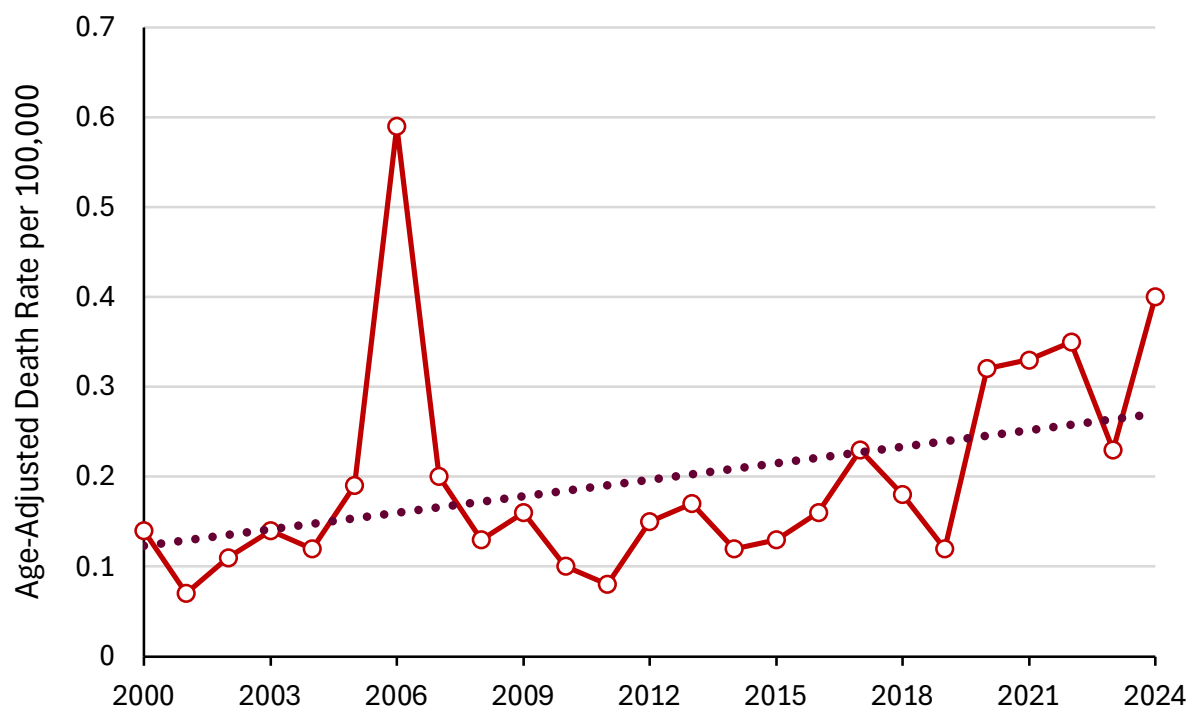


5.1 Heat-Related Deaths and Illnesses

In years with especially high summertime temperatures, heat-related deaths in California have spiked. During these same periods, emergency department (ED) visits and hospitalizations due to heat-related illnesses have increased as temperatures rise statewide. Because many heat-related cases are unrecognized and thus underreported, the actual number of heat-related illnesses and deaths is likely higher.

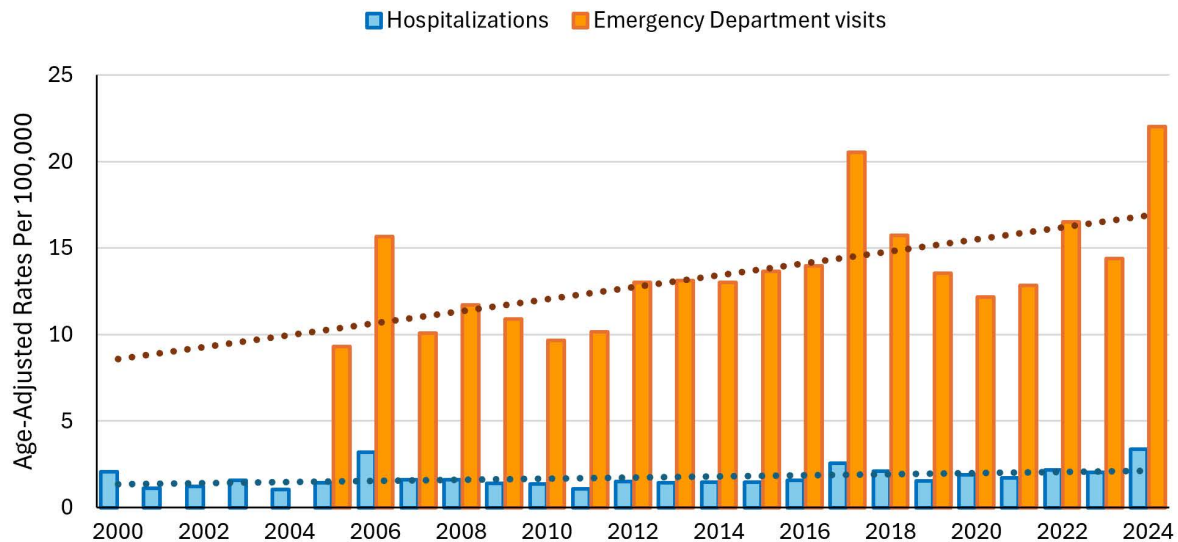
Figure 5.1.1. Heat-Related Deaths in California.



