

## Long-term ozone exposure linked to higher risk of death, finds nationwide study

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A new study finds that long-term exposure to ozone is linked to a higher risk of death from respiratory causes. This map shows average ozone concentrations for the years 1977-2000 in the 96 metropolitan regions included in the study. Image courtesy of Bernie Beckerman, UC Berkeley

Long-term exposure to ground-level ozone, a major component of smog, is associated with an increased risk of death from respiratory ailments, according to a new nationwide study led by a researcher at the University of California, Berkeley.

The study, to be published in the March 12 issue of the <u>New England</u> <u>Journal of Medicine</u>, analyzed the risk of death for both <u>ozone</u> and fine particulate matter, two of the most prevalent components of air pollution. The study followed nearly 450,000 people for two decades and



covered 96 metropolitan regions in the United States.

The researchers found that people living in areas with the highest concentrations of ozone, such as the Los Angeles metropolitan area and California's Central Valley, had a 25 to 30 percent greater annual risk of dying from respiratory diseases compared with people from regions with the lowest levels of the pollutant. Those locations included the Great Plains area and regions near San Francisco and Seattle.

"This is the first time we've been able to connect chronic exposure to ozone, one of the most widespread pollutants in the world, with the risk of death, arguably the most important outcome in health impact studies used to justify <u>air quality regulations</u>," said study lead author Michael Jerrett, UC Berkeley associate professor of <u>environmental health</u> sciences. "Previous research has connected short-term or acute <u>ozone</u> <u>exposure</u> to impaired lung function, aggravated asthma symptoms, increased emergency room visits and hospitalizations, but the impact of long-term exposure to ozone on mortality had not been pinned down until now."

The study found that for every 10 parts-per-billion (ppb) increase in ozone level, there is a 4 percent increase in risk of death from respiratory causes, primarily pneumonia and chronic pulmonary <u>obstructive pulmonary disease</u>.

"World Health Organization data indicate that about 240,000 people die each year from respiratory causes in the United States," said Jerrett. "Even a 4 percent increase can translate into thousands of excess deaths each year. Globally, some 7.7 million people die from respiratory causes, so worldwide the impact of ozone pollution could be very large."

The findings come a year after the U.S. Environmental Protection Agency (EPA) strengthened its National Ambient Air Quality Standards



for ground-level ozone from an annual average of 80 ppb to 75 ppb to reflect growing evidence of the harmful health effects of ozone. A group of leading scientists appointed to advise the EPA had actually recommended stricter health standards for <u>ozone levels</u> - from 60 to 70 ppb.

A month after the EPA released its new standards, a National Research Council report concluded that premature deaths related to ozone exposure of less than 24 hours are more likely among those with preexisting diseases. The report called for more research on the link between mortality and ozone exposure over a period of weeks and years.

Ozone - gas made up of three oxygen atoms - forms a protective layer from the sun's ultraviolet radiation when located in the Earth's upper atmosphere. However, that same gas is toxic at ground level where it can be breathed by humans. Ground level ozone is formed through a complex chemical reaction in sunlight between nitrogen oxides (NOx), commonly spewed from vehicle exhaust, and industrial factory emissions.

The Intergovernmental Panel on Climate Change considers ground-level ozone, along with carbon dioxide and methane, to be one of the primary greenhouse gases in the Earth's atmosphere.

"Ozone levels outdoors are not always highly correlated to ozone levels indoors, making it difficult to fully evaluate associations between ozone and health outcomes using ambient site monitors," said study co-author C. Arden Pope III, professor of economics at Brigham Young University. "The reality is that most of us spend the majority of our time indoors. But this study suggests that repeated exposures to elevated ozone levels over time have cumulative effects on respiratory health."

The new study analyzed data from 448,850 adults ages 30 and older



enrolled in 1982 and 1983 in the American Cancer Society Cancer Prevention Study II.

The researchers correlated the information from that study with data from EPA air pollution monitors while controlling for potentially confounding factors such as a participant's age, race, education, occupational exposures, smoking history and diet. The study also factored in other variables such as unemployment rates in the metropolitan and zip code area levels.

Ozone data were obtained from 1977 through 2000 between the months of April and September. Those months were chosen because ozone levels are typically higher when it's warmer and because insufficient data was available during the cooler months.

Researchers included EPA measurements of fine particulate matter particles equal to or smaller than 2.5 micrometers in diameter and typically found in smoke and haze - when they became available in 1999 and 2000. Because fine particle levels had already been linked to increased risk of premature death in previous studies, the researchers included them in the analysis to distinguish the effects of the two pollutants.

In an 18-year follow-up period, 48,884 of the people in the study died from cardiovascular causes such as heart disease and strokes, and 9,891 died from respiratory causes.

As has been observed in previous studies, the researchers found that fine particulate matter was linked to an increased risk of death from cardiovascular causes when analyzed alone and with ozone. The new finding was that the effects of ozone remained strongly linked to risk of death from respiratory problems, even after fine particle pollution was taken into account.



Not surprisingly, highly populated regions such as the Los Angeles, Riverside and Houston areas, where the climate is sunny for much of the year and the air mass is relatively stable, had the highest average concentrations of ozone, ranging from 62.5 to 104 ppb. The regions with the lowest ozone levels had average concentrations of 33.3 to 53.1 ppb.

"Places like the Pacific Northwest and the Minneapolis St. Paul region are cooler and see more rain in the summer, which keeps the ozone levels in check," said Jerrett. "Similarly, the San Francisco Bay Area's infamous summertime fog blocks the sun and helps protect the region from high ozone levels."

Because ozone formation depends on a complex interaction of multiple factors, it is challenging to regulate, the study authors said. "Our study for the first time presents evidence suggesting that long-term exposure to ozone and fine particle pollution have separate, independent effects on mortality, and that they seem to impact different parts of the body," said Jerrett. "With this research, we now know that controlling ozone is not only beneficial for mitigating global warming, but that it could also have near-term benefits in the reduction of deaths from respiratory causes."

<u>More information:</u> An EPA list of where U.S. counties stand in compliance with the current federal ozone standards is available at <u>epa.gov/air/ozonepollution/pdf ... values 2004 2006.pdf</u>.

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