bad AQ days
- Using masks or filters indoors

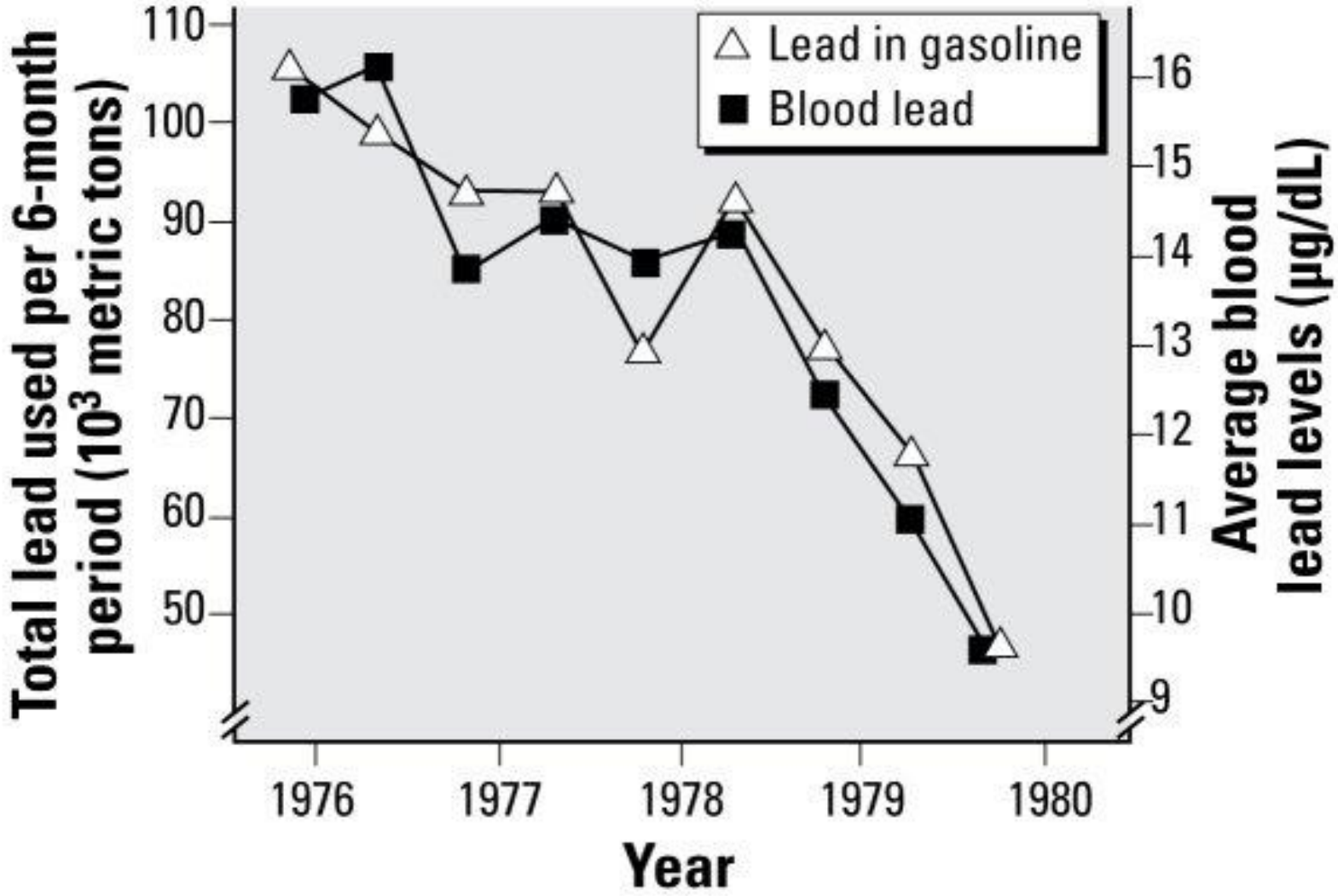
Some ways we can protect ourselves

Community Action

- Air quality monitoring
- Advocacy



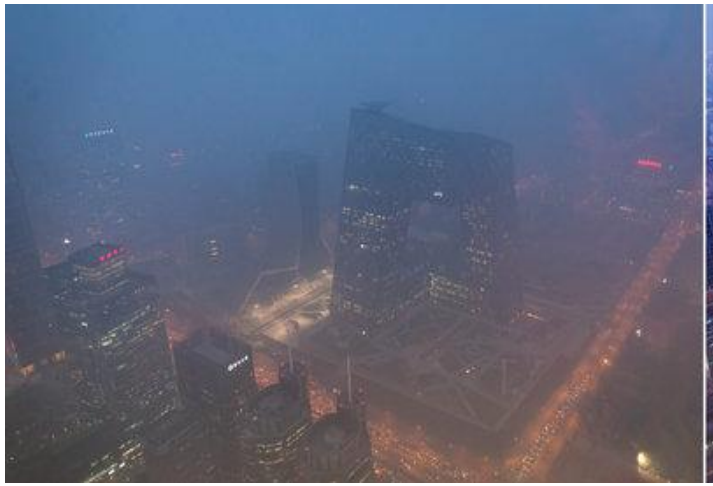
Success Story: Lead removal from gasoline



Success Story: Air quality improvement in Beijing

Jan 3, 2013

Jan 14, 2013



- Stricter emissions policy
- Impact on health
- The one good use for Twitter/X

Source: NPR [http://www.npr.org/blogs/thetwo-way/2013/01/15/169422960/beijings-pollution-seen-from-space-in-before-and-after-photos]

Susceptible Populations

Human populations are diverse and often broken into subpopulations, each with its own dose-response relationship to air pollutants.

1. Those likely to be more sensitive to a given air concentration, including the ill (respiratory or cardiovascular disease), elderly (>65 years), very young (0-3 years), undernourished, etc.

2. Those who have greater exposures and/or fewer options for avoiding exposure or seeking medical treatment, including the poor, uneducated, children, outdoor workers, etc.