The figure shows reported deaths in the warm season (May to September) from 2000 to 2024 due to heat exposure as a primary or contributing cause. Mortality rates peaked in 2006, coinciding with an unprecedented statewide heat wave. Year-to-year variability in deaths likely reflects differences in summertime temperature intensity and duration across years. The solid red line represents the annual values, and the dotted brown line is the linear trend. Source: Tracking California and the Dept of Health Care Access and Information (2026)



Figure 5.1.2. Heat-Related Illnesses in California.



The figure shows reported heat-related hospitalizations and ED visits during the warm season (May to September), from 2000 to 2024, with trendlines represented by dotted lines. Data for ED visits became available starting in 2005. Fluctuations across years likely correspond to variability in summertime heat conditions, including the frequency and severity of extreme heat events.

Note: Health cases related to heat are often unrecognized and thus underreported. In addition, people without adequate access to healthcare may not seek treatment. As a result, the true magnitude and health burden of heat-related illnesses and deaths in California are likely much higher than what is shown.

Source: Tracking California and the Dept of Health Care Access and Information (2026)

What does the indicator show?

Health impact from heat exposure is an ongoing and increasingly prevalent issue in California. Heat-related illnesses occur when a person is exposed to high temperatures or intense sunlight and their body's ability to cool itself becomes strained or overwhelmed, which can sometimes lead to death. Symptoms and illnesses include:

- Dehydration
- Heat exhaustion



- Heat cramps
- Heat rash
- Heat syncope (fainting)
- Heat stroke, which can be fatal

The trends in California align with nationwide trends. A recent assessment found 21,518 heat-related deaths in the US from 1999-2023, with an average of 861 deaths per year (Howard et al., 2024). Heat-related mortality in the United States has been increasing, on average, by 16.8% per year since 2016 and reached a record high of 2,325 deaths in 2023, the hottest year on record.

Figure 5.1.1 presents California's annual age-adjusted heat-related deaths from 2000 to 2024. Heat-related mortality rates peaked in 2006 due to the unprecedented heat wave that year, declining between 2007 and 2010 and have since trended upward. The number of reported deaths attributed to heat exposure nearly tripled in 2024 compared to 2000.

Figure 5.1.2 shows annual age-adjusted heat-related hospitalizations (2000 to 2024) and ED visits (2005 to 2024) in California. Relative to the early 2000s, when hospitalization rates ranged from 1.0 to 1.5 per 100,000 people, rates during peak heat years were significantly higher. In 2006 and 2017, hospitalization rates increased to approximately 2-3 per 100,000 – about a 50-100% increase above an average summer. Despite ongoing statewide adaptation efforts, rates of both heat-related ED visits and hospitalizations show an upward trend, consistent with rising temperatures and record-breaking heat events.

While data from past decades demonstrate significant health impacts from heat, many heat-related illnesses and deaths often go unreported. This is partly because heat exposure exacerbates many health conditions that might not be reported as heat related. In fact, warmer temperatures have been linked to:

- Increased cardiovascular and respiratory deaths
- Greater health care usage for a wide range of diagnoses, including electrolyte imbalance, diabetes, and renal, cardiovascular, and respiratory diseases



- Adverse birth outcomes such as preterm birth, stillbirth, and low birth weight
- Increased ED visits for mental health-related outcomes, such as for psychiatric conditions and self-harming or aggressive behaviors
- Increased ED visits for amphetamine, cocaine and opioid use or overdose

During the 2006 California heat wave, for instance, over 16,000 excess ED visits and 1,100 excess hospitalizations were observed. These were much larger than the 2,134 ED visits and 538 hospitalizations officially identified as heat-related, so many were not explicitly diagnosed as heat illnesses (Knowlton et al., 2009).

Why is this indicator important?

Extreme heat (see the *Extreme Heat Events* chapter) causes hundreds of deaths, thousands of injuries, and billions of dollars in economic losses in California, even though heat-related illnesses and deaths are generally preventable (CDI, 2024; Lubert et al., 2014; NOAA, 2026).

Assessing changes in frequency of heat-related deaths and illnesses over time provides a measure of how climate change-related temperature shifts are impacting human health. Despite heat-related illness and mortality counts being underreported, tracking the number of deaths and illnesses attributed either wholly or in part to heat can provide an indication of the trend in health impacts related to climate change.

Tracking trends in heat-related illnesses and deaths provides critical information for developing adaptation plans and evaluating their success, especially in relation to heatwaves. This information will become even more important as periods of warmer temperatures and heatwaves are expected to rise in frequency, duration, and intensity over the next century (IPCC, 2021; Lubert et al., 2014), placing an even greater public health burden on California.

