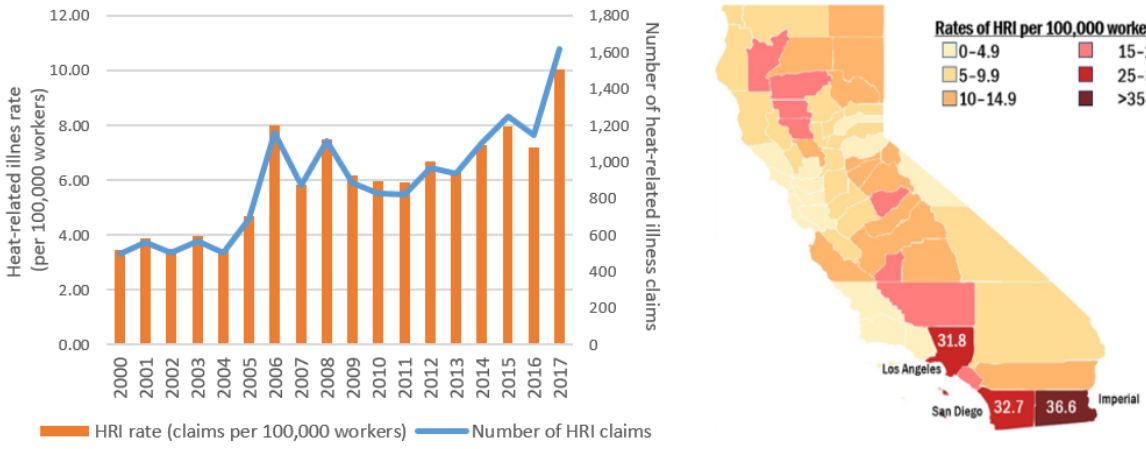
OCCUPATIONAL HEAT-RELATED ILLNESS

Heat-related illnesses reported by California workers have increased from 2000 to 2017.

Figure 1 Occupational heat-related illnesses in California, 2000-2017



Source: Workers' Compensation Information System data, California Department of Industrial Relations (Heinzerling et al., 2020)

What does the indicator show?

Exposures to high temperatures while at work can lead to a range of heat-related illnesses (HRI). Figure 1 presents annual rates of occupational HRI per 100,000 California workers from 2000 to 2017 based on an analysis of workers' compensation claims data. HRI cases were identified from claims that listed heat as the cause of injury or that specified heat-related illness key words (e.g., "heat stroke") or disease codes. Occupational HRI rates started to climb in 2005, reached about 8 cases per 100,000 workers in 2006, and in 2017 saw the highest number of cases (1616), with a rate of 10.1 cases per 100,000 workers. Occupational HRI rates over six-year periods also increased over time: the rate from 2012 to 2017 was two times greater than the rate from 2000 to 2005.

The map in Figure 1 shows worker HRI rates by county from 2000-2017. HRI rates were calculated by dividing the total number of cases over the study period by the total number of workers and multiplying by 100,000 to yield rates per 100,000 workers. Imperial County had the highest rate of 36.6 per 100,000 workers, followed by San Diego and Los Angeles counties, with rates of 32.7 and 31.8 per 100,000 workers, respectively. Orange, Kern, Kings, Mariposa, Trinity, Tehama, Glen, and Colusa counties (shaded pink) reported HRI rates of 15 to 25 per 100,000 workers.

Why is this indicator important?

The link between heat exposure and adverse health outcomes in workers is well documented across the globe (Fatimaa et al., 2021). HRIs are a broad spectrum of diseases, ranging from headaches, dizziness, cramps, rapid heartbeat, and disorientation to more serious outcomes including heat stroke (Gubernot et al., 2014). In

many cases employees have little control over their work environment and limited ability to adapt when faced with extreme heat conditions. Workers who are socially isolated and economically disadvantaged, have chronic illnesses, or have no health insurance are especially vulnerable to HRI; these workers are often from communities of color. HRI is a preventable occupational illness, with well-established strategies to protect workers (Heinzerling et al., 2020). While there is no federal workplace standard that protects workers from heat exposures and related illnesses, California's Division of Occupational Safety and Health (Cal/OSHA) enacts and enforces its own workplace standards for public and private sector employees. In 2005, in response to a series of heat-related farmworker deaths, California enacted an HRI prevention standard for outdoor workers, requiring employers to provide employees with HRI training and access to water, shade, and rest (https://www.dir.ca.gov/title8/3395.html). In spite of prevention and mitigation efforts, occupational HRI continues to increase in California.

