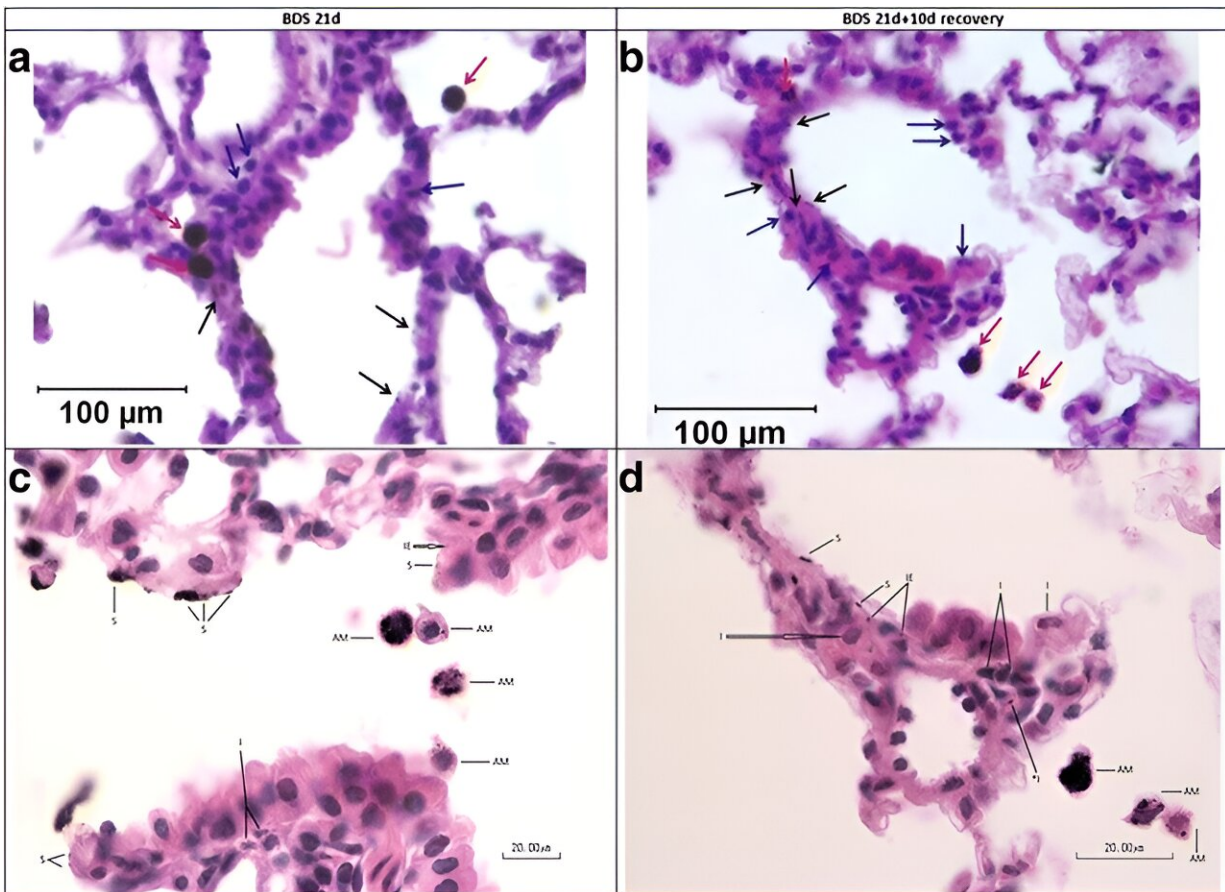


# Experts explain the dangers of wildfire smoke and how to stay safe

September 6 2024, by Julia Busiek



A [2016 study](#) investigated how lung tissue recovers from short-term exposure to  $PM_{2.5}$  in mice. Initial results (images a and c) found evidence of acute inflammation and higher white blood cell count. Ten days later (images b and d), researchers could still see soot particles trapped in the alveolae, connective tissue in the lungs was still inflamed and an analysis turned up evidence of increased oxidative stress. Arrows point to soot accumulations and inflammatory cells.

Credit: [Open-i, National Library of Medicine](#)

Wildfire season in California is getting longer, more intense and more destructive. That means millions more Californians breathe polluted air more often as smoke drifts into skies across the state.

UC experts have answers to critical questions about this new reality: What's in wildfire smoke that makes it so harmful? What happens to our bodies when we breathe it in? And what can governments and everyday Californians do to reduce the health risks of fire season?