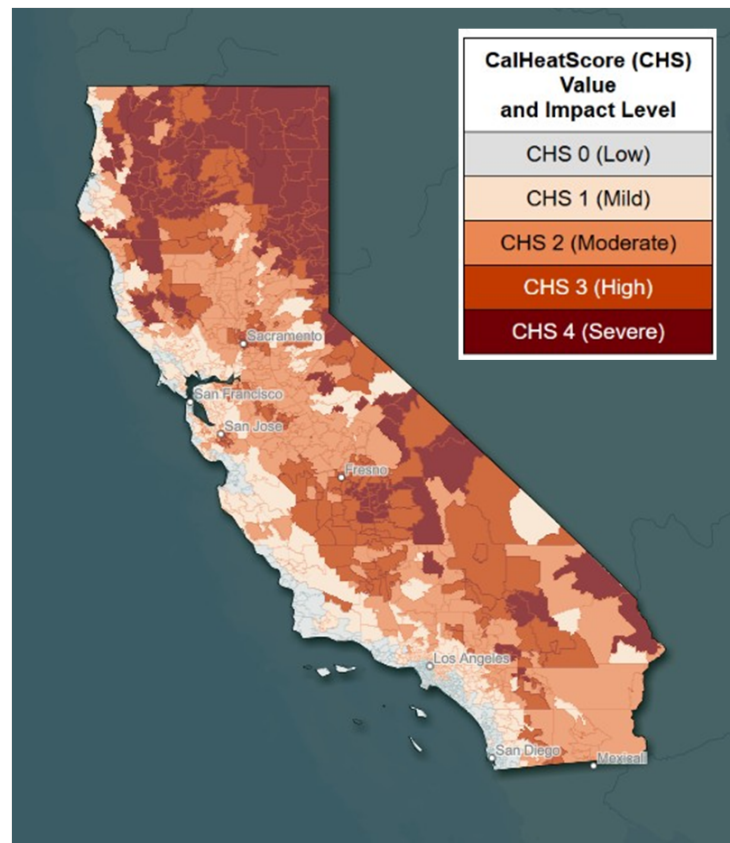
In response to the health risks posed by extreme heat, California has invested \$404 million through the state's [Extreme Heat Action Plan](#), with many initiatives already underway, including strengthening community services and response, increasing resilience of the environment, and utilizing nature-based solutions (CDPH, 2023a).



Tracked heat-related illness and deaths will serve as a metric to evaluate the effectiveness of these initiatives.

In early 2025, California’s Office of Environmental Health Hazard Assessment (OEHHA) launched CalHeatScore: a public health tool that provides near real-time daily, health-relevant heat rankings at the zip code level. CalHeatScore was developed to serve as a public early warning system for California communities to reduce heat-related illnesses and deaths (**Figure 5.1.3**). In addition to heat-risk rankings, the tool provides public-facing resources, including information on local cooling centers, recommended protective actions, and signs and symptoms of heat-related illnesses.

Figure 5.1.3. Screenshot of the CalHeatScore Map on July 14, 2025.



Source: CalHeatScore (2025)

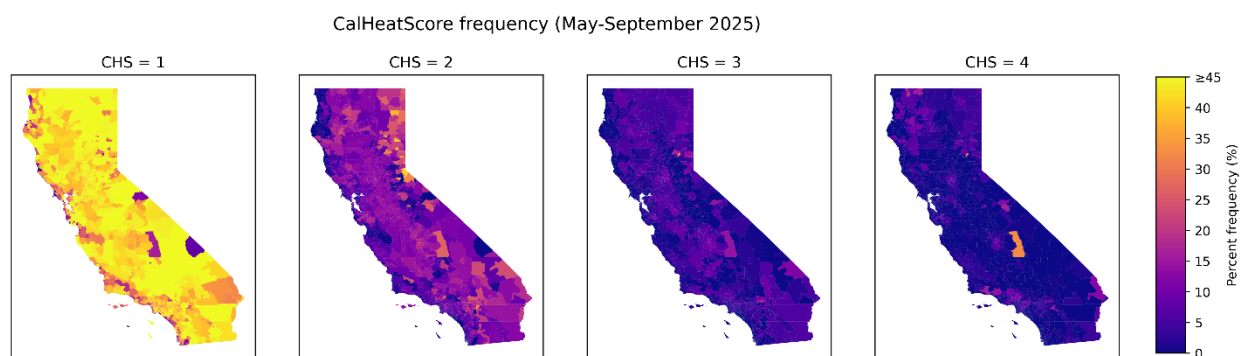


The ranking system uses historical relationships between climate conditions and heat-related illnesses to translate upcoming daily weather forecasts into easy-to-understand scores, ranging from 0 to 4 to indicate increasing levels of human health risk from extreme heat impacts. CalHeatScore is updated daily, using temperature forecasts for the next 7 days to anticipate upcoming heat events.

Data from the first year of CalHeatScore (May – September 2025) showed that the majority of daily CalHeatScore (CHS) ranks were 1 (mild, 39.5%) followed by 2 (moderate, 9.8%). Ranks 3 (high) and 4 (severe) were least frequent, occurring approximately 3.2% and 2% of the time, respectively. Because these higher-impact days were relatively rare, they provide clear opportunities to focus preparedness and response efforts when risks are most elevated.

These frequencies varied by location ([Figure 5.1.4](#)) and time ([Figure 5.1.5](#)). Looking across time, there were distinct patterns in the rank distribution across the summer period as well.

