Health impacts of diesel emissions

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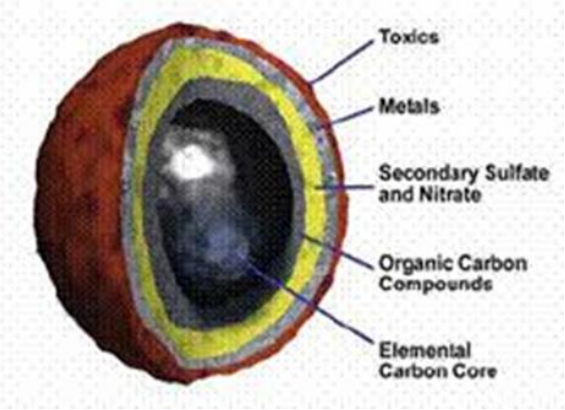
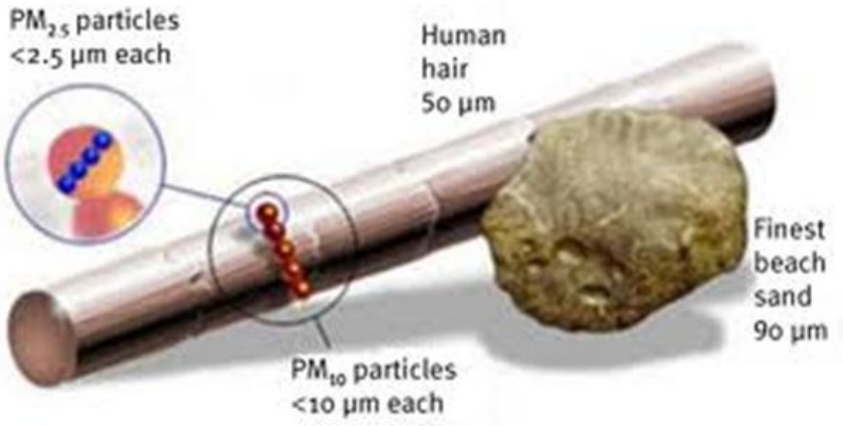
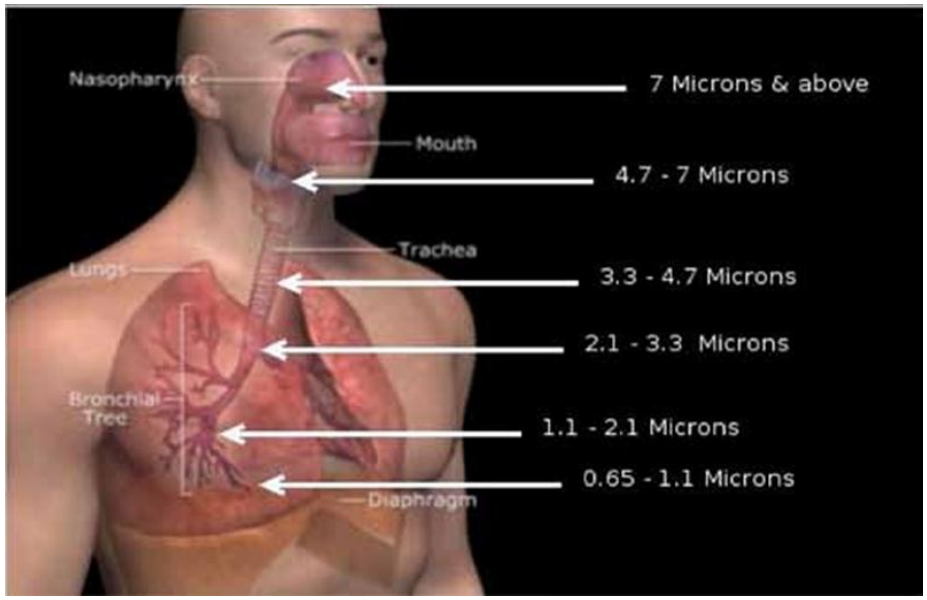
Diesel exhaust particles





- DEP consist of a carbon core surrounded by trace metals, quinones, VOCs
- The solid particulate fraction consists mainly of very small particles typically <1 µm in size
- Fine and ultrafine particles (UFP)
- Elemental carbon or organic carbon or soot used as a surrogate for diesel in epi studies

Concern with diesel exhaust particles



- Small size allows for high deposition rate into the airways
- High surface area allows better adsorption of other chemicals

How important are diesel emissions to health?

IARC, 2013

Major report deeming ambient air pollution as a cause of cancer (Group 1)

PM also separately classified as carcinogenic to humans (Group 1)

IARC, 2012

Reclassified diesel

exhaust as a carcinogen

What does this mean?

