

For Kids, Exposure to Wildfire Smoke Means a Future of Poor Health

As smoke and wildfire seasons intensify, investment in school infrastructure and education campaigns are urgently needed to protect kids' health.

Executive research summary

Smoke from wildfires is dangerous for human health – and particularly for kids. Wildfire smoke is composed of fine particulate matter – including PM2.5, particulate matter less than 2.5 micrometers in size, which is so small that it can enter the bloodstream from our lungs. Once this particulate matter gets into the body, it can never get out. Children are more vulnerable to air pollution than adults: their lungs are still growing, they're more active (and so breathing faster), and they breathe more air relative to their weight.

Smoke exposure causes more than short-term health impacts, such as trouble breathing, increased asthma attacks, chest pain, dizziness, and increased risk for upper respiratory infections – researchers are increasingly also finding long-term consequences. In addition to the risks posed by the carcinogenic pollutants found in wildfire smoke, long-term health effects include: reduced immune system functioning, changes in DNA, and increases in blood pressure that can all lead to cardiovascular and lung diseases later in life. There are also documented links between PM2.5 exposure and neuropsychological effects, such as ADHD, autism, impaired school performance, and decreased memory.

Improving school infrastructure: critical for equity in education and health

One of the strategies that schools use when air quality from smoke is very poor is to close. Schools often make this decision because of a lack of air filtration infrastructure and concerns around kids' smoke exposure, especially while traveling to and from school. For students, this could mean staying in homes that might not offer any further protection from smoke than being outside. For lower-income students with working parents, this could also mean staying at home unsupervised, without access to remote learning resources or to regularly-provided breakfast and lunch meals.

Brief prepared by the Action Lab for Planetary Health (ALPHA), an evidence-to-impact initiative based at the Stanford Center for Innovation in Global Health, in collaboration with Stanford's Sean N. Parker Center for Allergy and Asthma Research. For more information, visit www.globalhealth.stanford.edu/programs/alpha or contact Erika Veidis at eveidis@stanford.edu.



Photo credit: Joanne Francis

Key wildfire facts

Every year, about 7.4 million children across the United States are affected by wildfire smoke. A large proportion of these kids are in California.

More than 2000 emergency room visits a year in the United States are from children experiencing asthma because of the ozone generated by wildfires.

2020 had the most acres (10.3 million) burned by wildfires – and this number has been steadily increasing over the years. 40 percent of these acres were in California, comprising about four percent of the state.

Wildfires are expected to intensify as the climate changes. Since the 1980s, the number of autumn days in California that are dry, windy, and warm – weather that's especially dangerous for wildfires – have doubled.

Up to half of PM2.5 across the western United States has been linked to wildfires. Wildfires also produce toxic pollutants and ozone, which are harmful to health.

When a wildfire happens, people hundreds of miles away could be affected. Respiratory and cardiovascular consequences have been attributed to wildfires as far as 300 miles away.

Investments are being made to both fight and mitigate the fires, but there's also an urgent need to protect those suffering in their wake – especially kids.



Photo credit: Malachi Brooks

Our health up in smoke: what the research tells us

A Stanford research team has found that wildfire smoke exposure directly increases oxidative stress and inflammation in the body, which has far-reaching consequences for health, both in the short and long term.

Wheezing episodes, asthma, and rises in blood pressure (a risk factor for cardiovascular disease) have all been documented in individuals exposed to wildfire smoke – including children and adolescents.

Researchers have also found genetic changes associated with smoke exposure that have direct effects on the immune system and its future functioning.

In short, being exposed to wildfire smoke is dangerous for kids now – and might also put their future health at risk.

Prunicki, M. et al. "Air pollution exposure is linked with methylation of immunoregulatory genes, altered immune cell profiles, and increased blood pressure in children." *Scientific Reports* 11, 4067 (2021)

Prunicki, M. et al. "Immune biomarkers link air pollution exposure to blood pressure in adolescents." *Environmental Health* 19, 108 (2020)

How we can act now to help our kids

INVEST IN INFRASTRUCTURE

Schools may need to upgrade and maintain their HVAC systems with MERV 13+ filters, buy portable air filters and air monitors, and secure N95 respirators for students, teachers, and staff. To do so, they need outside investment, particularly from the state.

INFORM SCHOOLS

Schools should learn about different strategies to keep kids safe during smoke events, including through air filtration, monitoring air quality, and creating clean air rooms. Resources have already been developed by national- and state-level partners. A selection can be accessed at www.cde.ca.gov/ls/ep/airquality.asp.

EDUCATE PARENTS

Parents need to be informed about best practices to protect kids. Information on monitoring air quality, creating clean air rooms, keeping smoke out of homes, and properly wearing N95 respirators (since cloth masks don't offer smoke protection) can be accessed at ww2.arb.ca.gov/protecting-yourself-wildfire-smoke.

COVID-19 and air pollution



Living in places with poor air quality or experiencing a small increase in long-term PM2.5 exposure makes people more likely to die from COVID-19. Lower-income communities across the state – who might also have less access to healthcare – are especially at risk.



Keeping kids, teachers, and staff safe from COVID-19 – as well as from wildfires – requires high-quality air filtration and mask wearing. Investment in clean air infrastructure is a win-win solution.



Investing in clean air infrastructure is also an important precaution for future pandemics that might result from ongoing ecological disruptions. Researchers are exploring how climate change and changes in forest cover, land use, ecosystems, and human-environment interactions contribute to new pathogens and disease patterns.