HEALTH AND SAFETY CONSEQUENCES OF THE 2025 CALIFORNIA WILDFIRES: A REVIEW

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ABSTRACT

The California fires of 2025 destroyed homes, forests, and important infrastructure, leaving many communities in crisis. This paper looks at the main health and safety problems that occurred because of the wildfires, covering both short-term and long-term effects. Smoke and fine particulate matter (PM2.5 and PM10) caused poor air quality, which led to increased respiratory complications, especially for children, older adults, and individuals with pre-existing medical conditions. Water supplies were also contaminated by runoff, damaged infrastructure, and exposed to harmful chemicals, creating more dangers for public health. The fires also affected mental health. Many people suffered from psychological distress, including anxiety and depressive symptoms, after losing their homes or being forced to leave. Firefighters and rescue workers faced health risks and significant psychological strain while working in unsafe conditions. This study also explains how state and local agencies tried to manage these problems and what kind of challenges they faced, like resource constraints, delays in recovery operations, and communication disruptions because of the huge wildfire. By looking at real examples from affected areas, this study shows the need for better disaster plans, stronger safety rules, and more support for mental health after such events. It suggests practical ideas like community-based emergency preparedness training, better health services, and deployment of mobile medical units for rapid healthcare delivery. Understanding these health and safety problems after wildfires can help communities prepare better and reduce harm in future disasters.

Keywords: *California Wildfires, Health Impacts, Vulnerable, Toxic Smoke, Natural Disaster*

1. INTRODUCTION

Wildfires are unplanned, rapidly spreading fires that burn natural vegetation (such as forests, shrublands, and grasslands) and sometimes the built environment. They are driven by the "fire triangle": available fuel, dry or hot weather, and an ignition source. In recent decades, climate change has intensified fire-prone conditions by increasing heat extremes, drying soils and vegetation, and lengthening fire seasons, making many regions more susceptible to large and fast-moving fires. The IPCC Sixth Assessment Report highlights that warming has already increased wildfire risk and burned area in several parts of the world, particularly in western North America (IPCC Working Group II, 2022). Global analyses also reveal rising forest-fire emissions associated with climate-driven changes in temperature and moisture, highlighting wildfires as a growing component of the global carbon and air pollution burden (Jones et al., 2024).

At the worldwide scale, major wildfire "hotspots" include the Mediterranean Basin, the Amazon and other parts of South America, the boreal forests of Siberia and Canada, and Australia. These regions experience recurrent extreme fires due to seasonal droughts, heat waves, strong winds, and land-use pressures. Although global burned area trends vary by ecosystem, recent research indicates that climate change is increasing the occurrence of dangerous fire weather in many regions and is likely to amplify future wildfire activity if warming continues (Gallo et al., 2025). The consequence is not only ecological loss but also major public-health impacts because wildfire smoke can travel hundreds to thousands of kilometers, affecting populations far from the fire front.

North America has emerged as one of the most fire-affected continents in the last two decades. Large fires in Canada, the western United States, and parts of Mexico are increasingly frequent during hot, dry summers, and smoke episodes now commonly degrade air quality across the continent. In the United States specifically (Burke et al., 2021), wildfire activity remains substantial every year. National Interagency Fire Center (NIFC) statistics show that millions of acres burn annually, with 2024 alone recording about 64,897 fires and ~8.9 million acres burned (National Interagency Fire Center, 2025). Long-term U.S. indicators also reveal a pronounced rise in burned area in the West since the 1980s, consistent with warming-enhanced aridity and fuel dryness (U.S. Environmental Protection Agency, 2025).