The WHO classifies the cancer-causing potential of various substances into four groups, depending on the evidence available in both humans (epidemiological and chamber studies) and animals (toxicological studies):

Group 1 is used when a substance **causes** cancer in humans

Group 2A is used when a substance **'probably'** causes cancer in humans

Group 2B is used when a substance **'possibly'** causes cancer in humans

Group 3 is used when a substance is **not classifiable** in terms of its cancer-causing properties in humans because the evidence is inadequate

Group 4 is used when a substance is **'probably not'** a cause of cancer in humans

Why?

- Decision based on findings from epidemiological studies of workers exposed to diesel fumes.
- Recent large cohort study (US National Cancer Institute and NIOSH), published in March 2012, of occupational exposure to diesel exhaust in 12,315 US miners.
- Increased the risk of dying from lung cancer (1.26, 95% CI: 1.09 to 1.44).
- Case-control study, in this group (comparing 198 miners who had died from lung cancer with 562 miners who were alive at the time the 'case' died), found risk of lung cancer in workers increased with the length of exposure time – dose response.
- Studies were in heavily exposed workers to diesel fumes, however WHO recommends action to reduce exposure to diesel exhaust fumes should encompass both highly exposed workers and the general population.

Other views?

- **National Toxicology Program (NTP)** (US) (includes the National Institutes of Health (NIH), the Centers for Disease Control and Prevention (CDC), and the Food and Drug Administration (FDA). Classified exposure to diesel exhaust particulates as "reasonably anticipated to be a human carcinogen," based on limited evidence from studies in humans and supporting evidence from lab studies.
- The US **Environmental Protection Agency (EPA)** classifies diesel exhaust as "likely to be carcinogenic to humans."
- The **National Institute for Occupational Safety and Health (NIOSH)** has determined that diesel exhaust is a "potential occupational carcinogen."

Other health effects?

- Acute exposures:
  - can cause irritation to the eyes, nose throat and lungs, nausea
  - cough, lung function changes and asthma exacerbations
  - increase in inflammatory markers
  - act as adjuvants to allergen to increase allergic response (chamber studies)
- Chronic exposures
  - Cough, sputum production, lung function decrements
  - increased lung cancer risk
- USEPA has set a Reference Concentration for diesel exhaust (includes DPM) of 5 ug/m3.
- The US Health Effects Institute-Panel (2014) to report (in 18 mths time) on whether there is sufficient data form the recent studies to conduct a quantitative risk assessment for general exposures (that is lower dose levels)

How important is air pollution to health?

BOD 2010 Comparative risk assessment of BOD project (Lim et al, 2012, The Lancet):

