Health Effects of Particulates and Black Carbon

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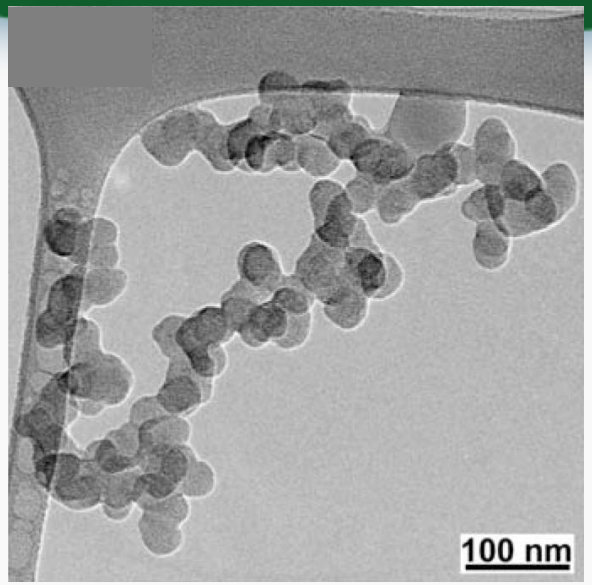
What is Black Carbon?

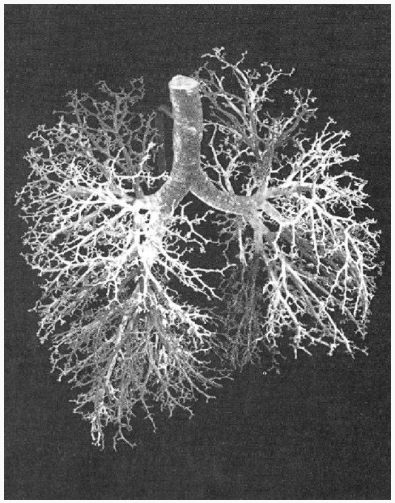


- Black carbon (BC) is the most strongly light-absorbing component of particulate matter (PM).
  - BC is a solid form of mostly pure carbon that absorbs solar radiation (light) at all wavelengths.
- Other types of particles, including sulfates, nitrates and organic carbon (OC), generally reflect light.

- BC is formed by incomplete combustion of fossil fuels, biofuels, and biomass.
- BC is emitted directly into the atmosphere in the form of fine particles (i.e., "direct $PM_{2.5}$").
- BC is a major component of "soot", a complex light-absorbing mixture that also contains organic carbon.