Wildfire smoke is now recognized as a critical environmental health hazard. Its fine particulate matter (especially PM2.5), carbon monoxide, ozone precursors, and toxic organic compounds can trigger acute respiratory symptoms and worsen asthma and chronic obstructive pulmonary disease, while also elevating cardiovascular risks. Systematic reviews and meta-analyses show consistent increases in all-cause mortality and respiratory hospitalizations during smoke events (Gould et al., 2023). Evidence is also growing that long-term or repeated smoke exposure raises cardiometabolic and cardiovascular mortality risks (Ma et al., 2024). Recent multi-region studies further demonstrate that short-term increases in wildfire-specific PM2.5 are associated with higher hospital admissions for asthma, COPD, and other respiratory infections (Zhang et al., 2025). Beyond physical outcomes, wildfires can cause substantial mental-health burdens (stress, anxiety, depression, PTSD), as displacement, property loss, and prolonged uncertainty strain individuals and communities (Health Canada, 2024).

California sits at the center of the U.S. wildfire problem because its Mediterranean climate, dense and often drought-stressed vegetation, and wind systems (Santa Ana/Diablo winds) create conditions for extreme fire spread. Attribution work and climate assessments indicate that human-induced warming is increasing the probability of severe fire weather in southern California, compounding risks from fuel buildup and expanding wildland-urban interfaces (Barnes et al., 2025).

Against this backdrop, the January 2025 California wildfires, dominated by the Palisades Fire and the Eaton Fire in Los Angeles County, became a defining recent disaster. These fires ignited on January 7, 2025, rapidly expanded under hurricane-force Santa Ana winds and very dry fuels, and burned until late January. Official incident and media records report over 57,000 acres burned, more than 18,000 structures damaged or destroyed, and over 200,000 people evacuated, making them among the most destructive events in California's history (CAL FIRE, 2025; Reuters, 2025). Subsequent epidemiological analysis suggested that indirect mortality linked to smoke exposure and disrupted care may have raised the total death burden far beyond initial counts, emphasizing how wildfire impacts extend well past immediate flames (Wikipedia contributors, 2025). This study aims to evaluate the

major health and safety issues that emerged following the 2025 California wildfires and to identify the immediate and short-term public-health risks posed by smoke exposure, displacement, and emergency response challenges.

2. METHODOLOGY

2.1 Research Framework

The research framework of this study provides a structured, review-based approach to systematically analyze the health and safety impacts of the 2025 California wildfires, as illustrated in Fig. 1. The study integrates information from peer-reviewed research articles, government agency reports, environmental monitoring documents, emergency response records, and credible news sources obtained through platforms such as Google Scholar, websites of relevant agencies, and ResearchGate. These diverse information sources were utilized to develop a comprehensive understanding of wildfire events and their associated consequences. The framework organizes the analysis into key thematic areas, including health impacts, mental health distress, fatalities, wildfire-related safety challenges, and safety and management implications, with particular emphasis on gaps in emergency management and future preparedness needs. This structured approach enables a systematic evaluation of both the immediate and long-term outcomes of the 2025 California wildfires, thereby supporting evidence-based conclusions across health and safety dimensions.

Figure 1: Framework of this Study

3. SYNTHESIS OF FINDINGS

3.1 Overview of the 2025 California Wildfires

In January 2025, a massive fast-moving wildfire struck in California. The fire started on the evening of January 7, 2025, in Eaton Canyon in the San Gabriel Mountains (Wikipedia contributors, 2025b). Santa Ana winds, characterized by strong downslope, low-humidity winds originating inland, blow from inland California toward the coast. These winds substantially increase fire spread rates due to high velocity and low moisture content. At that time, California had experienced severe fuel-aridity conditions associated with prolonged drought, and grass, trees, and bushes became which created highly combustible fine and coarse fuel loads. The weather was warmer than usual in January, which resulted