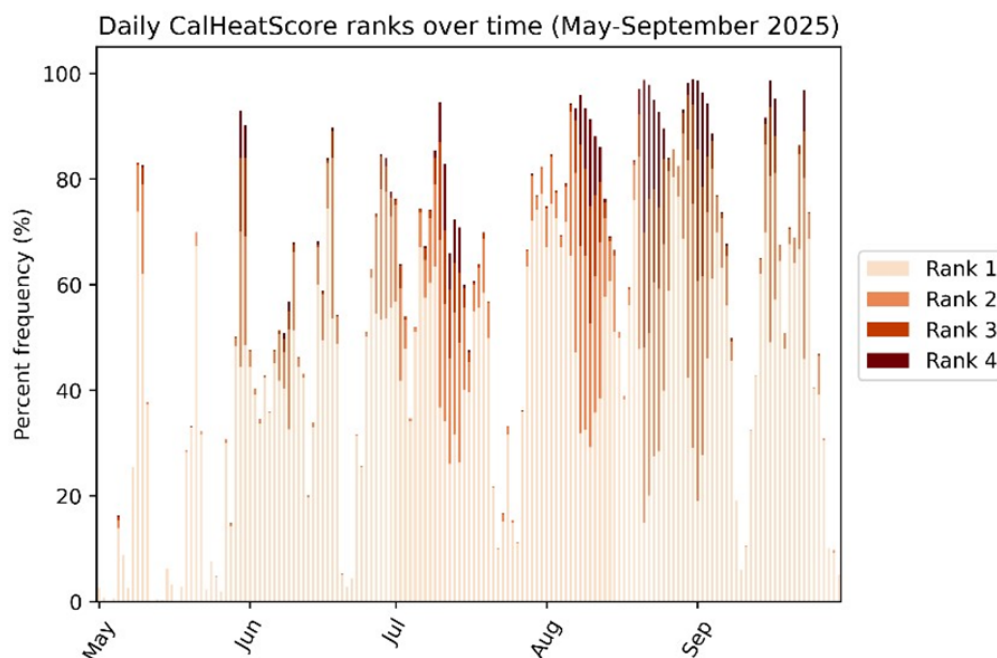
Figure 5.1.4. Spatial Distribution of CalHeatScore Rankings.



The maps show the frequency of CalHeatScore ranks in the summer of 2025.
Source: CalHeatScore (2025)

[Figure 5.1.5](#) shows that CalHeatScore ranks of 3 (high impact) and 4 (severe) increased in frequency later in the summer of 2025 which reflected the relatively mild start of the 2025 heat season. Once the late summer period was reached, there were multi-day stretches across the summer where higher CalHeatScore ranks were seen.



Figure 5.1.5. Daily Distribution of CalHeatScore Rankings.

The graph shows daily ranks over time in the summer of 2025.

1=mild, 2=moderate, 3=high, 4=severe

Source: CalHeatScore (2025)

As global temperatures continue to warm, increases in extreme heat and concurrent increases in community health risk driven by exposure to heat can be expected. OEHHA will continue to refine CalHeatScore's methodology to ensure the accurate reflection of localized heat-health risk. CalHeatScore will be informed by input from community organizations, tribes, local governments, health professionals, emergency responders, researchers, and the public.

What factors influence this indicator?

The association between exposure to high temperatures and increased illnesses or deaths is well established. Even short periods of extreme heat are associated with adverse health impacts (Gasparrini and Armstrong, 2011; Sherbakov et al., 2018).



Key factors influencing heat-related health outcomes in California include intensity and duration of the heat events, frequency of exposure (e.g., how often events occur and when they occur during the year), location of exposure (e.g., geographic location, acclimation to heat, air quality in the area), and population characteristics (e.g., age, health condition, socioeconomic status, occupation, access to protective measures, etc.) These factors are further discussed below.

Heat Wave Characteristics

The intensity, duration, frequency and spatial extent of heat events all play a role in whether people will experience heat-related effects and how severe those effects can be. Longer lasting heat waves are associated with higher mortality, ED visits, and hospitalizations in California. Heatwaves that span larger geographic areas of populated regions can have more significant health impacts, particularly when they affect vulnerable populations.

Specific characteristics of heat events further influence the impact of these heat-related health effects. Elevated nighttime temperatures during heat waves can exacerbate health impacts by preventing recovery from high daytime temperatures (Gershunov et al., 2009). Heatwaves accompanied by high humidity are also especially dangerous, as rising humidity can prevent evaporation of sweat, which impairs the body from regulating temperature. Heatwaves occurring outside the typical hot season, either early in the spring or late in the fall, could cause greater health burdens as people are less prepared for heat risks.

