

How does heat affect workers' health?

Scientific information on heat stress

Heat can be a serious threat to workers. Without proper protections, working in heat can cause illness and, in some cases, death.^{1, 2} Currently, the federal agency responsible for issuing worker protective policies, Occupational Safety and Health Administration (OSHA), is accepting public comments on the first-ever national heat protection policy, titled "[Heat Injury and Illness Prevention in Outdoor and Indoor Work Settings](#)."

What is heat stress?

"Heat stress," or how hot the body feels, is often measured using the [heat index](#), a combination of temperature and humidity (i.e., how much moisture is in the air). In higher humidity, our bodies can't sweat as well to cool off, making it feel hotter.¹ The higher the heat index, the greater the risk of illness and injury.³ Personal characteristics like age, physical fitness, hydration, chronic medical conditions, and use of medications and drugs, can increase or decrease the impact of heat on the body.^{1, 3} In extreme heat, people can experience rashes, cramps, dizziness, exhaustion, and stroke.^{3, 4}

	Illness	Description	Symptoms
SEVERITY ↑	Heat stroke	Body temperature rises above 104 degrees (potentially lethal emergency)	Confusion, altered mental status, slurred speech, loss of consciousness (coma), hot and dry skin or profuse sweating, seizures, possible death
	Heat exhaustion	Occurs after extended exposure to high temperatures and lack of fluids	Headache, nausea, dizziness, heavy sweating, irritability, weakness
	Heat Syncope	Occurs with prolonged standing, dehydration, and lack of acclimatization	Fainting, dizziness, lightheadedness
	Heat cramps	Muscle pains or spasms that happen during heavy exercise	Tightness or spasm of muscles (usually in abdomen, arms, or legs)
	Heat rash	Skin irritation from excessive sweating	Rash on skin

Figure 1: Heat related illness and injuries descriptions and symptoms. ^{3, 4}

How are workers affected?

Workers, especially those with physically demanding jobs, experience high amounts of heat stress. Between 2014-2016, **85% of heat-related worker deaths occurred in the construction, agriculture, landscaping, oil and gas, and warehouse sectors.**² Between 1992-2006, agricultural and crop workers died at an annual rate 20 times greater than the US civilian workforce.⁵ Many of these deaths occurred in Southern and Western States with **57% of crop-worker deaths occurring in North Carolina, California, and Florida.**⁵

Workers may experience different amounts of heat stress depending on a range of factors: if they're working in direct sunlight, hydrated, wearing personal protective equipment (PPE), the thickness of their PPE, using heavy machinery, and working for long periods of time.^{1, 3} Pressure and expectations to finish work can discourage workers from taking rest breaks or hydrating since it could risk losing their income.^{2, 4}

When does heat become dangerous?

One way of monitoring heat stress is using the heat index. Researchers have analyzed worker deaths to understand which heat indexes are workers at risk of illness or death. One study found that **96% of the 418 civilian workforce heat-related deaths occurred at heat index values greater than or equal to 80°F. Almost half (44%) of these deaths occurred at heat index between 91-103°F.**¹ Not all deaths occur at high heat indexes. Another study analyzed heat related worker deaths from 2014-2016 and the heat index on day of death (see Figure 2, below). Some deaths occurred on cooler days after long periods of high heat.² To effectively provide protection before death becomes a large risk, **researchers recommend worker protections should be in place at a heat index of 80°F.**¹

