NCAP-COALESCE
CarbOnaceous AerosoL Emissions, Source apportionment & ClimatE impacts
Understanding scientific complexities related to carbonaceous aerosols focussing on issues underlying their origin and fate, and their role as drivers of regional climate change over India.

Research BRIEFS

Global health burden of ambient PM2.5 and the contribution of anthropogenic black carbon and organic aerosols

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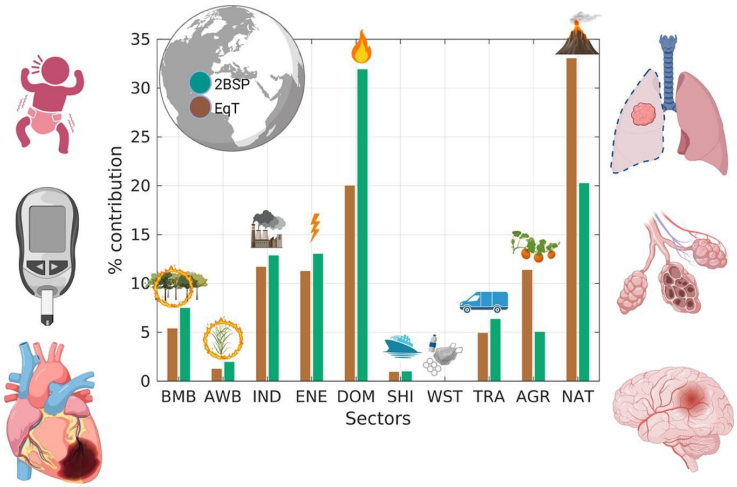

Key highlights:

- Estimated 4.23 (95% confidence interval 3.0–6.14) million excess deaths annually from the exposure to ambient $PM_{2.5}$.
- We find that domestic energy use by the burning of solid biofuels is the largest contributor to ambient BC, POA and aSOA globally.
- domestic energy use emerges as the leading cause of excess mortality attributable to ambient $PM_{2.5}$, notably in Asia and Africa.
- mportance of emissions from domestic energy use as a cause of premature mortality is robust to a range of assumptions about the magnitude of the excess risk.

Summary of your Research:

Chronic exposure to fine particulate matter (PM2.5) poses a major global health risk, commonly assessed by assuming equivalent toxicity for different PM2.5 constituents. We used a data-informed global atmospheric model and recent exposure–response functions to calculate the health burden of ambient PM2.5 from ten source categories. We estimate 4.23 (95% confidence interval 3.0–6.14) million excess deaths annually from the exposure to ambient PM2.5. We distinguished contributions and major sources of black carbon (BC),primary organic aerosols (POA) and anthropogenic secondary organic aerosols (aSOA). These components make up to ~20% of the total PM2.5 in South and East Asia and East Africa

We find that domestic energy use by the burning of solid biofuels is the largest contributor to ambient BC, POA and aSOA globally. Epidemiological and toxicological studies indicate that these compounds may be relatively more hazardous than other PM2.5 compounds such as soluble salts, related to their high potential to inflict oxidative stress.

We performed sensitivity analyses by considering these species to be more harmful compared to other compounds in PM2.5, as suggested by their oxidative potential using a range of potential relative risks. These analyses show that domestic energy use emerges as the leading cause of excess mortality attributable to ambient PM2.5, notably in Asia and Africa.

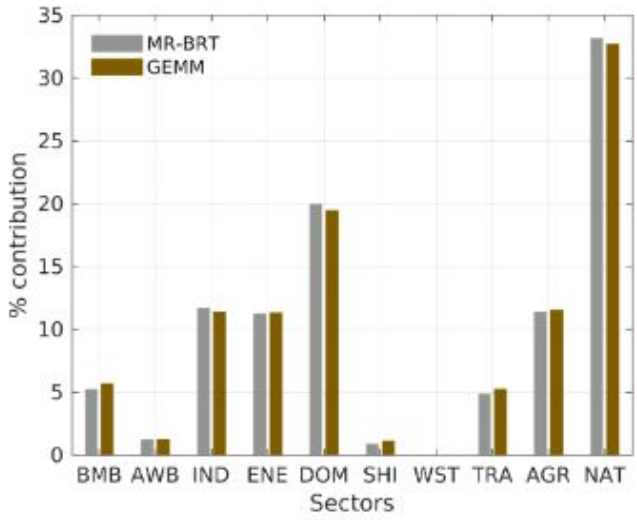

Fig. 8. Percentage contributions of source sectors to excess mortality burden from $PM_{2.5}$ calculated using the MR-BRT and GEMM exposure response functions. The sectors at the x-axis are BMB- Biomass burning; AWB- Agricultural waste burning; IND- Industries; ENE- Power generation; DOM- Domestic solid fuel burning and other commercial activities; SHI- Ships; WST- Waste Incineration; TRA- Transportation; AGR- Agricultural soils; NAT- Natural and biogenic emissions.

Take away/conclusion :

- Using the recent MR-BRT exposure–response functions of the GBD (Murray et al., 2020), we estimated 4.23(3.0–6.14) million excess deaths from the exposure to ambient PM2.5 globally for 2015 of which 92%, 5%, and 3% occur among adults, neonates and children, respectively.
- We estimated a global mortality burden of about 1.3 million per year from ozone in 2015 (Chowdhury et al., 2020), but this does not affect the current discussion on PM2.5 toxicity.
- We identified DOM as the globally largest source category of BC, POA and aSOA and the leading anthropogenic sector contributing to excess mortality from exposure to $PM_{2.5}$. The major sources of BC in our calculations are DOM and TRA, which concurs with previous findings (Anenberg et al., 2011, Janssen et al., 2011, Li et al., 2016).
- The relative contributions of sectors that use fossil fuels as well as DOM are expected to increase significantly under the 2BSP assumption (as well as other enhanced toxicity assumptions).

Research Article citation

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