

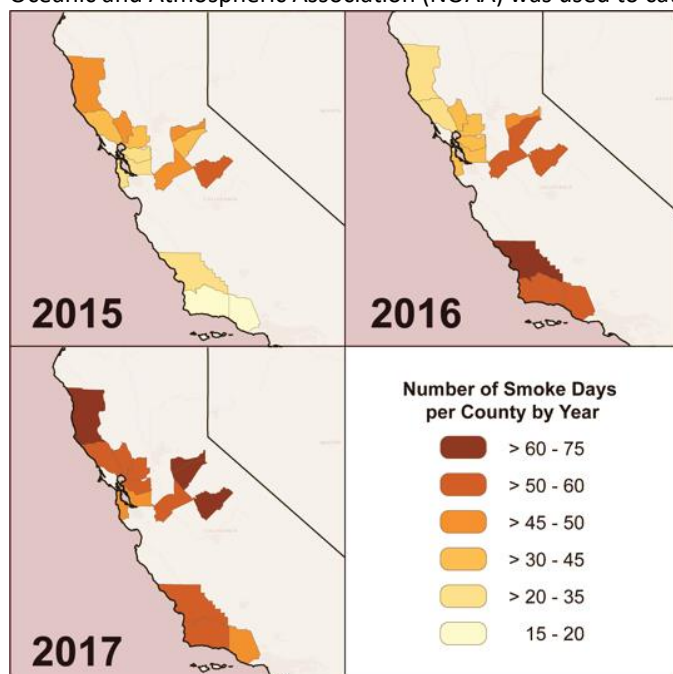
Using CARES Data to Study Wildfire Smoke and Out-of-Hospital Cardiac Arrests in the 2015-2017 California Wildfires

By Sumi Hoshiko, MPH, California Department of Public Health

As the number and severity of wildfires has increased in recent years, so has scientific knowledge of the health impact of smoke from wildfires. While studies have shown increases in respiratory illnesses under smoky conditions produced by wildfires, a similar increase in cardiovascular illnesses has not been consistently seen. This has been puzzling, because decades of scientific research have linked ambient air pollution to cardiovascular problems. This prompted public health researchers in California to search for ways to investigate this question, and the CARES dataset on out-of-hospital-cardiac arrests provided just such an opportunity.

“We reasoned that because these cases often result in sudden death outside of a hospital, they may not have been captured in earlier wildfire studies of cardiovascular outcomes, as these studies typically use hospital-based datasets,” explained senior author Sumi Hoshiko of the California Department of Public Health. It quickly became clear that CARES data could be invaluable in understanding the true relationship between wildfire smoke and a critical adverse cardiovascular event, and a collaborative research project was formed between CARES, the California Department of Public Health, and the United States Environmental Protection Agency.

Fourteen counties in California with active CARES surveillance programs and that experienced wildfire smoke between 2015 to 2017 participated. During this time period, wildfires burned over 3 million acres across the state, exposing millions of people in different locations and points in time to wildfire smoke emissions. Satellite data from the National Oceanic and Atmospheric Association (NOAA) was used to categorize smoke plumes into none, light, medium and heavy density.



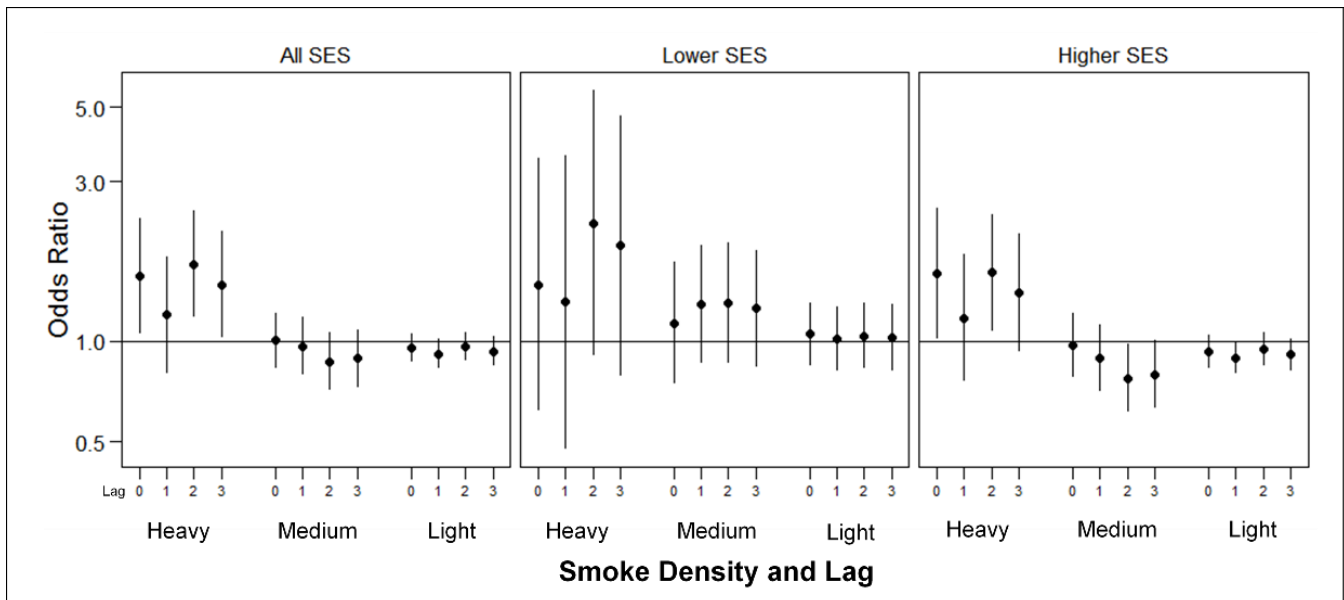
Map of the 14 California counties in the study region showing the number of smoke days in each county from 2015 – 2017, based on NOAA HMS wildfire smoke plume.

