School of Medicine & Health Sciences

THE GEORGE WASHINGTON UNIVERSITY

Air Quality, Climate Change, and Transportation

The Medical Society Consortium on Climate and Health Webinar

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“…patients are becoming the human face of the climate crisis.”

–Dr. Renee Salas

Health Benefits of Cleaner Air

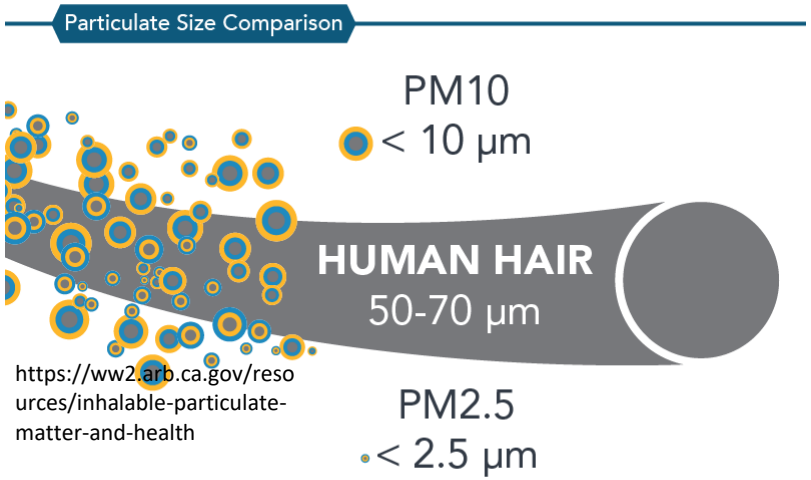
- Since the Clean Air Act was implemented in 1970
  - Emissions of major pollutants were reduced by 73% between 1990 and 2015
  - The EPA determined that 230,000 deaths were avoided per year due to lower concentrations of outdoor particulate matter
  - Economic benefits: valued at 2.0 trillion in 2020

TRAP: Traffic Related Air Pollution

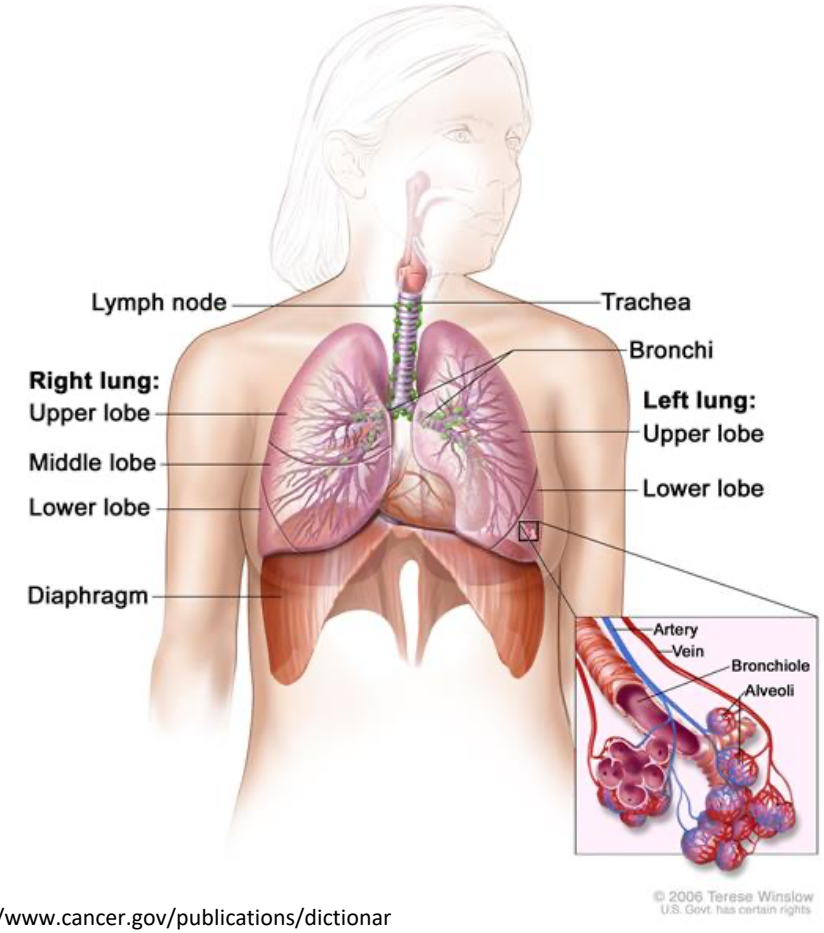
- Nitrogen dioxide (NO_2)
- Sulfur dioxide (SO_2)
- Particulate matter
  - <2.5 μm ($PM_{2.5}$)
    - Ultrafine PM
  - <10 μm (PM_{10})