As climate change increases, average daily temperatures and the frequency and intensity of extreme heat events, occupational HRIs, and deaths are projected to rise (ILO, 2019). A study of rising heat exposure and health risk faced by U.S. crop workers estimates that climate change at its current pace will double occupational HRI by the middle of the century (Tigchelaar et al., 2020). As more and more workers are placed at risk, additional strategies and interventions will be needed to protect workers from HRI.

The effects of rising temperatures on workers are impacting global employment sectors and economies. Borg et al. (2021) reviewed 20 studies to estimate the past and potential future global economic burden of workplace heat exposure. They estimated substantial heat stress-related expenses from lost productivity, decreased work efficiency, and healthcare costs and highlighted the need for workplace heat management policies to minimize future economic burden. A study of workplace heat-related injuries in California estimated financial costs at between $525 and $875 million per year, considering health care expenditures, lost wages and productivity, and disability claims (Park et al., 2021).

Exposure to elevated workplace temperatures may also exacerbate trends in labor market inequality. Park et al. (2021) report that lower wage workers are more likely to live and work in places with greater heat exposure and experience larger increases in risk on hotter days. People in the state's lowest household income tier are approximately five times more likely to be affected by HRI or injuries on the job than those in the top income tier. Moreover, workplace injuries for low-income workers can lead to large direct health care costs and persistent wage impacts that affect subsequent earnings trajectories.

What factors influence this indicator?

California has been experiencing higher temperatures and extreme heat events, particularly since the 1980s (see *Annual air temperature and Extreme heat events* indicators). These warming trends coincide with increasing reports of worker HRI, as shown in Figure 1. In 2006 there was an uptick in HRI cases that coincided with a prolonged heat wave in California.

Excessive heat during work restricts a worker's physical functions and leads to loss of productivity (ILO, 2019). Workplace temperatures above 75-79 degrees Fahrenheit (˚F) are associated with reduced labor productivity. At 91-93˚F, a worker operating at moderate work intensity loses 50 percent of his or her work capacity. In California, a comparison of workers' compensation claims with local weather data from 2001 to 2018 showed that on days with a high temperature above 90˚F, workers have a 6 to 9 percent greater risk of injuries than on days with high temperatures of 50 to 60˚F (Park et al., 2021). When temperatures top 100˚F, the risk of injuries increases by 10 to 15 percent.

Workers who perform exertional tasks or work outdoors are particularly vulnerable to HRI (Heinzerling et al., 2020). Between 2000 and 2017, most of the 15,996 HRI cases in California identified from workers' compensation data occurred in summer months. July had the highest number of cases (4199 cases; 26.3 percent), followed by August (3161 cases; 19.8 percent), and June (2915 cases; 18.2 percent). Certain demographic groups were found to be at higher risk of occupational HRI: rates among men were 2.3 times higher than among women, and rates were highest among young workers (the highest age group was 16-24 years). Younger people may be at higher risk of HRI because they tend to work in industries or occupations with higher risk of HRI, may be more likely to undertake more physically demanding work, and may also lack work experience and adequate acclimatization to hotter temperatures. Relatively high HRI rates for temporary employees in service industries suggested they may be particularly vulnerable to occupational health threats.