Health disparities

Although anyone can experience heat exposure impacts, some populations face higher risk. **Figure 5.1.6** and **Figure 5.1.7** show reported deaths, ED visits, and hospitalizations from May to September with heat exposure as a main or contributing cause, with greater risks of heat illnesses among males (likely driven in part by occupational exposure), adults aged 65 and older, and the non-Hispanic Black demographic. These groups have consistently higher rates of heat-related deaths, ED visits and hospitalizations than those in other comparable demographic groups. A more detailed analysis by race revealed higher risks of heat-related illnesses among the



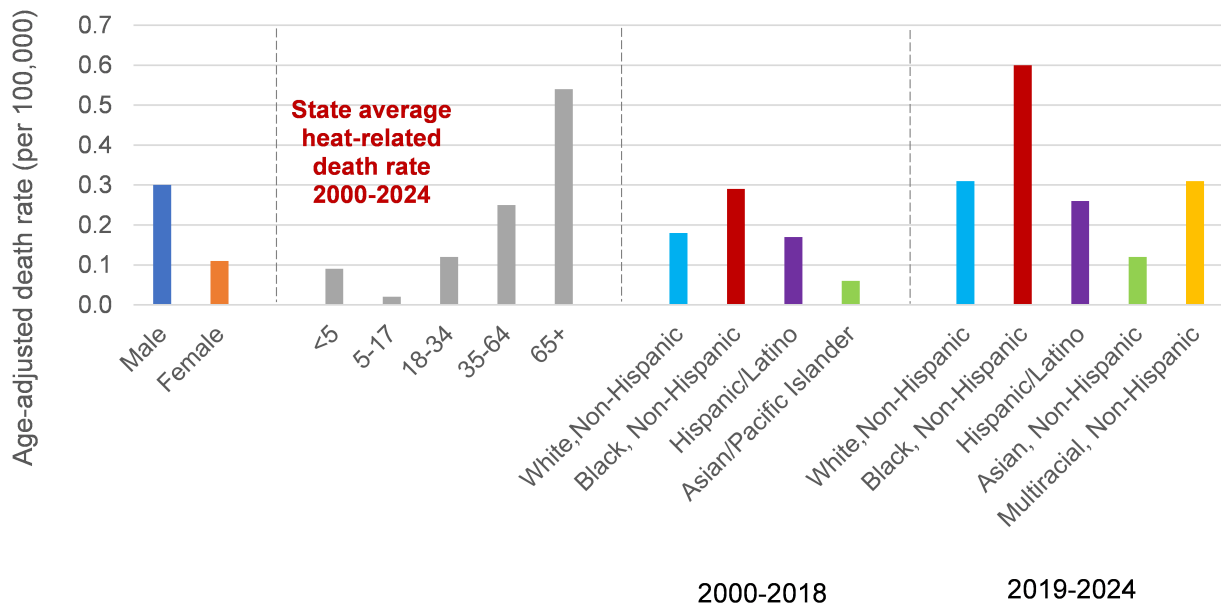
Pacific Islander demographic (**Figure 5.1.7b**). A separate analysis by the California Department of Insurance (CDI, 2024) examined seven extreme heat events in California from 2013 to 2022 and found substantial health impacts, including an estimated:

- Higher mortality rates in disadvantaged communities (SB535 census tracts) than non-disadvantaged communities, with heat-related mortality rates 14-30% higher in SB535 tracts across six of seven extreme heat events evaluated statewide.
- Blacks, Native Americans, and Hispanic populations experienced disproportionately higher adverse health outcomes than White and Asian populations, with heat-attributable mortality rates up to approximately two times higher during several extreme heat events.
- People over 65 had disproportionately more adverse health outcomes than younger age groups, with mortality rates of approximately 16-29 deaths per 1,000,000 compared with about 1 death per 1,000,000 among those under age 65.

Factors such as age, race/ethnicity, and socioeconomic status (including homelessness or inadequate access to air conditioning) could all interact with each other to worsen disparities. Racial and ethnic disparities are directly linked to the inequitable distribution of social, political, and economic power and the subsequent health burden and disadvantaged living conditions (CDPH, 2023b). The following figure shows heat-related death rates in California by sex, age, and race/ethnicity for 2000 to 2024. Rates are age-adjusted for all groups except the rates of different age groups (**Figure 5.1.6**).



Figure 5.1.6. Heat-Related Death Rates in California, by Sex, Age, and Race/Ethnicity (2000-2024).

