CENTER FOR LABOR & A JUST ECONOMY
AT HARVARD LAW SCHOOL

The Effect of Heat Standards on Deaths Related to Outdoor Work

Adam Dean, George Washington University
Jamie McCallum, Middlebury College

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Introduction

In the summer of 2005, a brutal heat wave brought weeks of triple-digit temperatures to central California's agricultural fields, killing four farmworkers there. The state responded quickly with a series of policies designed to mitigate the risks of heat-induced injury, illness, and death, protocols that in 2006 evolved into the country's first heat standard regulation.

Though an important step, the heat standard lacked adequate enforcement mechanisms, as California's Occupational Safety and Health agency was chronically underfunded and understaffed. In 2012, the United Farm Workers (UFW) sued CAL/OSHA, alleging its non-enforcement of the 2006 standard when workers continually faced hyperthermia in the fields and packinghouses.[1]

Finally, after a review of its decade-long policy experiment, the state's Occupational Safety and Health office revised the standard in 2015 to include significant improvements in the critical pillars of heat protection—rest, water, shade, enforcement—which translated into better health and safety outcomes for workers.

We found that California's 2015 revised heat standard decreased deaths related to outdoor work by 43 percent relative to the average county that reported deaths related to outdoor work from 2001 through 2020. The average effect over 5 years was a decrease of 0.35 deaths per 100,000 residents. In a county the size of Los Angeles, our results suggest that California's revised 2015 heat standard saved the lives of roughly 35 workers each year. While prior studies have established a link between heat exposure and health outcomes, no previous studies have estimated the effect of heat standards on injuries or deaths related to outdoor work. These findings demonstrate the urgent need for effective heat legislation at the national level to safeguard all workers against rising temperatures.[2]

In the past three years, Colorado, Maryland, Nevada, Oregon, and Washington have tried to meet this challenge by passing new laws that mandate water, shade, and regular rest breaks for all outdoor workers on hot days. In some cases, these regulations include a temperature threshold, usually around 80 degrees, that triggers the policy protocols into effect, and an acclimatization process that allows workers time to more safely adjust to high temperature worksites. The Maryland standard in particular has received much attention because it also came in the wake of a recent high-profile heat death.

In the summer of 2024, Ronald Silver II, 36, stumbled out of his Baltimore sanitation truck in blazing 100-degree temperatures and rang a random doorbell of a local resident. Unable to

[1] Mohan, G. (2015, June 12). Cal-OSHA settles farmworker suits over heat-related deaths - Los Angeles Times. *Los Angeles Times*. https://www.latimes.com/business/la-fi-cal-osha-farm-workers-20150612-story.html
[2] Weiner, Peter H and Ira J Klein. (2015). *Revisions to California's heat Illness Prevention Standard to take effect on May 1, 2015 | Paul Hastings LLP*. https://www.paulhastings.com/insights/client-alerts/revisions-to-californias-heat-illness-prevention-standard-to-take-effect-on-may-1-2015

stand by that point, he begged the person who answered the door to pour water on his head. He was pronounced dead hours later from heat exhaustion. Though officially deemed an "accident" by the coroner's office, Silver's death ignited a local fury over what critics identified as systematic and structural problems: toxic workplace cultures at the city's sanitation department, lax enforcement of existing health and safety measures, and a lack of enforceable guidance over how to handle high heat in worksites specifically.

At a Department of Public Works hearing soon after his death, frontline workers testified for almost two hours detailing the hardships and dangers that come with working through high heat. One former DPW employee and current city councilmember, Antonio Glover, spoke of management practices that demanded long hours without access to water. "There are many Mr. Silvers who have passed away behind that truck, that never got noticed," Glover said, identifying a long history of ignoring the dangers of high heat on the job.[3]

By September of 2024, the state passed its first official heat standard that resembled the strong protections laid out in the California regulation, and Maryland joined a growing trend. However, around the same time, the Occupational Safety and Health Administration (OSHA) proposed a new standard that would require heat protections for workers across the United States, but it has yet to move forward, highlighting the glaring lack of federal heat illness legislation.

Extreme heat and weather are increasing in intensity and duration, with 2024 being the hottest year since record keeping began. Research has long connected heat to adverse health outcomes.[4] Recent studies find that exposure to high heat leads to cognitive decline and decreased decision-making ability that increase the risk of injury and deaths.[5] Higher temperatures significantly increase workplace injuries in the United States, especially for workers performing manual

[3] CharmTV Citizens' Hub. (2024, August 23). *City Council hearing; August 22, 2024* [Video]. YouTube. https://www.youtube.com/watch?v=6VaUUf0e6Lg

[4] Adam-Poupart, Ariane, Audrey Smargiassi, Marc-Antoine Busque, Patrice Duguay, Michel Fournier, Joseph Zayed, and France Labreche (2014), "Summer outdoor temperature and occupational heat-related illnesses in Quebec (Canada)." *Environmental Research*, 134, 339– 344. ; Kjellstrom, Tord, David Briggs, Chris Freyberg, Bruno Lemke, Matthias Otto, and Olivia Hyatt (2016), "Heat, human performance, and occupational health: a key issue for the assessment of global climate change impacts." *Annual review of public health*, 37, 97–112. ; Ramsey, Jerry D (1995), "Task performance in heat: a review." *Ergonomics*, 38, 154–165. Ramsey, Jerry D, Charles L Burford, Mohamed Youssef Beshir, and Roger C Jensen (1983), "Effects of workplace thermal conditions on safe work behavior." *Journal of safety Research*, 14, 105–114.; Basu R, Samet JM. Relation between elevated ambient temperature and mortality: A review of the epidemiologic evidence. Epidemiol Rev. 2002;24(2):190–202. doi: 10.1093/epirev/mxf007.