https://www.momscleanairforce.org/5-reasons-moms-need-a-strong-soot-standard/

Size of particulate matter impacts health



https://ww2.arb.ca.gov/resources/inhalable-particulate-matter-and-health



https://www.cancer.gov/publications/dictionaries/cancer-terms/def/alveoli

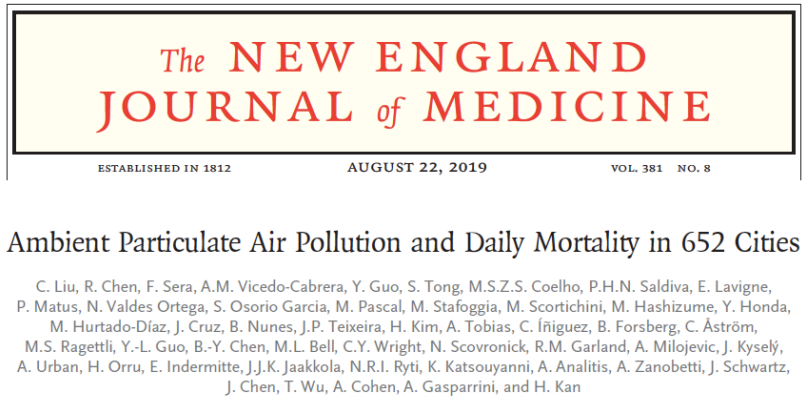
Respiratory Disease and $PM_{2.5}$

- Mechanisms
  - Oxidative Stress
  - Inflammation
    - Acute
    - Chronic
      - Airway remodeling

Cardiovascular Disease and $PM_{2.5}$

- Mechanisms linking particulate matter and cardiovascular disease
  - Direct
  - Indirect

Health Impacts



The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 AUGUST 22, 2019 VOL. 381 NO. 8

Ambient Particulate Air Pollution and Daily Mortality in 652 Cities

C. Liu, R. Chen, F. Sera, A.M. Vicedo-Cabrera, Y. Guo, S. Tong, M.S.Z.S. Coelho, P.H.N. Saldiva, E. Lavigne, P. Matus, N. Valdes Ortega, S. Osorio Garcia, M. Pascal, M. Stafoggia, M. Scortichini, M. Hashizume, Y. Honda, M. Hurtado-Díaz, J. Cruz, B. Nunes, J.P. Teixeira, H. Kim, A. Tobias, C. Íñiguez, B. Forsberg, C. Åström, M.S. Ragettli, Y.-L. Guo, B.-Y. Chen, M.L. Bell, C.Y. Wright, N. Scovronick, R.M. Garland, A. Milojevic, J. Kyselý, A. Urban, H. Orru, E. Indermitte, J.J.K. Jaakkola, N.R.I. Ryti, K. Katsouyanni, A. Analitis, A. Zanobetti, J. Schwartz, J. Chen, T. Wu, A. Cohen, A. Gasparrini, and H. Kan

- Data shows an independent association between short-term exposure to PM_{10} and $PM_{2.5}$ and daily all-cause, cardiovascular, and respiratory mortality in more than 600 cities across the globe.

Children and $PM_{2.5}$

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 SEPTEMBER 9, 2004 VOL. 351 NO. 11

The Effect of Air Pollution on Lung Development from 10 to 18 Years of Age

W. James Gauderman, Ph.D., Edward Avol, M.S., Frank Gilliland, M.D., Ph.D., Hita Vora, M.S., Duncan Thomas, Ph.D., Kiros Berhane, Ph.D., Rob McConnell, M.D., Nino Kuenzli, M.D., Fred Lurmann, M.S., Edward Rappaport, M.S., Helene Margolis, Ph.D., David Bates, M.D., and John Peters, M.D.

- Results of the study demonstrate that current levels of air pollution have a chronic, adverse affect on lung development in children from the ages of 10 to 18 years

Children and $PM_{2.5}$

Review article

Exposure to traffic-related air pollution and risk of development of childhood asthma: A systematic review and meta-analysis

Results from this meta-analysis indicate a statistically significant association of exposure to black carbon, nitrogen dioxide, $PM_{2.5}$, and PM_{10} and risk of asthma development.

Does cleaner air = better health?