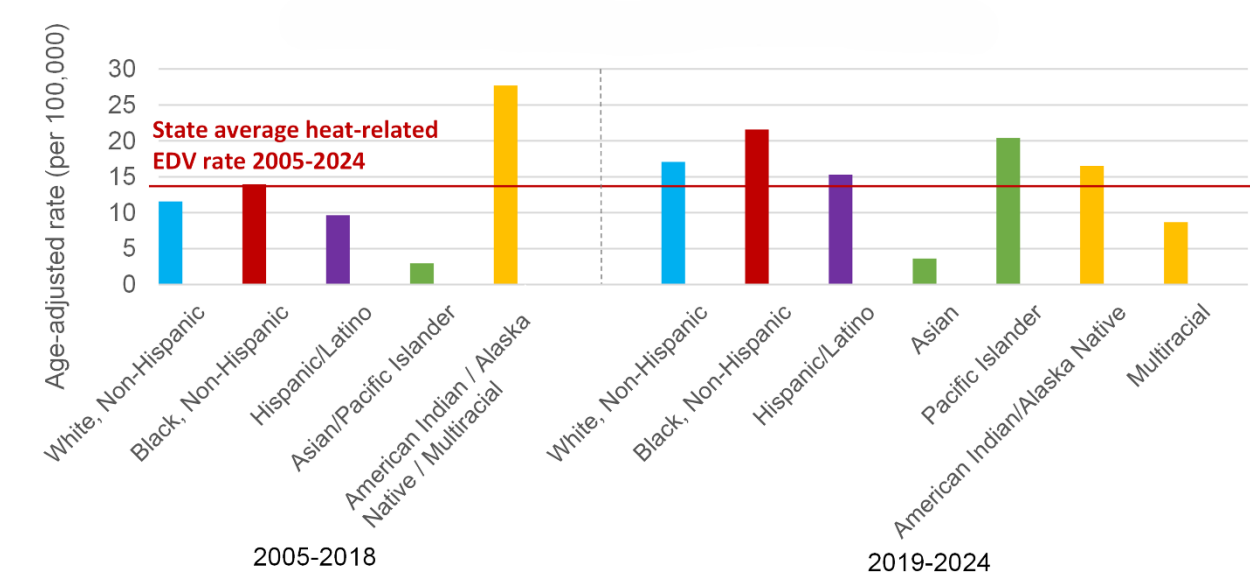


Less than 1% of the deaths were excluded from the sex- and age-stratification due to missing dates of birth needed to calculate age-adjusted rates, and the impact to the overall distribution was minimal. Source: Tracking California and the Dept of Health Care Access and Information (2026).

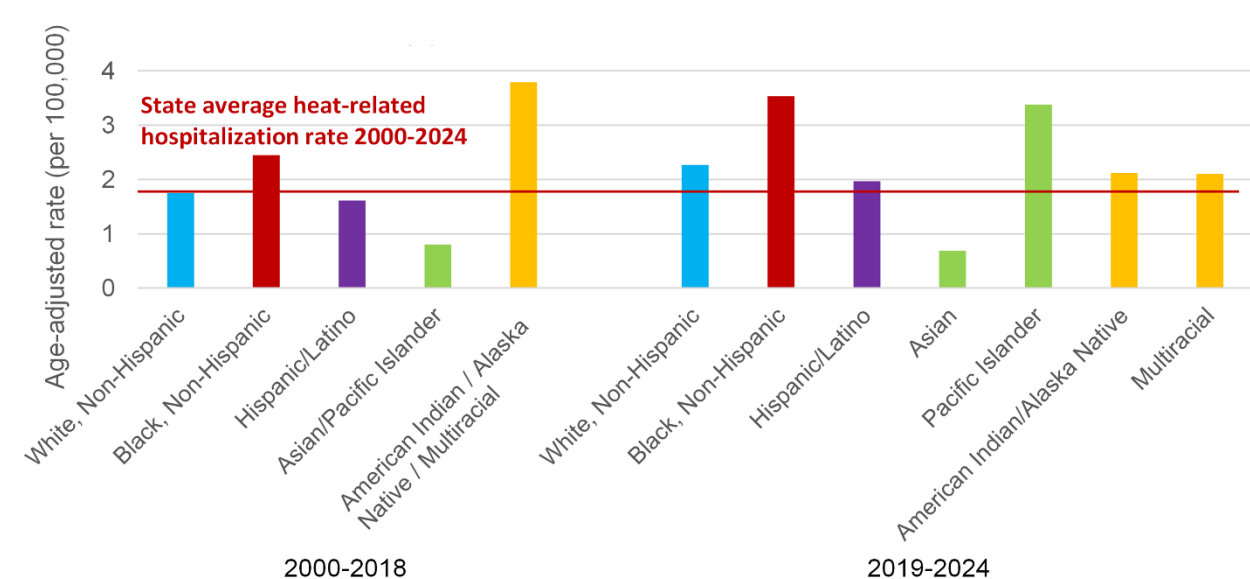


Figure 5.1.7. Heat-Related Illness Rates in California, by Race/Ethnicity.

(A) Heat-related Emergency Department Visits



(B) Heat-related Hospitalizations



American Indian/Alaska Native and Multiracial demographics are reported separately beginning 2019. Their relatively large rates in 2000-2018 may be reflective of their small sample size.

Source: Tracking California and the Dept of Health Care Access and Information (2026).



A study of pediatric hospitalizations and ED visits in California from 2005 to 2019 found that children in communities with lower incomes, lower education levels, less access to insurance, less access to air conditioning, and higher percentages of Black, Hispanic, and Pacific Islander residents were most vulnerable to extreme heat events (Ndovu et al., 2025).

Furthermore, people engaged in extended outdoor activities during hot days, such as workers in construction, agriculture, delivery service, and firefighting are also at risk. Over the past two decades, reported occupational heat-related illnesses have increased in California (see *Occupational Heat-Related Illnesses* chapter). Athletes, hikers, tourists, and those who spend a lot of time outdoors on hot days are also subject to higher risks. Heat-related illness is one of the leading causes of death of teenage athletes in the US (Adams, 2019; Kerr et al., 2013).

