

# WILDFIRE SMOKE, EXPOSURE & HEALTH

Wildland firefighters are exposed to a wide range of hazardous environmental factors during their work. The hazard that has been most studied is smoke.

## WHAT IS IN WILDFIRE SMOKE?

- Wildfire smoke is a complex chemical mix of particles and gases that varies by fuel type and combustion phase.
- Key toxicants linked to human health effects include:

	<p><b>Particulate matter (PM2.5):</b> Tiny particles that penetrate deep into the lungs and enter the bloodstream, triggering inflammation and oxidative stress</p>		<p><b>Polycyclic aromatic hydrocarbons (PAHs):</b> Compounds formed during incomplete combustion that can damage DNA and increase cancer risk</p>
	<p><b>Carbon monoxide:</b> A colorless, odorless gas from incomplete combustion that interferes with oxygen delivery to organs; at different levels can cause headaches, illness, or death (at very high levels)</p>		<p><b>Carcinogenic volatile organic compounds (VOCs):</b> Including benzene and formaldehyde</p>

## SMOKE EXPOSURE ROUTES

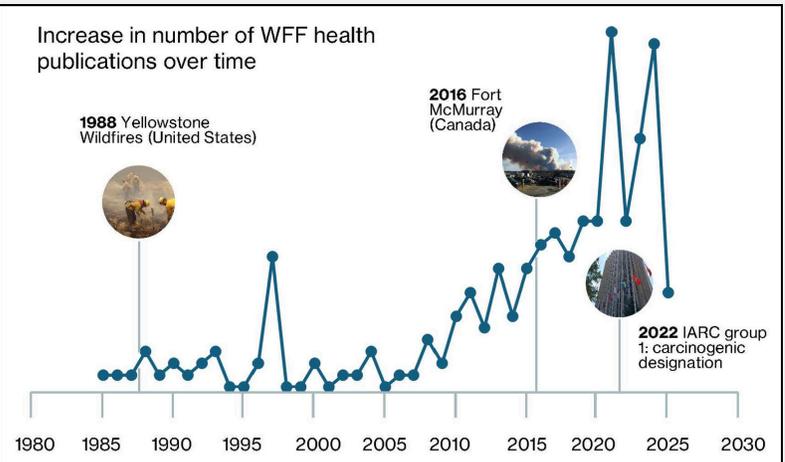
Inhalation	
Absorption	
Ingestion	

## OTHER EXPOSURE SOURCES IN WILDLAND FIREFIGHTING

- Diesel
- Valley fever (caused by fungal spores)
- Poison oak
- Industrial materials
- Crystalline silica (naturally occurring in soils)
- Trees
- Noise exposure
- Heavy metals, radionuclides, asbestos
- Fire retardant

## HEALTH IMPACTS RESEARCH

- Research on wildfire smoke increased after major fires, such as Yellowstone (1988) and Fort McMurray (2016).
- In 2022, the International Agency for Research on Cancer classified firefighting as a Group 1 carcinogenic activity, finding that firefighting causes mesothelioma and bladder cancer.



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But published research documenting long-term health impacts related to wildland firefighting is still very limited.

## PUBLISHED RESEARCH

Authors, Context	Study type	Takeaways
Semmens et al. 2016 USA <sup>1</sup>	Survey	Longer time as a WFF associated with higher cardiovascular risk factors and musculoskeletal surgeries.
Navarro et al. 2019 USA <sup>2</sup>	Modeling study	Estimated increased mortality risk from lung cancer (8–43%) and cardiovascular disease (16–30%) based on particulate matter exposure and career duration.
García-Heras et al. 2022 Spain <sup>3</sup>	Survey	Approximately 60% reported chronic pain; older age and longer career duration were significantly associated with pain.
Cherry et al. 2025 Canada <sup>4</sup>	Cohort study	WFF found to be at increased risk of lung conditions (COPD, pneumonia, asthma); no increased cancer risk observed in this cohort.

Similarly, research on mitigation methods to reduce exposure is very limited.

## RESEARCH ON MITIGATION METHODS

- Administrative strategies: Adjust fire camp placement and sleeping areas, limit high-exposure tasks, reduce shift lengths, and use real-time air quality monitoring. These strategies are recommended by researchers and occupational health experts, but there is no published evidence on their implementation.
- Respirators: Lab and limited field testing (including prescribed burns in Australia) show that respirators with filters for particulates and gases are more effective than particulate-only filters.<sup>5</sup> Laboratory testing in the U.S. found that N95, P95 and P100 filters were effective at filtering wildfire smoke.<sup>6</sup> N95 use in Canada reduced respiratory and eye symptoms,<sup>7</sup> but another study found no reduction in PAH exposure with mask wearing.<sup>8</sup>
- Skin hygiene: Showering thoroughly and changing into clean clothes reduced PAH exposures in Canadian research.<sup>9</sup>

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## ADDITIONAL RESOURCES

### The National Firefighter Registry for Cancer

- Database studying cancer in firefighters; open to anyone who has worked in firefighting. Managed by NIOSH.



### Presumptive coverage for federal firefighters

- Eligible for certain cancers, heart, and lung conditions. See FECA Bulletin No. 23-05 and the Federal Wildland Firefighter Health and Wellbeing website for details.



### Workers' compensation info

- Guidance for federal employees navigating workers' compensation available at Grassroots Wildland Firefighters.



### Public Safety Officers' Benefits

- Firefighters and their beneficiaries are now eligible for death, disability, and education benefits if the firefighter dies or is permanently disabled from occupational cancers. Does not appear to address firefighters working for private contractors.



## CREDITS AND REFERENCES

This info sheet was prepared by Arielle Milkman. This is a living document based on a comprehensive review of WFF health research conducted in 2025. You can contact Arielle with feedback or questions at [arielle.milkman@colostate.edu](mailto:arielle.milkman@colostate.edu).

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- References:

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