in elevated surface temperatures and reduced moisture levels that increased ignition probability. These combined climatic and environmental conditions accelerated the rate of fire spread. The wildfire forced more than 200000 people to evacuate, destroyed more than 18000 homes and structures, it burned over 57529 acres of land in total. Fatality estimates varied among early reports, although official numbers were still being consolidated. All these happened because of the two largest fires. Two starting locations of California fires were the Pacific Palisades neighborhood of Los Angeles for the Palisades Fire, and for the Eaton Fire, the Eaton Canyon area in Los Angeles County, near Altadena and Pasadena. The Palisades Fire was started by a former resident, and the Eaton Fire is being investigated as a potential cause of a potential electrical infrastructure failure involving a damaged transmission tower. Extinguishing wildfires in California was very difficult due to dry weather, strong winds, and rough terrain. Fires spread quickly and often reached remote areas where firefighters struggled to access. High heat and low humidity made water and retardants less effective. Thick smoke also limited air support and visibility. Even after control, hidden flames sometimes reignited, which required weeks of monitoring. From 2001 to 2023, the area of land burned by forest fires around the world increased by about 5.4% every year. In California, the amount of land burned by wildfires has grown even more sharply. Compared to the 1970s, California wildfire burn areas increased by 172%, and between 1996 and 2001 alone, the increase reached about 320% (Global Health, 2024).

3.2 General Health Effects of wildfires

Wildfires have immediate health effects. Wildfires release large amounts of carbon dioxide, black carbon, brown carbon, and ozone precursors into the atmosphere. Wildfires generate a lot of smoke, significantly degrading air quality. As a result, many health problems can arise from poor air quality and smoke exposure. Common issues include coughing, difficulty breathing, and irritation of the eyes or throat. Sometimes, individuals also experience chest pain, asthma attacks, or worsening of existing lung and heart conditions. Inhaling smoke can lead to headaches, dizziness, and fatigue. Prolonged exposure may result in heart attacks or long-term lung damage. Long-term lung injury occurs when harmful particles and gases are inhaled over time, causing lasting damage to the lungs. Literature reports that several toxic compounds in smoke are linked to lung damage, especially airway injury (Cancio, L. C., 2009). Very small particles in smoke can penetrate the airways and damage lung tissue. A recent study found that during a severe wildfire, exposure to smoke caused a 70% increase in out-of-hospital cardiac arrests.

3.2.1 Health Effects on California Wildfire Victims

One of the health problems people suffered after the California wildfires was mental health problems or post-traumatic stress disorder (PTSD). Post-traumatic stress disorder is a mental disorder that develops from experiencing a traumatic event, such as domestic violence, warfare, and its associated traumas, natural disaster, bereavement, traffic collision, or other threats to a person's life or well-being (World Health Organization: WHO, 2024). Many people suffered from post-traumatic stress disorder (PTSD) after the 2025 California wildfires. Survivors experienced a range of mental health issues, including anxiety, depression, and PTSD, which were directly associated with evacuation stress, displacement, home loss, and perceived threat to life. Residents and firefighters have suffered physical injuries, and clinical observations reported in news coverage suggest significant psychological strain among both civilians and first responders (Kekatos, 2025). Another big health concern was respiratory issues. Inhalation of wildfire smoke represents a major acute health hazard (Global Health, 2024). Respiratory issues after the California fire can include coughing, wheezing, and difficulty breathing. The fine particulate matter in wildfire smoke is a significant health hazard, leading to acute and chronic respiratory problems. It was particularly severe among individuals with pre-existing conditions such as asthma or chronic obstructive pulmonary disease (COPD). During the fires, a substantial increase in emergency room visits and telehealth consultations was reported due to respiratory distress. Media reports also highlighted respiratory and occupational health impacts among rescue workers. Recent medical studies have further characterized the physiological effects of wildfire smoke exposure (Rizzo & Rizzo, 2025). Long-term health problems after the California wildfires continued even after the flames were gone. Prolonged exposure to wildfire smoke is associated with chronic pulmonary

