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Black carbon associated adverse health effects

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Black carbon is useful in health risk assessment of burning-derived fine particles

Black carbon (BC) is an easy-to-measure optical parameter that universally indicates a complex mixture of toxic and carcinogenic PAH compounds, other persistent organic species (POPs), acids etc. – all simultaneously co-released with BC from various incomplete burning processes. Combustion-derived BC is never equal to elemental carbon, but this is the major BC component that adsorbs effectively and carries organic compounds and other toxic agents on its surfaces.

| | Spherical organic carbon particles | Soot (elemental carbon aggregates) | Inorganic ash particles |
|---|---|---|---|
| Schematic drawing |  |  |  |
| Diameter measured by electron microscopy* | 50-600 nm ^{52, 53} | 20-50 nm ^{52, 73} | 50-125 nm ⁹⁷ |
| | Poor burning of firewood or forest in nature | Conventional burning of firewood or pellets | Well-controlled burning of wood pellets |



Which incomplete combustion sources of BC are the most harmful to human health?

Closeness to the source is important: release of emission indoors at home or easy infiltration of outdoor emission to home indoors increase personal exposures and health risks

- ***Burning of household firewood, other biomass or coal**** inside residence or anywhere outside
- ***Exhaust fumes from road vehicles**** (especially old diesel cars)
- ***Shipping, agricultural and industrial machinery***
- ***Old coal, peat, or heavy fuel oil -fired power plants**** without effective emission after-treatment technology
- ***Surplus oil and gas burnt or flared off in oilfields***
- ***Forest and other landscape fires****, and purposeful agricultural fires



BC is highly involved in the large Global Burden of Disease as assessed for 2015 with WHO

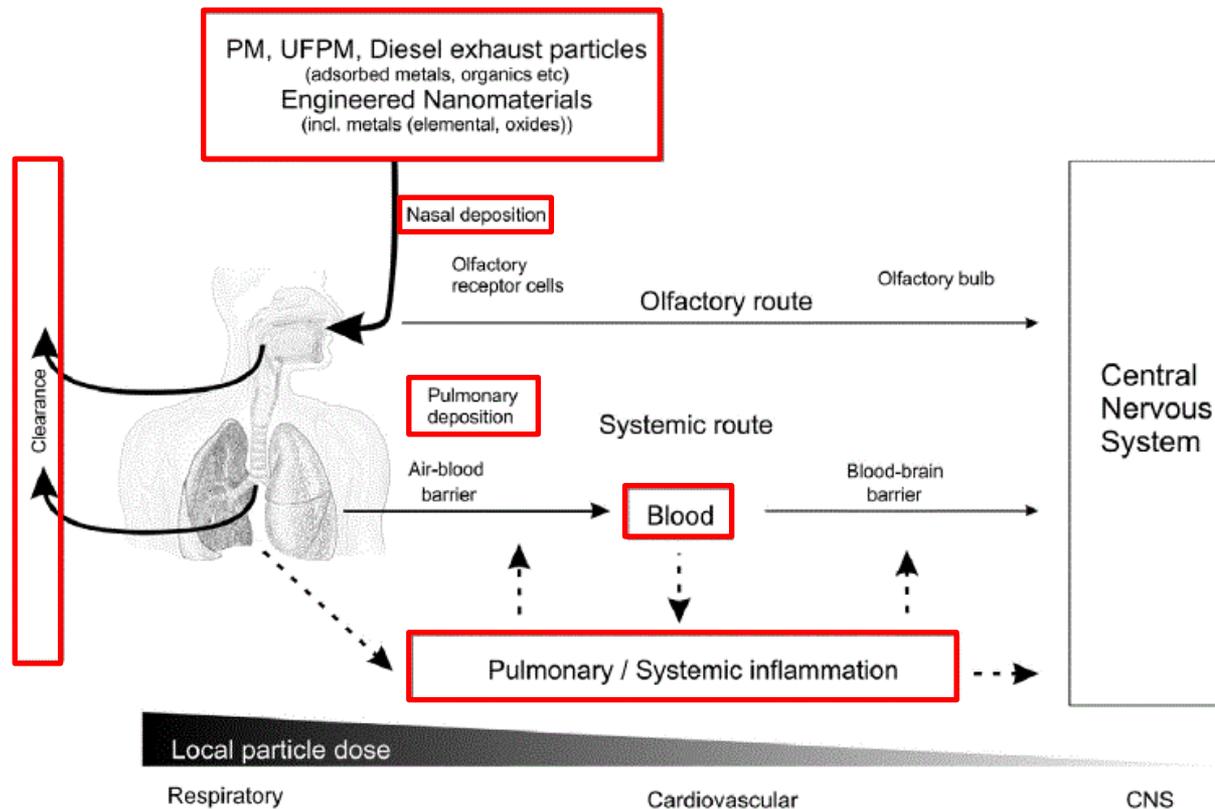
Comparative risk assessment of the burden of disease (= premature mortality + loss of healthy life years) attributable to 249 causes of death in 2015 (*Cohen et al, Lancet 2015 and 2016*)