## **How air pollution affects your body**

The most common measure of [air pollution](#)—the number you'll see reported on apps like PurpleAir—is the concentration of PM<sub>2.5</sub>, or [microscopic particles](#) smaller than 2.5 micrometers.

Depending on the source of pollution, these particles can contain dirt, soot, heavy metals, chemicals, pollen, mold and more. Whatever they're made of, these particles are all small enough to skirt your upper respiratory defenses and wind up deep in your alveolae, the delicate membranes in your lungs that exchange gases between your [circulatory system](#) and the outside world.

"The reason we monitor, measure, study and regulate PM<sub>2.5</sub> is that when it gets into the alveolae, it can get into your bloodstream, and then it goes everywhere throughout your body, including [vital organs](#)" says Tarik Benmarhnia, an environmental epidemiologist who studies the health effects of wildfire smoke at UC San Diego's Scripps Institution of Oceanography.

"And that can lead to some negative consequences."

As you might expect, people exposed to air pollution have higher rates of respiratory diseases like asthma. But UC research is finding that the risks of breathing in toxic air go way beyond your lungs. Researchers at UC Davis are finding links between air pollution and blood clots, stroke and arrhythmia.

One study from UC Irvine found that breathing in traffic exhaust caused memory loss and triggered neurological pathways that lead to Alzheimer's disease, and another linked long-term exposure to polluted air with higher rates of postpartum depression. And UC San Francisco researchers identified a link between PM<sub>2.5</sub> and COVID-19 infections.

## **Why does PM<sub>2.5</sub> cause so much trouble for our bodies?**

Benmarhnia cites three main sources: inflammation, oxidative stress and weakened immunity.

When it clocks pollution particles, your [immune system](#) first responds with inflammation, generating heat and bombarding the point of entry with specialized cells meant to attack anything your body recognizes as foreign. Inflammation is good when it fights off viruses and bacteria, but too much of it for too long can also wear down your organs and contribute to chronic conditions like heart disease and diabetes.

Meanwhile, our bodies' constant work of breathing, digesting and moving generates waste molecules, which can damage your cells if they hang around and accumulate. To counter this damage, known as oxidation, your cells produce antioxidants, molecules that act like a cleanup crew.

But some substances commonly found in air pollution can react with

your cells in a way that generates more damaging waste and throws off the balance of antioxidant defense. Studies have found evidence of this process, known as [oxidative stress](#), in the lungs, heart, brain, liver and kidneys of people and animals exposed to air pollution.

Finally, breathing in PM<sub>2.5</sub> can depress your immune system. In part that's because your body works so hard to respond to the flood of incoming particles that it's likelier to let a harmful virus or bacteria slip through, Benmarhnia says. What's more, some ingredients in PM<sub>2.5</sub> actually attack specific parts of your immune system.

Studies have found that iron from air pollution, for instance, can weaken macrophages, the white blood cells that gobble up invading microorganisms. The result? "Your immune system is lazier than it would normally be," leaving you more vulnerable to infections of all kinds, Benmarhnia says.

## **Wildfire smoke: 10x more harmful than 'regular' air pollution**

Wildfire is far from the only source of air pollution in the Golden State. Traffic, freight, industry and agriculture also release PM<sub>2.5</sub>, meaning millions of Californians breathe perennially polluted air.

"But wildfire smoke is very special," Benmarhnia says. Wildfires typically burn much hotter than car engines or industrial machinery. "That's going to increase what we call its oxidative potential, which basically means it's much more active and can be very, very toxic."

In a 2021 study in Southern California, Benmarhnia's team found that an increase of 10 micrograms of PM<sub>2.5</sub> from typical sources of pollution led to roughly a 1% increase in hospitalizations for respiratory conditions.

An equivalent increase in  $PM_{2.5}$  from wildfire smoke, meanwhile, caused respiratory hospitalizations to jump by 10%. "So you could basically say particulate matter from wildfire smoke is up to 10 times more harmful than ambient air pollution," Benmarhnia says.

As a [warmer climate](#) as collided with ever-more-overgrown wildlands across California, wildfire smoke has pretty quickly gone from an occasional, localized nuisance to a statewide threat. State data show Californians' average smoke exposure was 3.6 times higher during 2017–2023, compared to 2010–2016. And a UCLA study published this summer found that wildfire smoke was to blame for 52,000 premature deaths in California between 2008–2018.

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Citation: Experts explain the dangers of wildfire smoke and how to stay safe (2024, September 6) retrieved 7 September 2024 from <https://medicalxpress.com/news/2024-09-experts-dangers-wildfire-stay-safe.html>

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