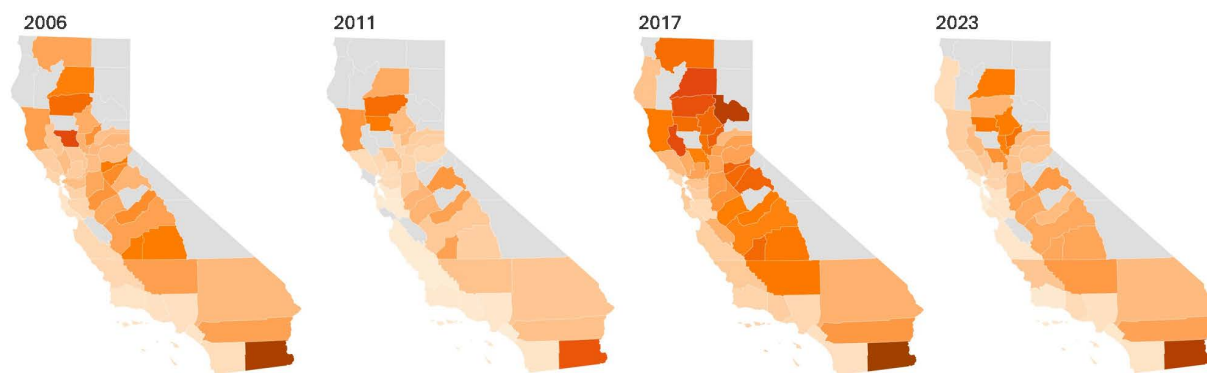
Regional differences

Some California regions face greater challenges than others due to differences in climate, infrastructure, and population characteristics. A statewide analysis of hospital admissions from 2004 to 2013 found substantial heat burdens in the Central Valley and a high variation in heat-related hospitalizations in coastal cities. The Central Valley and the southern inland areas consistently observe higher summer daytime temperatures than the state average. Daytime heat events had the greatest impact in the Central Valley, while nighttime heat events drove burdens in the southeastern desert regions (Hansen et al., 2024). Meanwhile, coastal populations tend to be less acclimated to higher temperatures and have lower rates of air conditioner ownership.

Figure 5.1.8 shows heat-related ED visit rates across California in 2006 (extended summer heat wave), 2011 (cool summer season), 2017 (exceptionally hot summer), and 2023 (relatively warm summer). Darker colors indicate higher heat-related illness rates. The Central Valley, northern inland, southeastern desert, and northwest coast always appear as high-risk areas. Note the distinction between 2006 and 2017 and which counties are most impacted.



Figure 5.1.8. ED visits by County Due to Heat Illness, Selected Years.



Source: Tracking California (2025)

Urban residents may experience higher temperatures than those in surrounding suburban and rural areas due to the urban heat island effect, in which built environments retain and generate heat. Urban heat islands are created by a combination of:

- Heat-absorbing surfaces (such as dark pavement and roofing)
- Heat-generating activities (such as engines and generators)
- Absence of vegetation (which provides evaporative cooling)

Average daily summer temperatures in urban areas were warmer than those for nearby rural areas by the following magnitudes:

- Smaller urban areas: Up to 5°F (3°C) warmer
- Moderately large urban areas: Up to 9°F (5°C) warmer
- Very large urban areas: Up to 19°F (11°C) warmer (southern California)

Urban heat islands also strongly influence nighttime temperatures. Warmer nights limit the body's ability to cool down and recover before temperatures begin to climb again the next day, increasing the risk of illness and fatalities (CalEPA, 2015). Most of the urban areas are concentrated along the coast, Sacramento Valley, and San Joaquin Valley.



Air pollution

High temperatures and heat waves can worsen air quality and amplify the health effects of air pollutant exposures and thus pose a threat to public health (Nolte et al., 2018; O'Lenick et al., 2019). Heat accelerates the formation of ground-level ozone and traps ozone, particulate matter and other harmful air pollutants. Exposure to these pollutants has been linked to adverse respiratory, cardiovascular, mental health, and reproductive outcomes (Bekkar et al., 2020; Nguyen et al., 2021; US EPA, 2019).

Air pollution often acts synergistically with extremely high temperatures to exacerbate adverse cardiovascular, respiratory and other health effects (Anenberg et al., 2020; Schwarz et al., 2021). Communities burdened by high air pollution levels may be more likely to experience adverse health effects during heat events.

Emerging research suggests that the health impacts of co-exposure to extreme heat and air pollution (particularly wildfire smoke) can produce greater health impacts than in isolation. This has been observed in studies on mortality (Rahman et al., 2022), cardiorespiratory hospitalizations (Chen et al., 2024), and preterm births (Ha et al., 2024). The risk of preterm birth from combined exposure to heat and wildfire smoke is highest for Black, Hispanic, Asian, and American Indians/Alaskan Native populations.

Along with outdoor air pollution, heat can significantly influence indoor air quality. Sources of indoor air pollution include building materials, gas appliances, cleaning products, personal care products, and furniture. Exposure to indoor air pollutants is associated with adverse health effects, such as eye and throat irritation, asthma and other respiratory diseases, and cancer (California Air Resources Board, 2025). Heat can accelerate the release of volatile chemicals from household products (Beel et al., 2023) and materials and increase the rate of indoor chemical reactions. As outdoor levels of ozone rise on hot and sunny days, ozone can infiltrate buildings through cracks and gaps in buildings. Once indoors, ozone can react chemically with components of buildings and building furnishings, as well as some indoor air pollutants, to form air pollutants like formaldehyde and ultrafine particles that can pose a hazard to human health (Berkeley Lab Indoor Air Quality, 2025). Moreover, when people use air conditioning, they often close doors and windows, which may trap pollutants indoors,



potentially worsening allergies and respiratory issues. These combined indoor and outdoor pathways further contribute to heat-related health burdens, particularly during prolonged heat waves.