- ❖ **Long-term exposure to *ambient air fine particles (PM_{2.5})* estimated globally as the 6th most powerful risk factor for burden of disease**
 - ❖ **About 4,2 million premature deaths annually** due to cardiovascular causes (coronary heart disease, vascular events in the brains) and respiratory causes (chronic bronchitis, infections, lung cancer)
 - ❖ **Primary and secondary PM from engine emissions, residential heating with solid fuels, industries, energy plants, forest & landscape fires etc.**
- ❖ **Long-term *indoor exposures to household air pollution from solid fuels (wood, other biomass, coal)* assessed globally as the 8th most powerful risk factor for burden of disease**
 - ❖ **About 2.8 million premature deaths annually** mainly due to cardiovascular and respiratory causes
 - ❖ **Mainly indoor air pollution from cooking with unvented stove**

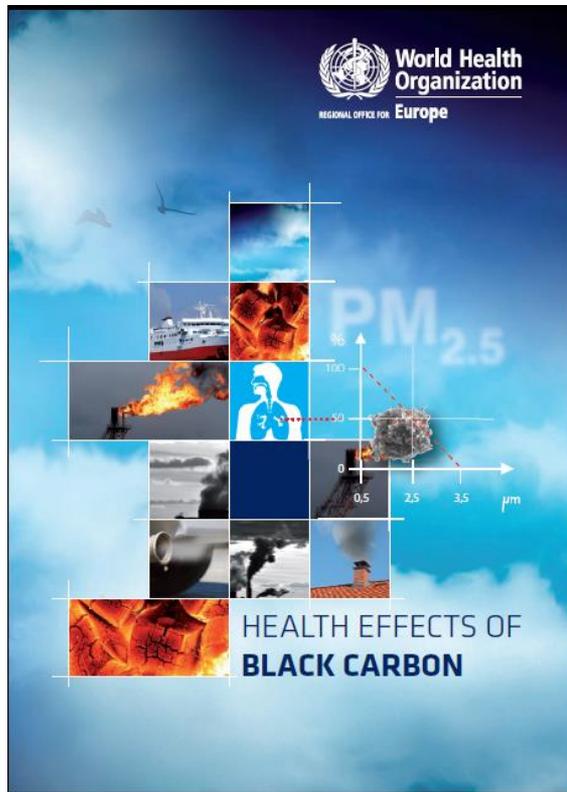


How do toxic agents adsorbed mainly on elemental carbon affect the human body?

BC is a universal indicator of burning-derived toxic and carcinogenic chemical species in ultrafine-to-fine particle size-range to sensitive targets of the human lungs, blood and other organs like the heart and the brain (WHO-UNECE CLRTAP / TFH 2012)



WHO / UNECE CLRTAP Task Force on Health



Sufficient evidence of an association of short-term (daily) variations in BC concentrations with short term changes in health (all causes and cardiovascular mortality, cardio-pulmonary hospital admissions).

Sufficient evidence of associations of all causes and cardio-pulmonary mortality with long-term average BC exposure.

Janssen N, Gerlofs-Nijland ME, Lanki T, Salonen RO, Cassee F, Hoek G, Fischer P, Brunekreef B, Krzyzanowski M. **Health effects of black carbon. Copenhagen: WHO Regional Office for Europe. Report for the Joint Task Force on Health of the WHO and UNECE Convention on Long-range Transboundary Air Pollution, 2012, vii+86 p.**

<http://www.euro.who.int/en/what-we-publish/abstracts/health-effects-of-black-carbon>

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