Significant Impacts of $PM_{2.5}$ on Public Health

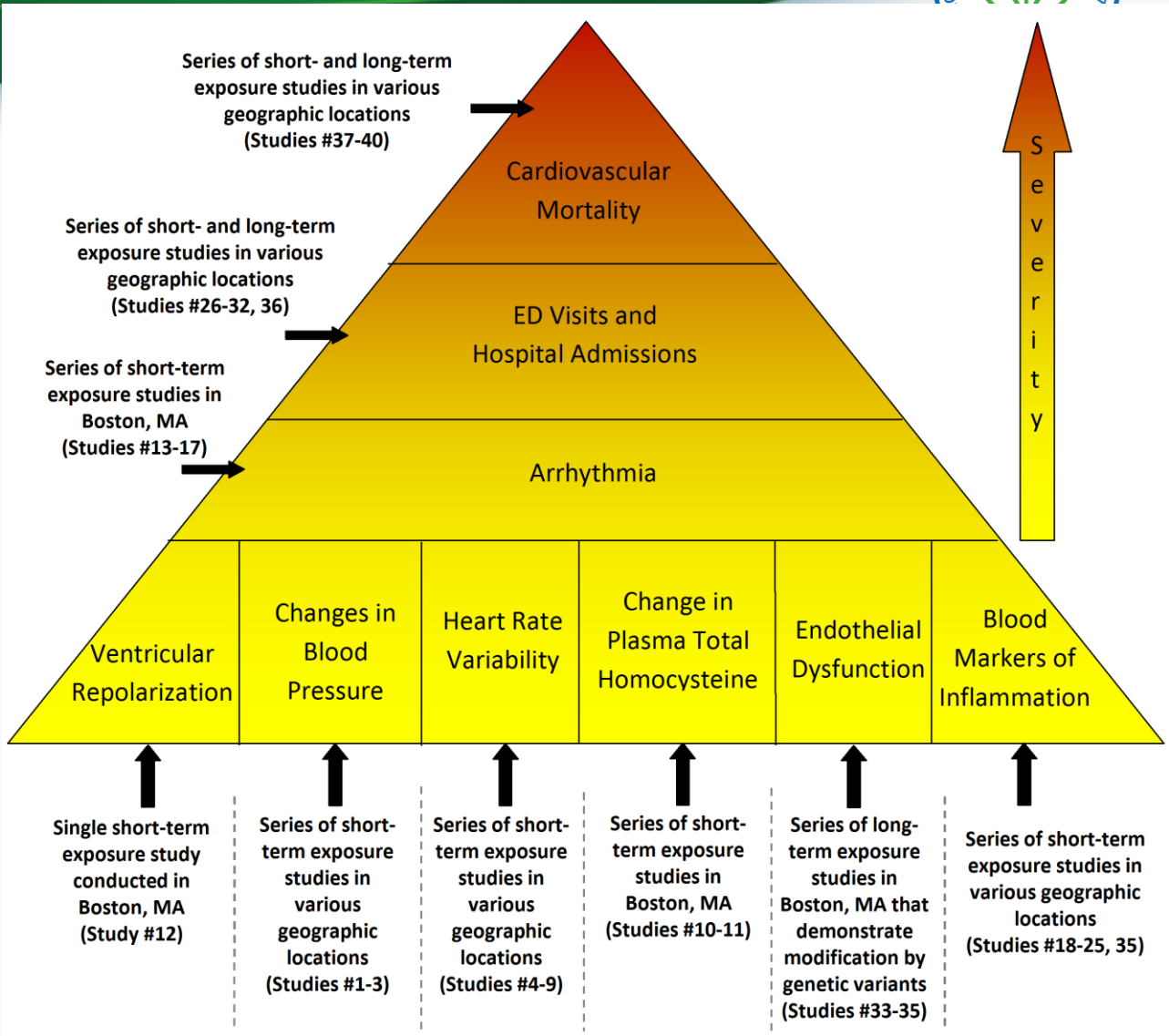
- Studies indicate that fine particles pose a serious public health problem. Due to their small size, fine particles ($PM_{2.5}$) can penetrate deep into the lungs. Even the largest fine particle is about 30 times smaller than the diameter of the average human hair.
- Exposures to fine particles ($PM_{2.5}$), including black carbon, can cause premature death and harmful effects on the cardiovascular system (the heart, blood, and blood vessels).
- Fine particle exposure also is linked to a variety of other public health problems, including respiratory diseases.
- The people most at risk include people with heart or lung disease (including asthma), older adults, children, and people of lower socio-economic status.
- Exposure to $PM_{2.5}$ linked to 130,000-320,000 premature deaths in the U.S. in 2005 (5.4% of all deaths)[1]
- Decreases in long-term $PM_{2.5}$ exposures in the U.S. have been associated with an estimated increase in average life expectancy[2]



[1] Source: Fann et al., 2012, Estimating the National Public Health Burden Associated with Exposure to Ambient $PM_{2.5}$ and Ozone, *Risk Analysis* 32(1) 81-95.

[2] Pope CA III, Ezzati M, Dockery DW. 2009. Fine-particulate air pollution and life expectancy in the United States, *New England Journal of Medicine* 2009;360:376-386.
Correia, Andrew W., C. Arden Pope III, Douglas W. Dockery, Yun Wang, Majid Ezzati, Francesca Dominici. 2012. The Effect of Air Pollution Control on Life Expectancy in the United States: An Analysis of 545 US Counties for the Period 2000 to 2007. *Epidemiology*, December 3, 2012 online edition

Cardiovascular Effects of BC



Conceptual Diagram of the Epidemiologic Evidence for the Association of BC with the Continuum of Cardiovascular Effects, including sub-clinical effects (bottom level of the pyramid) and clinical effects, increasing in severity moving up the pyramid.

Health Benefits of Reducing BC

- Health effects associated with BC are consistent with those associated with $PM_{2.5}$.
  - Includes respiratory and cardiovascular effects and premature death.
  - Also includes indoor smoke exposures (e.g., cookstoves in developing countries).

- Emissions and ambient concentrations of BC and other direct $PM_{2.5}$ are often highest in urban areas, where large numbers of people live.

- The 2010 Global Burden of Disease (GBD) analysis found that outdoor air pollution in the form of $PM_{2.5}$ is a much more significant public health risk than previously known - **contributing annually to over 3 million premature deaths worldwide and over 74 million years of healthy life lost.** It now ranks among the top global health risk burdens.

- The GBD places outdoor air pollution among the top 10 risks worldwide.

Health Benefits of Reducing BC

- BC reductions can provide large public health benefits.
  - Globally, can potentially avoid hundreds of thousands of premature deaths each year.
  - In the United States, reducing directly emitted $PM_{2.5}$ can provide health benefits ranging from $230,000-$880,000 per ton (2010$).
  - The cost of the controls necessary to achieve these reductions is generally far lower.
    - The costs of PM controls for new diesel engines are estimated to be less than $13,000 per ton $PM_{2.5}$ in the U.S.

More information

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