Air pollution: How does it cause heart and lung disease?

Presented by: Stephan van Eeden MD PhD
Respirologist, Pacific Lung Health Centre, St Paul’s Hospital
Investigator, Institute for Heart and Lung Health

London Fog (Smog) of 1952


Effect of ambient air pollution on mortality


Particulate matter deposition in lung tissues

Nemmar A et al. Circulation. 2003

How small are these particles?

PM10
(10 µm)

PM1.0
(0.1 µm)

PM2.5
(2.5 µm)

Human Hair
(50 -100 µm diameter)

Deposition of Particles into the lungs

Particulate Matter:
Carbon nucleus
Polycyclic aromatic hydrocarbons
Transition metals (iron, copper)
Bioactive (LPS etc)

Nemmar A et al. Circulation. 2003
Wildfires in BC in 2010

- 1600 fires over 330,000 hectare area
- Central interior hardest hit
- Williams Lake record PM2.5 levels 2010:
  - Hourly max 421ug/m³
  - 24 hour max 267ug/m³
  - Smoke travel hundred’s of kilometers

Macrophages with particles

Lung Inflammation causes by woodsmoke

Smoke Exposure Causes bloodstream inflammation

South-East Asia haze of 1997
Blood Stream inflammation causes by Woodsmoke

Vascular responses to Air Pollution: Impact on Atherosclerosis
First direct evidence that air pollution causes blood vessel disease

Air pollution stimulates lipid uptake in Atherosclerosis plaques

Lipids in Plaques

Effect PM$_{10}$ on plaque morphology

Air Pollution and blood vessel responses

Traffic and blood vessel disease?

NEW YORK TIMES— The closer a person lives to heavy traffic, the more likely he or she is to have atherosclerosis, also referred to as “hardening of the arteries,” a chief risk factor for heart disease and stroke, German researchers report.

Circulation Jul 2007
Living near a heavy traffic route: Coronary Heart Disease

How does Air Pollution impact Heart and Lung disease?
- Hospital admission within days of episode of pollution (Schwartz et al 1994, Alberti et al 1998)
- Hospital admissions for lung infections (pneumonia), exacerbations of COPD & Asthma, and Heart Attacks, Heart failure and Strokes (Dockery et al 1993)
- Predominantly the very young & elderly (Schwartz J 1994)
- Impact correlates the best with particle levels (Bates DJ 1992)

How air pollutants aggravate heart and lung disease

Industry & Air Pollution

American Lung Association: Lung Action Network

Industry:
1) Industry such as coal-fired power plant, emit toxins such as arsenic, lead, formaldehyde, hydrogen chloride, mercury, and dioxins, just some of the more than 84 toxic emissions coming out of these plants.
2) They emit an estimated 386,000 tons of these toxic pollutants each year in the USA. Some of these toxins may cause cancer, birth defects, trigger asthma attacks, and cause heart attacks and strokes. Estimated to responsible for 17,000 death annually.
3) The Clean Air Act directed EPA to start getting these hazardous pollutants out of the air in 1990. This is a ongoing battle with industry.

http://action.lungusa.org

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