impairment, exacerbation of asthma, and elevated long-term risks of cardiovascular events such as myocardial infarction and stroke. Epidemiological studies suggest that sustained exposure to wildfire-related pollutants may increase the risk of malignancies, particularly lung cancer. Besides physical problems, many people suffered mental health impacts because they lost homes, personal belongings, and loved ones. Such traumatic stressors contributed to elevated rates of anxiety, depressive symptoms, and post-traumatic stress disorder (PTSD). In many cases, these long-term effects were worse for low-income families and already vulnerable groups, exacerbating existing health inequalities. Wildfire smoke contains carcinogenic compounds and toxic pollutants, which have been linked to increased long-term cancer risk, particularly lung cancer (Rizzo & Rizzo, 2024b). Some research has documented higher risks of early births and low birth weight among babies whose mothers were exposed to wildfire smoke. Increased incidence of dermatological symptoms (e.g., rashes, irritation) and ocular conditions (including redness, burning, and dryness) were also reported (Grant & Runkle, 2022).

3.2.2 Impacts on Vulnerable Populations

During the 2025 California wildfires, certain groups faced higher health risks than others (US EPA, 2025). Pregnant individuals exposed to wildfire smoke demonstrated elevated risks of preterm birth, fetal growth restriction, and low birth weight. Children, with their developing lungs and immune systems, were particularly vulnerable to respiratory irritation and pollutant-induced inflammation due to immature pulmonary and immune systems, while older adults experienced heightened susceptibility to respiratory decompensation and cardiovascular events. People with disabilities were also at higher risk because many encountered significant barriers to evacuation and emergency mobility and relied on electrically powered medical equipment, making them vulnerable during power outages. Mortality among individuals with disabilities who were unable to evacuate during rapid fire progression.

3.3 Fatalities During the 2025 California Wildfire

Official records show that the January 2025 wildfires in Los Angeles County caused 31 deaths. However, a new study by the School of Public Health and the University of Helsinki found that the real number of deaths was approximately fifteen times higher than the official count (McKoy, 2025). News reports suggested that more than 400 individuals may have died, including those with severe burn-related injuries. The latest study revealed that around an estimated 440 deaths occurred because of the wildfires between 5 January and 1 February (BBC, 2025). A new study found that many people also died from the effects of the fires in the immediate post-fire period, raising the total death toll to about 440. Researchers from the University of Helsinki in Finland and Boston University in the United States studied all deaths in Los Angeles County between January 5 and February 1, 2025; to find how many were linked to the wildfires (McKoy, 2025). They discovered that smoke, poor air quality, and delayed medical care caused many indirect deaths in addition to those who died directly in the flames. The study shows that the true impact of the fires was far greater than initial official reports indicated.

3.4 Safety Challenges After the Wildfire

The wildfire of California 2025, this massive wildfire damaged around 57,000 acres of land in total. Power lines, communication towers, as well as water and sewer infrastructure, were heavily impacted. Roads and highways were blocked or destroyed. The IAE estimated that the 2025 Los Angeles wildfires resulted in approximately $28.0–$53.8 billion in property damage (LAEDC, 2025). Environmental conditions at the time were exceptionally hot and dry, contributing to rapid vegetation ignition and spread. Strong winds accelerated fire movement into new areas within minutes, severely limiting containment efforts. Many fires also started in steep, remote terrain, which hindered firefighter access and equipment deployment. Dense smoke reduced visibility and decreased the effectiveness of aerial suppression operations (Fig. 3). All these conditions together made the 2025 California wildfires collectively create extreme challenges for fire suppression efforts to stop and control. The intensity and scale of the fire made situational awareness difficult for affected residents. It became highly challenging for emergency personnel and rescue teams to reach survivors. It made evacuation and rescue operations extremely difficult and significantly delayed the safe return of displaced residents.

