

# German study links long-term exposure to air pollution before the pandemic to greater risk of severe COVID-19

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Long-term exposure to air pollution is linked to a greater risk of severe COVID-19, new research being presented at Euroanaesthesia, the annual

meeting of the European Society of Anaesthesiology and Intensive Care (ESAIC) in Milan, Italy (4-6 June), finds.

The German study found that people living in counties with higher levels of the pollutant nitrogen dioxide (NO<sub>2</sub>) were more likely to need ICU care and [mechanical ventilation](#) if they had COVID-19.

Long-term exposure to NO<sub>2</sub>, a gas released into the atmosphere when fossil fuels are burned, can have harmful effects on the lungs. This includes damage to the [endothelial cells](#), which play a key role in oxygen transfer—the transfer of oxygen from inhaled air to the blood.<sup>1</sup>

Although the links between [air pollution](#) and COVID have been analysed before, few studies have focused on severity of disease or taken into account population density, underlying [health conditions](#) and other factors which affect the impact of the disease.

Dr. Susanne Koch, of the Department of Anaesthesiology & Intensive Care, Charité—Universitätsmedizin Berlin, Berlin, Germany, and colleagues explored the impact of long-term air pollution on the need for ICU treatment and mechanical ventilation of COVID-19 patients.

Air pollution data from 2010 to 2019 was used to calculate the long-term annual mean level of NO<sub>2</sub> for each county in Germany. This ranged from 4.6 µg/m<sup>3</sup> to 32 µg/m<sup>3</sup>, with the highest level in Frankfurt and the lowest level in Suhl, a small county in Thuringia.

The German Interdisciplinary Association for Intensive Care and Emergency Medicine (DIVI) registry, which was set up to monitor ICU capacity during the pandemic, was used to provide information on how many COVID-19 patients in each hospital needed ICU treatment and mechanical ventilation.

The period studied was from April 16 2020, when the reporting of data to the DIVI registry became mandatory, to May 16 2020, when lockdown restrictions were lifted. 392 out of Germany's 402 counties were included in the analysis.

Demographic factors (population density and age and sex distribution), socio-economic factors and health parameters, including pre-existing health conditions which can affect COVID-19 severity, were all adjusted for.

The study found that there was a greater need for ICU treatment and mechanical ventilation of COVID-19 patients in counties with higher long-term annual mean NO<sub>2</sub> levels.

Each 1 µg/m<sup>3</sup> increase in long-term annual mean NO<sub>2</sub> concentration was associated with a 3.2% increase in the number of ICU beds occupied by COVID-19 patients and a 3.5% increase in the number of COVID-19 patients who needed mechanical ventilation.

On average, 28 ICU beds and 19 ventilators were needed for COVID-19 patients in each of the ten counties with the *lowest* long-term NO<sub>2</sub> exposure, during the month studied. This compares to an average of 144 ICU beds and 102 ventilators in the ten counties with the *highest* long-term NO<sub>2</sub> exposure.

The researchers say that while their results do not prove causation, there is a potential biological explanation for them.

ACE-2, the protein that the COVID-19 virus binds to when entering our cells, has many key roles in the body, including helping regulate the activities of angiotensin II, a protein which increases inflammation. In other words, ACE-2 helps "put the brakes" on inflammation.

When the SARS-CoV-2 virus binds to ACE-2, however, these brakes are removed. Air pollution also "releases the brakes" and so the combination of COVID-19 and long-term air pollution exposure could lead to more severe inflammation and more severe COVID-19.

The researchers add that their results are in line with other recent studies which have linked long-term NO<sub>2</sub> exposure with a higher COVID-19 incidence<sup>2</sup> and a higher fatality rate.<sup>3</sup>

Dr. Koch says: "Long-term exposure to NO<sub>2</sub> long before the pandemic may have made people more vulnerable to more severe COVID-19 disease.

"Exposure to ambient air pollution can contribute a range of other conditions, including heart attacks, strokes, asthma and lung cancer and will continue to harm health long after the COVID-19 pandemic ends.

"A transition to renewable energy, clean transportation and sustainable agriculture is urgently needed to improve air quality. Reducing emissions won't just help to limit climate crisis, it will improve the health and the quality of life of people around the world."

**More information:** 1. Pascale S. J. Lakey et al, Chemical exposure-response relationship between air pollutants and reactive oxygen species in the human respiratory tract, *Scientific Reports* (2016). [DOI: 10.1038/srep32916](https://doi.org/10.1038/srep32916)

2. Huang, G., et al., Long-term exposure to air pollution and COVID-19 incidence: A multi-country study. *Spat Spatiotemporal Epidemiol*, 2021.

3. Ogen, Y., Assessing nitrogen dioxide (NO<sub>2</sub>) levels as a contributing factor to coronavirus (COVID-19) fatality. *Sci Total Environ*, 2020.

Provided by The European Society of Anaesthesiology and Intensive Care (ESAIC)

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