By comparing exposure among cases on the day of their cardiac arrest with control days, investigators were able to study whether smoke was associated with increased numbers of cardiac arrests. The study also looked at whether those risks differed based on age, sex, and socioeconomic status. The latter was based on population income levels in the census tract where the cardiac event occurred.

“We saw that the number of cardiac arrests increased on days with heavy smoke exposure, but also that the risk seemed to persist for several days afterwards,” explained Caitlin Jones, who led the analysis. While this was true for cases in both lower and higher socioeconomic categories on heavy smoke days, the lower socioeconomic group also appeared to be impacted on medium smoke days (Figure on page 16).

The finding that cases in lower socioeconomic areas were most affected is important to keep in mind when attempting to understand the effects of smoke exposure; in other words, there isn’t a single, simple relationship between exposure and outcome – it varies depending on the vulnerability of the population exposed. There could be numerous explanations for this disparity; for example, underlying health problems may be more common and

healthcare less accessible in low socioeconomic status communities. It could also be that persons in higher socioeconomic areas are better positioned to take protective action, such as leaving the area during smoky periods, staying indoors or using air filters in their home, and avoiding exertion, all of which could decrease smoke exposure and reduce the chances of a cardiac arrest during wildfires. Any single one of these factors, or a combination of these, might explain the disparity in risk based on socioeconomic status.



Odds ratios and 95% confidence intervals for OHCA in 14 California counties, May – October, 2015–2017, by wildfire smoke exposure on the day of exposure and several following (lag) days for the whole study population and by socioeconomic status (SES). Odds ratios above 1 indicate an increased risk for OHCA for the given exposure level. For example, on the second day following a day with heavy smoke concentrations, the odds of OHCA was estimated to be 70% higher than expected.

Both males and females, and all age groups age 35 and above were affected when exposed to heavy smoke days. Because other wildfire smoke studies have found that older adults are typically the most highly impacted, it was intriguing that this analysis also found that persons between 35 and 64 were at elevated risk. “It may be that this younger group is not aware that they could be at risk, causing them to continue activities involving exertion and exposure during wildfire smoke episodes, whereas older persons may be more likely to make changes to reduce exposure to protect their health,” suggested Jones.

By using CARES data to investigate this critical cardiovascular outcome, researchers were able to show that smoke from wildfires likely has the potential to trigger fatal and near-fatal cardiac arrest. “Studying out-of-hospital cardiac arrests proved invaluable in furthering our scientific understanding of the cardiovascular risks from exposures to wildfire smoke,” said Hoshiko. “We are grateful to the CARES Surveillance Group and also the individual EMS agencies and organizations that chose to include their data in this research.”

The last few years have awakened the world to more frequent, intense and large-scale wildfires and the smoke plumes they emit, and climate models predict that the weather conditions which create these fires will continue. Researchers anticipate that in addition to these forces, health effects from wildfire emissions will also be affected by the aging American population, as the proportion and number of persons with underlying cardiopulmonary disease increases. Coauthor and cardiologist Dr. Wayne Cascio, Director of the Center for Public Health and Environmental Assessment at the US Environmental Protection Agency emphasized, “Because of this, it is especially important to protect persons with cardiopulmonary disease who may be at greatest risk, namely patients with ischemic heart disease, heart failure, cerebrovascular disease, arrhythmia, COPD, and asthma.”

An expert panel convened by the American Heart Association and others recommends advising patients with cardiovascular disease about risks from air pollution. The US EPA, in partnership with the Centers for Disease Control and Prevention, offers continuing education for health care providers on wildfire smoke on the [EPA website](https://www.epa.gov/wildfire-smoke-course).¹

¹ <https://www.epa.gov/wildfire-smoke-course>

Reference: Hoshiko S, Jones C, Rappold A, Vargo J, Cascio W, Kharrazi M, McNally B. Out-of-Hospital Cardiac Arrests and Wildfire-Related Particulate Matter During 2015–2017 California Wildfires. *JAHA*. 2020;9:e014125.

Press Release: <https://newsroom.heart.org/news/breathing-heavy-wildfire-smoke-may-increase-risk-of-out-of-hospital-cardiac-arrest>