DALYs-includes mortality and morbidity effects

Notable in that it is an unavoidable exposure & relevant to the whole population

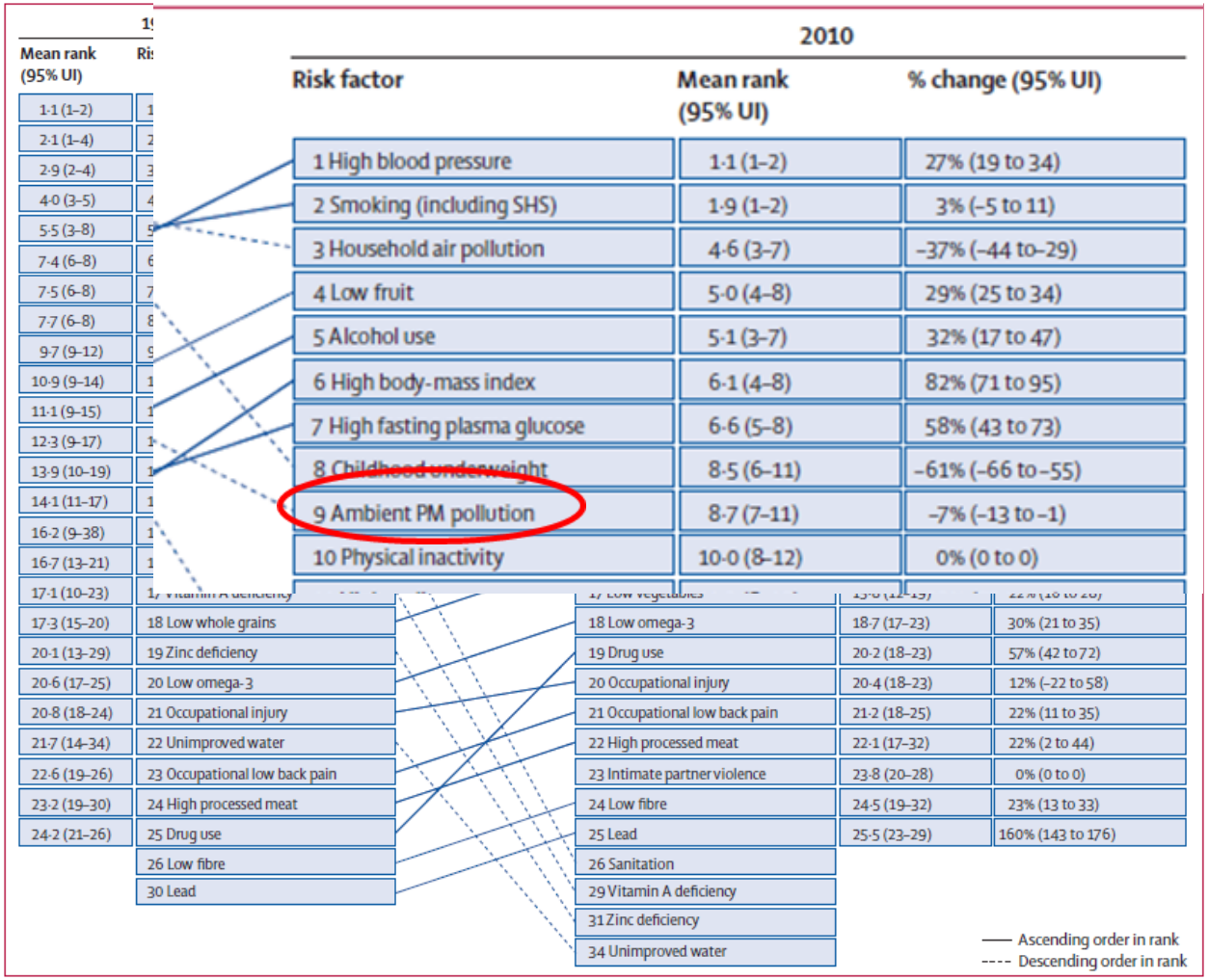


Figure 3: **Global risk factor ranks with 95% UI for all ages and sexes combined in 1990, and 2010, and percentage change**
PM=particulate matter. UI=uncertainty interval. SHS=second-hand smoke. An interactive version of this figure is available online at http://healthmetricsandevaluation.org/gbd/visualizations/regional.

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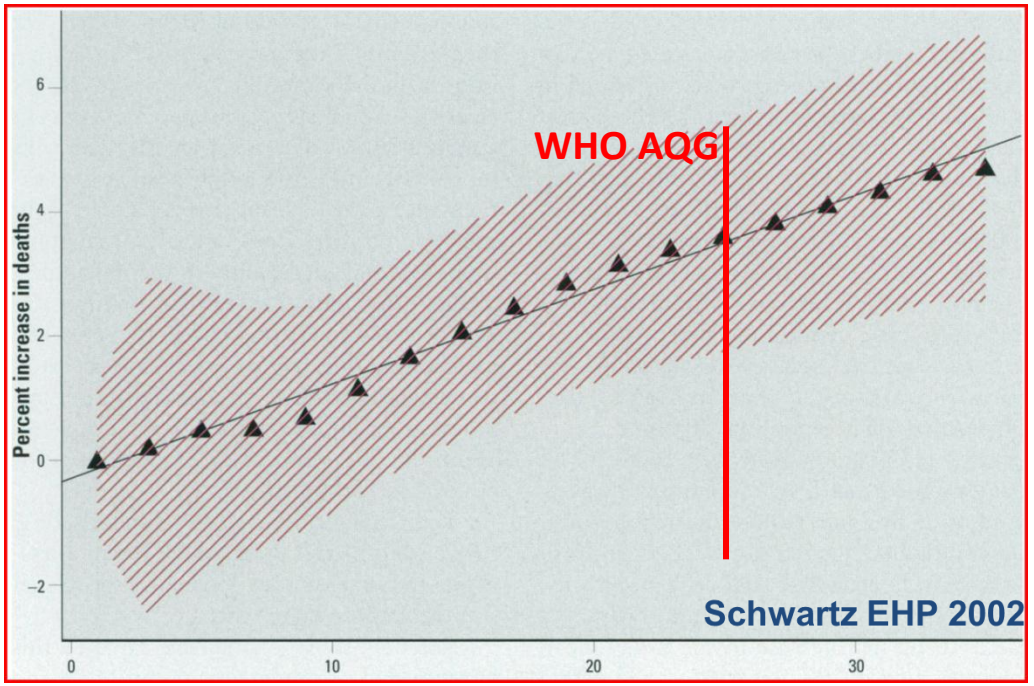
Knowledge gaps: concentration response functions (CRFs) of particulate matter (PM) at low and at very high (peak) levels

- Is there a threshold of effect to $PM_{2.5}$?

Concentration-response Relation Between $PM_{2.5}$ and Daily Deaths



<u>$PM_{2.5}$ short-term effects</u>

- Substantial evidence of associations at very low levels of $PM_{2.5}$
- No observed threshold of effect

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