

Breathing in black carbon from polluted air linked to alterations in lung blood vessels

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Evidence that breathing in tiny particles of black carbon, typically a result of burning diesel, is linked to an increased volume of peripheral, smaller blood vessels in the lungs has been observed for the first time in new research published in the *European Respiratory Journal*.

The study adds to the evidence that exposure to diesel pollutants at what are considered relatively low levels may contribute to subtle changes in the lungs that may make people more prone to developing [chronic lung disease](#), the third leading cause of death globally.

The researchers say the differences observed in people exposed to higher levels of black carbon were comparable in magnitude to those associated with smoking a pack of cigarettes a day for 15 years.

The project was based in the US National Heart, Lung, and Blood Institute's Multi-Ethnic Study of Atherosclerosis (MESA) Lung and Air Pollution Studies. Lead researcher Dr. Carrie Pistenmaa Aaron performed this work as an Assistant Professor at Columbia University in New York, USA. She said: "A few previous studies have suggested a link between air pollution and the pulmonary circulation, but we wanted to evaluate whether there were associations between chronic air pollution exposure and the vascular structure of the lungs. We were interested in the [lung](#) vasculature as we think it may be related to chronic lung conditions."

The researchers analysed data for more than 3,000 people from six

metropolitan areas in the USA. A team led by scientists at the University of Washington calculated participants' long-term exposure to outdoor air pollutants using specific monitoring data from the US Environmental Protection Agency's (EPA) monitoring database, and by analysing traffic, weather patterns and land use data.

The participants' pulmonary blood vessels were then measured using chest CT scans between 2010-12. Each participant's age, height, weight, sex, race and ethnicity, pack-years of cigarette smoking, exposure to secondhand smoke, medical history and other socioeconomic factors were also accounted for in the analyses, as these factors can also have an impact on lung health.

The researchers estimated that on average, study participants were exposed to annual levels of black carbon of 0.8 micrograms per cubic meter and fine particulate matter (PM_{2.5}), another measure of air pollution that includes black carbon particles, of 11 micrograms per cubic meter.

These levels are below the current air pollution limits for PM_{2.5} as set by the EPA in the USA, and lower than current EU limit values for pollution. Despite this relatively low average exposure, the analyses showed that exposures to a higher level of black carbon was associated with a greater volume of blood vessels in the periphery of the lungs.

Dr. Aaron explained: "Our findings suggest that long-term exposure to black carbon may impact the pulmonary circulation. No previous research has looked specifically at whether these changes in humans lead to disease, so we cannot say for certain how this may be affecting health. However, other studies of similar pulmonary vascular measures on CT and MRI in humans, in addition to a number of studies in animals, suggest that differences in the pulmonary vasculature might make people more likely to develop chronic lung disease."

The researchers say the main contributors to black carbon levels in the cities of developed countries are diesel-fuelled vehicles, oil furnaces and coal power plants, and worldwide the major sources of black carbon are from wood burning stoves, forest fires and forest clearing.

Dr. Aaron added: "There are many ways to reduce outdoor air pollution levels—they start with [energy efficiency](#), switching to clean or renewable energy sources, and by using technology to make fossil-fuel based energy as clean as possible."

The researchers say the study's design may limit their conclusions, as they relied on cross-sectional observational data rather than findings from direct experiments carried out with participants. They plan to conduct further research that will look in more detail at how pulmonary blood vessels relate to chronic lung disease, and understand the biological processes involved in remodeling of the pulmonary vessels.

Professor Thierry Troosters is President Elect of the European Respiratory Society and was not involved in the research. He said: "A large proportion of the European population lives in areas with unhealthy outdoor air quality and those people are unable to avoid exposure to the harmful effects of pollution. Lots of previous research has shown that in the long term, outdoor [air pollution](#) can reduce life expectancy, affect lung development, increase asthma incidence and lead to other chronic respiratory diseases.

"This study provides interesting data on how exposure to black carbon—likely a result of burning diesel—may be damaging the lungs, and highlights further how we need strict policies for cleaner air in order to reduce the impact of [pollution](#) on health of European citizens and patients. Together with the World Health Organization, the European Respiratory Society advocates for such policies at both a European and global level."

More information: Carrie P. Aaron et al, Ambient air pollution and pulmonary vascular volume on computed tomography: the MESA Air Pollution and Lung cohort studies, *European Respiratory Journal* (2019).
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