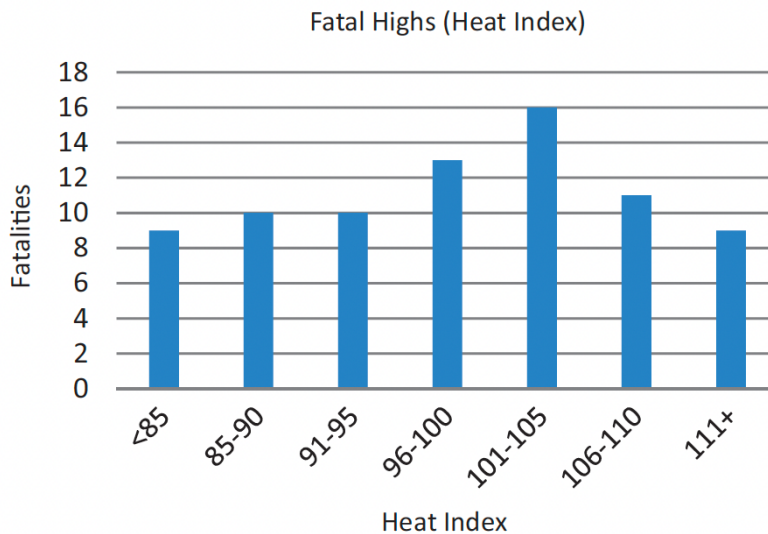


Figure 2: Heat Index for Worker Fatalities 2014-2016. Note Temperature and humidity from National Climate Data Center data reported for 12pm on the day of the fatality at the nearest weather station.²

What are ways to protect workers?

Heat related illness and injury are preventable. Several common heat protections can be implemented at the workplace to better protect workers from harmful effects of heat.

- **Hydration:** Easy access to clean water on the job site.
 - Centers for Disease Control (CDC) defines proper hydration as drinking 1 cup [8 oz.] of water or other fluids every 15–20 minutes.³
 - Children farmworkers in North Carolina reported their availability to clean water can be inconsistent and at the discretion of the supervisor or employer.⁴
- **Rest Breaks:** Taking frequent rest breaks in shade or AC.⁴
 - Children farmworkers in North Carolina reported that employers rarely provided shaded places to take breaks. Children reported sitting underneath tobacco or blueberry plants to find shade.⁴
- **Acclimatization:** New workers can undergo a period of “acclimatization,” where they start with a smaller workload and gradually progress into full workload to acclimate to heat (typically 2-weeks).³
 - For example, “Shun Jones, aged twenty-three, was hired through a temporary staffing agency to work as garbage collector for Waste Management Inc. in Houston, TX. He died due to heat stress on his first day on the job.”²
 - Climate change and greater temperature variability may make acclimatization less effective.²
- **Switching Work Tasks:** Changing work tasks, such as working in the shade or doing less laboriously intensive tasks can relieve heat stress.⁴
- **Education:** Educating employers and workers about the dangers of heat stress, signs & symptoms, and legal protections with culturally and age-appropriate trainings is important for preventing illnesses

Comment on Proposed Rule:

“Heat Injury and Illness Prevention in Outdoor and Indoor Work”

Heat can be dangerous for workers without proper protections in place. OSHA is actively accepting public comments on the proposed. Read the [proposed rule](#), [fact sheet](#), [list of questions for the public](#), and [how to submit a public comment](#). The following peer-reviewed scientific information can help in responding to OSHA’s questions. **Deadline for Public Comment: December 30th, 2024.**

Questions related to context and background of worker heat stress:

- 1. What are the occupational health or safety impacts of hazardous heat exposure?**
 - Among 165 children farmworkers in North Carolina, who were surveyed about their experiences working in heat, participants reported the following heat related illnesses: dizziness (29%), muscle cramps (22%), hot/dry skin (18%), nausea (8.5%), confusion (6%), and fainting (2%).⁴
 - OSHA recorded 79 worker deaths due to environment heat between 2014-2016. Almost all (92%) these deaths occurred during the months of May–September.²
- 2. Are there industries, occupations, or job tasks that should be considered when evaluating the health and safety impacts of hazardous heat exposure in indoor and outdoor work?**
 - Between 2014-2016, 85% of heat-related worker deaths occurred in the construction, agriculture, landscaping, oil and gas, and warehouse sectors.²
 - *“Eduardo Garcia, aged thirty-four, died of a heart attack, heat stroke, and severe dehydration with an internal body temperature of 105 F. He had been working in moderately high heat for the region (86 F was the high that day in Houston, TX), but in direct sunlight, framing a roof of a house.”²*
 - *“An 18-year-old farm laborer in Idaho was told to leave the field by the crew boss because he was not working fast or well enough. He was found the following day, a quarter mile away from the main road, deceased. The Heat Index value for the day he died was 102.”²*
 - Between 1992 to 2006, crop workers had an average annual death rate ~20 times greater than that of all U.S. civilian workers.^{5 5}
- 3. Are there specific populations facing disproportionate exposure to or outcomes from hazardous heat in indoor or outdoor work settings?**
 - While the rule lists age as a factor that influences heat, the rule does not account for the population of children farmworkers. Children as young as ten are legally hired for farm work.⁴ Since children have physiological differences and have less control of their environments compared to adults, it is difficult to compare children farmworker and adult studies.^{2,4} However, a study on children farmworkers in North Carolina found that 47.9% of child workers experienced heat related illnesses. This percentage is slightly greater than other studies in North Carolina.⁴
 - We favor the reduction or elimination of child labor in all industries, including agriculture. We recognize, however, that an occupational heat standard is not a legal vehicle through which this can be accomplished. **Hence, we ask OSHA to take into account the reality that there are many child employees are exposed to heat at work.**
 - Workers without union representation, with language and cultural barriers, with limited knowledge of workers’ rights, and workers lacking legal immigration documents may less heat awareness education and less power to report violations.⁶

4. What factors, beyond those discussed in rule, contribute to heat stress in outdoor and/or indoor occupational settings?

- While these factors are identified in the introduction (undocumented, migrants, low-wage workers), they are not accounted for in the section “Contributions to Heat Stress in the Workplace,” despite having an impact on heat protections.
 - “Workers’ dependency on employment creates an inherent vulnerability that if not addressed through protective policies, may force workers to choose employment over their health.” Factors like discrimination on the basis of race/ethnicity, immigration status, or gender, or socioeconomic vulnerability from limited education, English language, or job skills, influence whether workers understand, seek out, or report violations of heat protective actions.^{2,7}
- Working alone and working in remote location may also contribute to heat related fatalities, include working alone and working in remote locations.²

5. How does geographic region contribute to occupational heat hazards and the outcomes?

- Previous research has shown that a majority of heat related deaths are concentrated in the southern and western states.^{2,8,9} Between 1992 and 2006, 57% of crop-worker deaths related to heat occurred in California, Florida, and North Carolina. North Carolina had the highest annual rate.^{4,5}

Questions related to implementing heat protective actions

6. Do employees take rest breaks if employers offer rest breaks?

- Children farmworkers in North Carolina reporting using rest breaks as a protective behavior against heat stress. Among a cohort study of 165 children, 87.9% of children took rest breaks in the shade.⁴

7. What are the challenges to providing rest breaks if needed to prevent overheating?

- If there isn't a permeant shade structure to take rest breaks, then children have been shown to improvise. "For example, a few described sitting under tobacco leaves or blueberry plants for shade or that access to shade depended on whether the fields were located near trees." ⁴

8. How do productivity or output-based payment schemes affect the ability of workers to follow heat illness and injury prevention training, guidance or requirements?

- The "piece-rate payment systems, production quotas, and workers’ fears of employer retaliation" influence workers' ability to take rest breaks or access water.⁶
- Children farmworkers in North Carolina, who were interviewed about their experiences working in heat, explained how the pressure to work fast can influence one's ability to take a break.
 - One child farmworker who was interviewed said, "well, if they're rushing you, then you will feel stressed out. It's like, you need a break. Or you'll pass out or something. You feel like if you don't take a break, you're going to pass out. There were times where the [other workers] would get mad and be like, they have things to do; they ain't got time for us to take a break. So they would just let you drink water and keep working." ⁴
 - Another child farmworker who was interviewed said, "if your schedule is your 10:30 break, they don't want you to take it because they want you to finish the field . . . the farmers come and say, "I need this field by 12:00 so you need to finish," so we can't take a break."⁴

9. Is the requirement to provide a minimum of 1 quart per hour per employee appropriate?

- Children farmworkers in North Carolina that have been interviewed about hydration said, “I drink lots of water. But sometimes you can’t drink water the whole day. It starts hurting your stomach. So you have to drink at least one soda . . . you get tired of the water, and the grown-ups, the older people, they drink a little, like, beer ‘cause they get tired of the soda and the water.”⁴