Rates of occupational HRI also varied by industry and occupation. The occupational group with both the highest number of cases and highest HRI rate was *protective services*, which includes police and firefighters, with 3380 total cases and an HRI rate of 57 per 100,000 workers (Heinzerling et al., 2020). When exposed to high ambient temperatures, the body depends on evaporative cooling and is susceptible to anything that restricts evaporation, such as personal protective equipment or clothing (Gubernot et al., 2014). Firefighting presents significant challenges for heat illness prevention, given the high heat exposure and exertion involved and heavy personal protective equipment required (West et al., 2020). Risk of HRI in this group, especially among wildland firefighters, is likely to continue to increase as wildfires become larger and more severe and as the fire seasons lengthen (see *Wildfires* indicator).

The *crop production* industry, which includes most types of farming, reported 1335 total HRI cases with a rate of 41 per 100,000 workers. The majority of farmworkers in California are migrant workers, work long days during the summer season, and have limited control over their work schedule and job tasks (ILO, 2019). The common payment system is based on the amount of produce harvested, which discourages workers from taking breaks to eat, drink water, or rest. A study of heat strain in California farmworkers found increased odds of acute kidney injury after a day of work, especially in female workers paid by amount harvested (Moyce et al., 2017).

In a California Heat Illness Prevention Study, core body temperature (CBT) increase and work rate (monitored using a personal accelerometer) over a work shift were used to monitor HRI risk in 587 farmworkers throughout the state (Langer et al., 2021).

Almost seven percent of workers were at higher risk of HRI based on elevated CBT. With an estimated 829,000 farmworkers in California, this translates to about 58,000 workers at risk of elevated CBT. Despite consuming more water compared to less active workers, those at risk became dehydrated (15.7% of men and 3.3% of women). The study concluded that risk of HRI was exacerbated by work rate and environmental temperature despite farms following Cal/OSHA HRI regulations (described above).

Technical considerations

Data characteristics

Workers who experienced HRI were identified through the California Workers' Compensation Information System (WCIS) electronic database managed by the California Department of Industrial Relations (Heinzerling et al., 2020). Since 2000, California has required workers' compensation claims administrators to report to WCIS any claim resulting in more than one day of lost work time or requiring treatment beyond first aid. Claims were considered HRI cases if they included specific WCIS heat-related cause of injury codes (e.g., temperature extremes); if they contained certain HRI key-words in the injury description (e.g., “heat stroke”); or if their billing data contained an International Classification of Diseases (ICD) (Ninth or Tenth revision) code indicating heat illness. All claims with date of injury from January 1, 2000 to December 31, 2017 meeting these criteria were extracted from WCIS in January 2018. Claims meeting only ICD criteria were manually reviewed, and only those deemed to be heat-related based on the injury description were included as HRI cases.

HRI cases were categorized by sex and age group, month and year of injury, county of injury (using ZIP code), industry, and occupation. WCIS reports do not include worker race, ethnicity, or medical comorbidities. Employment denominators used in rate calculations for all variables except county were obtained from the National Institute for Occupational Safety and Health (NIOSH) Employed Labor Force tool, which estimates total numbers of workers based on the U.S. Census Current Population Survey and includes all non-institutionalized civilian workers aged 16 and older. Employment denominators by county were obtained from the California Employment Development Department.

Strengths and limitations of the data

There is limited public health surveillance of occupational HRI in the United States. The primary source of this information in most states comes from the Bureau of Labor Statistics Survey of Occupational Injuries and Illnesses (BLS SOII). These data, based on self-reporting from a small sample of employers nationwide, underestimate the true number of occupational illnesses and injuries. Numbers of HRI cases identified using California’s WCIS database, shown in Figure 1, are higher than those from other sources, such as BLS SOII. They are, however, still likely to be underestimates, as they do not include other types of illnesses and injuries where heat may have been a contributing factor, and occupational illnesses are not always reflected in workers’ compensation data (Heinzerling et al., 2020).

Rates of reporting may also differ by industry and occupation. Those in certain occupations may be unaware of workers' compensation eligibility. Occupational groups

that are particularly vulnerable to employer reprisal, such as farmworkers, may be less likely to report illnesses or injuries and file workers' compensation claims.

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