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Fossil fuel air pollution blamed for 1 in 5 deaths worldwide

Ingrid Torjesen

Fossil fuel air pollution is responsible for around one in five deaths, which is more than double the number previously thought, a study has found.

The researchers estimated that 8.7 million people worldwide died in 2018 as a result of breathing in air containing particles from burning fuels like coal, petrol, and diesel, which aggravate respiratory conditions like asthma and can lead to lung cancer, coronary heart disease, strokes, and early death. The highest rates of death linked to fossil fuel related air pollution were found in South East Asia, Europe, and eastern North America. The study was published online in the journal *Environmental Research*.¹

Previous estimates from the Global Burden of Disease Study put the total number of deaths each year from all outdoor airborne particulate matter (not just fossil fuel emissions, but including dust and smoke from wildfires and agricultural fires) at 4.2 million people.² This study relied on satellite and surface observations to estimate the average global annual concentrations of PM_{2.5} airborne particles (particulate matter less than 2.5 microns in size), but these cannot distinguish between particles from fossil fuel emissions and those from dust, wildfire smoke, or other sources.

“With satellite data, you’re seeing only pieces of the puzzle,” said Loretta J Mickley, senior research fellow in chemistry-climate interactions at the John A Paulson School of Engineering and Applied Sciences (SEAS) at Harvard University. “It is challenging for satellites to distinguish between types of particles, and there can be gaps in the data.”

Instead, the research team, led by Harvard University in collaboration UK researchers, used a global 3D model of atmospheric chemistry developed at SEAS called GEOS-Chem to estimate pollution levels at a more granular level. GEOS-Chem has high spatial resolution, meaning researchers could divide the globe into a grid with boxes as small as 50 km by 60 km, enabling them to look at pollution levels in each box individually.

Karn Vohra, a graduate student at the University of Birmingham, UK, said: “Rather than rely on averages spread across large regions, we wanted to map where the pollution is and where people live, so we could know more exactly what people are breathing.”

To model PM_{2.5} generated by fossil fuel combustion, the researchers input estimates of emissions from multiple sectors, including power, industry, ships, aircraft, and ground transportation and simulated detailed oxidant-aerosol chemistry driven by meteorology from the NASA Global Modelling and Assimilation Office.

The emission and meteorology data used were primarily from 2012 because El Niño, which can worsen or reduce air pollution, had little influence

that year, and the data were adjusted to take into account that fossil fuel emissions from China almost halved between 2012 and 2018.

Once they had the concentration of outdoor fossil fuel PM_{2.5} for specific areas, the researchers had to determine how those levels affected human health. Previous research, including the Global Burden of Disease Study, applied health risks of indoor secondhand smoke exposures to estimate the risks of outdoor PM_{2.5} at very high levels of exposure such as those found in China or India. Recent studies have found this approach substantially underestimates the impact.³

Researchers at the Harvard TH Chan School of Public Health developed a new risk assessment model that linked the concentration levels of particulates from fossil fuel emissions to health outcomes to better estimate their effect. This new model found higher mortality for long term exposure to fossil fuel emissions, including at lower concentrations.

Eloise Marais, associate professor in physical geography at University College London, said: “Our study adds to the mounting evidence that air pollution from ongoing dependence on fossil fuels is detrimental to global health. We can’t in good conscience continue to rely on fossil fuels, when we know that there are such severe effects on health and viable, cleaner alternatives.”

In December, a coroner concluded that air pollution from road traffic in south London made a substantial contribution to the death of a 9 year old Ella Adoo Kissi-Debrah. This is thought to be the first time in which exposure to air pollution has been recorded as a medical cause of death.⁴

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2 Cohen AJ, Brauer M, Burnett R, et al. Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: an analysis of data from the Global Burden of Diseases Study 2015. *Lancet* 2017;389:1907-18. doi: 10.1016/S0140-6736(17)30505-6. pmid: 28408086

3 Vodonos A, Awad YA, Schwartz J. The concentration-response between long-term PM_{2.5} exposure and mortality: A meta-regression approach. *Environ Res* 2018;166:677-89. doi: 10.1016/j.envres.2018.06.021. pmid: 30077140

4 Dyer C. Air pollution from road traffic contributed to girl's death from asthma, coroner concludes. *BMJ* 2020;371:m4902. doi: 10.1136/bmj.m4902 pmid: 33334738