10. Should the agency require the provision of electrolyte supplements/solutions in addition to water?

- A firefighter who performs high levels of physical exertion for prolonged periods of time, spoke about the need to monitor electrolyte levels in his work. “You have to constantly monitor your water and electrolyte intake, and over a 16-hour shift, this can be a challenge.”¹⁰

11. Should OSHA account for clothing as a modifier for initial or high heat triggers?

- Working in clothing can increase heat stress by limiting the body’s heat exchange like sweat evaporation. “Comprehensive workplace heat stress assessment should account for environmental heat, metabolic heat, and **clothing factors**.”¹ For children, specifically, the “The American Academy of Pediatrics” reports that inappropriate clothing modifies heat related illnesses in youth sports.^{4, 11, 12}

12. What are ‘Stakeholders’ experiences with implementing observational systems such as those that OSHA is proposing? OSHA is proposing “implementing buddy systems to ensure workers are watching out for signs and symptoms of heat-related illness in each other.”

- Children farmworkers have described heat related illnesses as commonplace. For example, “a fifteen-year-old boy who had been going to the fields since he was six years-old described the experience of other workers fainting as relatively routine, something he would “[see] only once or twice a year.”⁴
- Observational systems should be paired with education on how to respond to heat related symptoms. One study remarked, “Latinx child farmworkers often recognize the dangers of working in the heat, but they do not always possess the knowledge or workplace control to intervene effectively on their situation.”⁴
- Without proper education for the employers and employees, the symptoms may not be properly addressed. In a study analyzing OSHA reports, “an 18-year-old farm laborer in Idaho was told to leave the field by the crew boss because he was not working fast or well enough. He was found the following day, a quarter mile away from the main road, deceased. The Heat Index value for the day he died was 102.”²
- During a California campaign to raise awareness to the dangers of heat, “participants learned about the causes and effects of heat illness, how to identify and respond to an emergency, the roles and responsibilities of workers and employers under Cal/OSHA regulations, and how workers’ exercising their rights can prevent illness and fatalities.”⁶

13. How will climate change affect the risk of occupational heat-related illness and mortality in the different regions of the United States?

- Greater temperature variability will affect the effectiveness of acclimatization.²
- One firefighter reported on physical and mental effects working in increased air temperature due to climate change. “The actual misery of the heat is generally ignored by everyone, but ironically you become like a lizard on an ice pond—you move very slowly, with an understanding of the pace you can maintain. You have to constantly monitor your water and electrolyte intake, and over a 16-hour shift, this can be a challenge.”¹⁰

14. Should the Heat Injury and Illness Prevention Plan be made available in a language that each employee, supervisor, and heat and safety coordinator understands?

- It is critical to communicate the heat prevention plan and information about legal rights in a language that the audience understands. Researchers have noted that, "educational campaigns targeted at Latinx youth can increase knowledge and prevention strategies of HRI;"⁴
 - A California campaign, related to educating stakeholders about heat stress, used flip-guides in each of the five target languages to illustrate importance of water, rest, and shade and about worker's rights and included information.⁶
 - Educational trainers incorporate participants' personal experiences directly into the curriculum, including correcting misinformation (e.g., teaching that excessive heat can cause not only discomfort but death, that salted coffee is not advisable for hot environments, etc.)."⁶

15. What are workers experience with the state-specific heat standards (California, Colorado, Minnesota, Oregon, and Washington)? What are the challenges with implementing existing state standards?

- A study reporting on a heat awareness campaign in California reported several critiques of California's heat law. "Critics charged that it contained too many ambiguities to be effective, that it placed the onus unfairly on workers to initiate breaks to drink water or recover from heat, and that Cal/OSHA was doing too little to enforce it, even in industries such as agriculture where rates of heat illness remained high. Three farmworkers died in California in 2007—two years after the emergency standard went into effect—and inspectors found more than half of the employers they audited out of compliance with the standard."⁶

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