Technical considerations

Data characteristics

Heat-related hospitalizations and ED visits were identified for the months of May to September (2000–2023) by Tracking California (<https://trackingcalifornia.org>), a program of the [Public Health Institute](#), in partnership with the [California Department of Public Health](#), and formerly the Centers for Disease Control.

Cases were included when heat stress was explicitly listed, as either the primary or contributing cause of diagnosis. Heat-related diseases were identified using International Classification of Diseases (ICD-9 for 2000-2015, ICD-10 for 2015-2024) codes for: heat stroke and sunstroke; heat syncope; heat cramps; heat exhaustion; heat fatigue; heat edema; other specified heat effects; unspecified effects of heat and light; and exposure to excessive natural heat or sunlight. Illnesses that were due to a man-made source of heat were excluded. Hospitalization data were available from 2000 to 2024, with ED visit data from 2005 to 2024.

Tracking California also identified heat-related deaths for the months of May to September from 2000 to 2023, using ICD-10 codes for the following as the main or contributing causes of death: heat stroke and sun stroke, heat syncope, heat cramps, heat exhaustion, heat fatigue, heat edema, other specified heat effects, unspecified effects of heat and light, and exposure to excessive natural heat, and sunlight. Again, deaths due to a man-made source of heat were excluded. More information about data and methods, including rate calculations, can be found at [Tracking California](#).

Strengths and limitations of the data

As noted earlier, the available data on heat-related death and illnesses likely underestimate the full health impacts of heat exposure. Heat-related deaths from coroners' reports rely on deaths coded as "heat-related" without universally applied classification of these diseases and often require knowledge of the circumstances



surrounding the death to be communicated by other parties. Consequently, heat is infrequently listed as a primary cause of death, even when it contributes substantially to fatal outcomes (English et al., 2009). It is likely that there were three to four times as many deaths in the July 2006 heatwave than reported (Ostro et al., 2009; Joe et al., 2016). Similarly, for the 2022 heatwave, the estimated number of all-cause excess deaths was significantly higher than the number coded as heat-related on death certificates (395 vs. 20) (CDPH, 2023a). Recent studies of annual heat-related deaths in the US also support that the number of deaths is substantially larger than what has been previously reported (Weinberger et al., 2020; Vaidyanathan et al., 2020).

Non-fatal outcomes may similarly be undercounted. Heat-related health effects can manifest in several clinical outcomes, including urinary tract infection, renal failure, septicemia, hypotension, cardiac dysrhythmia, ischemic stroke, ischemic heart disease, diabetes, and mental health conditions (Basu et al., 2012; Green et al., 2010; Sorensen and Hess, 2022). Heat exposure has also been associated with preterm birth, low birth weight, and stillbirth (Bekkar et al., 2020). People with chronic health problems are more susceptible to heat effects compared to healthy individuals. However, these cases are usually unrecognized and not reported as heat-related in the current reporting system, unless they happened during or right after a heat event. It is often difficult to determine whether an illness is heat-related when it involves multiple organ systems, and there is no standardized training among healthcare providers to make these determinations (Madrigano et al., 2015).

Outpatient visits are generally not considered in reported cases of heat-related illnesses, and the California Department of Insurance found that the 2022 Coastal Inland Heat wave (August 31-September 13) and 2017 Full Coastal Heat wave (August 27-September 8) each resulted in tens of thousands of excess outpatient visits (around 55,000 and 35,000, respectively) and more than \$10 million in excess medical costs (CDI, 2024). Therefore, the full magnitude of health impacts from heat exposure could be much greater than indicated by hospitalization and ED visit data alone.

For hospitalizations and ED visits, ambiguity in diagnosis classifications of heat-related visits due to the transition from ICD-9 to ICD-10 in the 4th quarter of 2015 may also



impact observed patterns in those indicators. Also, only ED visits and hospitalizations for California residents are reported. Out-of-state residents and unhoused patients with no recorded address are excluded from the rates (Tracking California, 2025), suggesting that the number of heat-related visits may be higher.

Furthermore, due to the requirement for age-adjusted mortality and morbidity calculations, records without valid dates of birth were excluded from the analytical dataset. This exclusion accounted for approximately 1% of mortality records and a negligible fraction of morbidity records. Sensitivity analyses of the omitted records demonstrated minimal deviation in distributional patterns, including within low-frequency racial groups.

Despite these known limitations, heat-related ED visits, hospitalizations and deaths can be used to document trends, monitor vulnerable areas, and assess local climate-adaptation strategies. These metrics are tracked at the national level as part of the [National Environmental Public Health Tracking Network](#), enabling comparisons across states. This tracking provides a better understanding of risks to specific groups and helps with designing interventions and communication efforts (CDC, 2026).

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