JAMA | Original Investigation

Association of Changes in Air Quality With Incident Asthma in Children in California, 1993-2014

Erika Garcia, PhD; Kiros T. Berhane, PhD; Talat Islam, PhD; Rob McConnell, MD; Robert Urman, PhD; Zhanghua Chen, PhD; Frank D. Gilliland, MD, PhD

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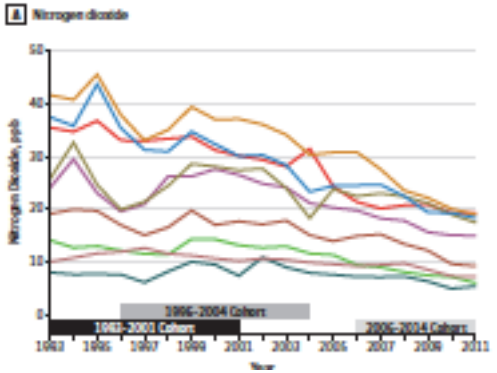
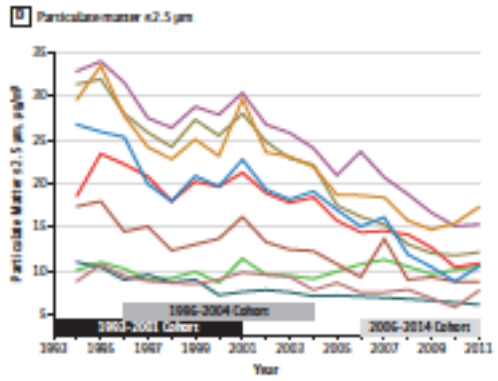


$PM_{2.5}$



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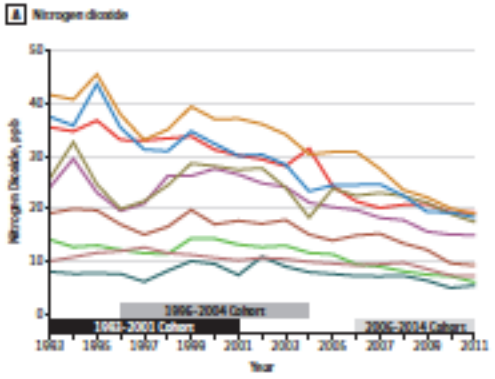
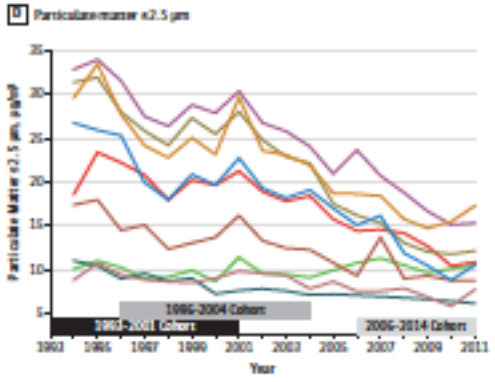
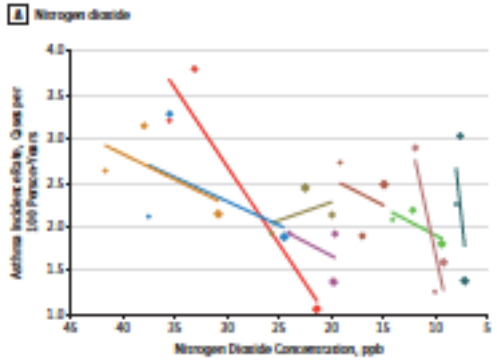
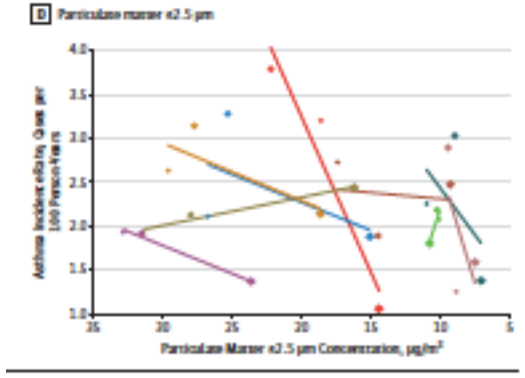


$PM_{2.5}$



Asthma incidence





COVID-19 and $PM_{2.5}$

- Multiple public health concerns
- *Exposure to air pollution and COVID-19 mortality in the United States: A nationwide cross-sectional study*
  - "an increase of 1 $\mu g/m^3$ in $PM_{2.5}$ is associated with an 8% increase in the COVID-19 death rate"

- Questions/future connections
  - Twitter: @NeeluTummala