Figure 2: Hazardous Ash and Debris Remaining After the Wildfire (Jazeera, 2025)

Figure 3: Firefighters Working to Distinguish the Wildfire in Poor Visibility (McGrath, 2025)

Toxic debris and ash became a significant public health and safety concern after the California wildfires. When homes burned, not only wood materials but also plastics, electronics, furniture, paint, and insulation also burned and released hazardous chemicals and toxic compounds. These harmful substances, including asbestos, lead, and various heavy metals, mixed with the ash, and settled on the ground and in the air, as shown in Fig. 2. The ash was unsafe for dermal contact or inhalation. Cleanup workers and residents needed masks, gloves, and protective clothing to reduce exposure risk. Without proper protection, people risked serious health problems such as lung damage, skin irritation, and potentially long-term illnesses, including elevated cancer risk.

3.5 Challenges in Health and Safety Management

After the incidents, post-event analyses of the California wildfires identified multiple gaps and challenges in health and safety management. Key issues included hazardous smoke exposure, loss of homes and loved ones, emergency response shortcomings, infrastructure vulnerabilities, and long-term mental health impacts. The 2025 California wildfires showed major gaps in health and safety management in the state. These fires not only burn forests, but also destroy houses, vehicles, and urban infrastructure, creating highly toxic urban smoke containing plastics, metals, chemicals, asbestos, and other hazardous pollutants. This made the smoke much more hazardous for people to breathe. Public health communication during the fires was reported to be weak and inconsistent, and many residents, especially marginalized communities, expressed limited trust in official warnings. At the same time, vulnerable groups like children, older adults, pregnant women, people with disabilities, and those with heart or lung diseases faced greater health risks and more difficult evacuations. Medical facilities struggled to operate because of power outages, infrastructure damage, and delays in medical supply delivery. Firefighters also suffered heavy strain, with long working hours, extreme heat, exposure to toxic smoke, and higher cancer risk, which led to both physical and psychological exhaustion. Overall,

the 2025 wildfires demonstrated that current systems for prevention, communication, medical response, and evacuation were not strong enough, and the disaster highlighted the urgent need for improved preparedness, equitable resource access, stronger infrastructure resilience, and enhanced mental and physical support systems.

3.6 Recommendations for Future Preparedness

To be better prepared for future wildfires, California must improve its safety systems and response plans. Public warning messages should be timelier and more consistent. Evacuation plans also need to be improved, especially for people with disabilities, older adults, pregnant women, and children, and for individuals without access to personal vehicles. The state should invest in stronger infrastructure, like safer power lines and better road access, to reduce damage and make it easier for emergency services to respond. Communities should receive more training on wildfire safety and emergency planning, and building rules should be updated to ensure that homes in fire-prone areas incorporate fire-resistant materials and minimize the release of toxic emissions during combustion. In addition, more support is needed for firefighters and for mental health services for both survivors and first responders. Using strategies like controlled burns and enhanced vegetation and fuel management practices can help reduce fuel and lower the risk of large wildfires in the future.

4. CONCLUSIONS

California wildfires in 2025 caused widespread destruction and long-term health and safety issues for affected communities. The fire burned homes, damaged infrastructure, and generated highly toxic urban smoke that posed significant health dangers, especially for those already sick or medically vulnerable. Many people suffered both physical and psychological health effects, and some lost their lives due to fire-related injuries or secondary health problems. The crisis also exposed major shortcomings in public health communication, access to emergency services, and protection for vulnerable groups like older adults, children, pregnant individuals, and people with disabilities. Toxic debris and ash left behind after the fires further polluted the air and soil, increasing the risk of respiratory illnesses, skin irritation, and long-term exposure to hazardous chemicals. Firefighters and first responders endured extreme physical strain, smoke inhalation, and mental health stress during prolonged response efforts. Overall, the disaster revealed that existing systems for preparedness, evacuation, medical response, and infrastructure resilience were insufficient to handle an event of this magnitude. To minimize future wildfire damage, urgent improvements are needed in planning, public communication, infrastructure safety, healthcare support, mental health services, and targeted protection for vulnerable populations.

AI Declaration
For conducting this research, AI tools were used only for language and grammatical improvement.

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