[5] Graff Zivin, Joshua, Solomon M Hsiang, and Matthew Neidell (2017), "Temperature and human capital in the short- and long-run." *Journal of the Association of Environmental and Resource Economists*.; Heyes, Anthony and Soodeh Saberian (2019), "Temperature and decisions: evidence from 207,000 court cases." *American Economic Journal: Applied Economics*, 11, 238–65.

labor, who receive low wages and are disproportionately people of color.[6] [7] [8] Heat-related deaths have more than doubled in the last twenty-five years, and rising temperatures put more workers at risk of heat stress and heat exposure every year.[9]

Evaluating the Effect of California's Heat Standards

California implemented outdoor heat standards to protect workers from extreme heat, first in 2006 and then with a stronger version in 2015. This study examined how these rules affected deaths related to outdoor work from 2001 to 2020, focusing on California and its neighboring states—Arizona, Nevada, and Oregon—which did not have similar regulations. To measure deaths related to outdoor work, we used publicly-available data from the National Center for Health Statistics Mortality Data on CDC WONDER. We focused on county-level deaths caused by exposure to heat and sunlight, as well as vehicle accidents related to agriculture, construction, and transportation. We analyzed these data using difference-in-differences, a statistical method that compared mortality trends in California before and after the heat standards were adopted with trends in the neighboring states.

Since California adopted two different outdoor heat standards during this period, we analyzed whether the effect of California's 2015 revised heat standard differed from the effect of its original 2006 heat standard. In short, we found that California's revised 2015 heat standard reduced deaths by 43 percent, while California's original 2006 heat standard failed to reduce deaths.

These different effects can be seen clearly in Figure 1, which displays death rates related to outdoor work for California and the neighboring states of Arizona, Nevada, and Oregon. From 2001 through 2006, death rates in California and its neighboring states followed similar trends, peaking in 2006 with a regional heat wave. Given these similar trends from 2001 through 2006, we can gauge the effectiveness of California's 2006 heat standard (dashed line) by comparing the evolution of deaths rates in California and its neighboring states in the years after 2006. During this period, death rates in these states continued to follow similar trends, with little evidence that California's death rate improved relative to its neighbors. This dynamic changed fundamentally with the implementation of California's 2015 revised heat standard (solid line), when deaths rates diverged dramatically, with California's death rate much lower than the death rate in its neighboring states.

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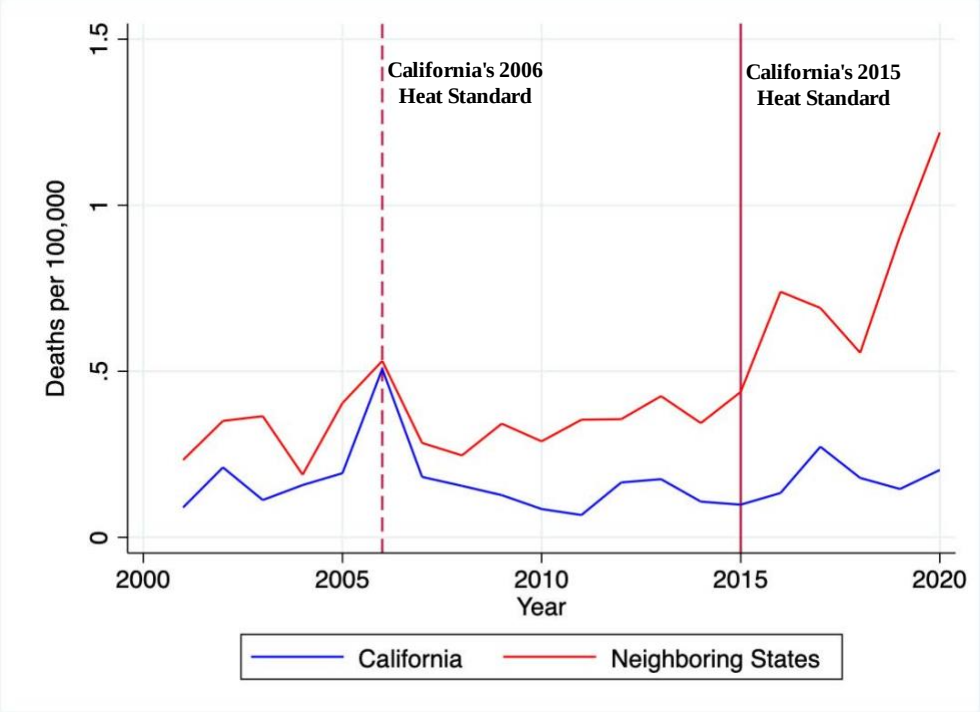
[6] Park, Jisung and Pankratz, Nora M. C. and Behrer, A. 2021. "Temperature, Workplace Safety, and Labor Market Inequality." For: Washington Center for Equitable Growth. Available at: https://equitablegrowth.org/working-papers/temperature-workplace-safety-and-labor-market-inequality/

[7] Park, Jisung and Pankratz, Nora M. C. and Behrer, A., Temperature, Workplace Safety, and Labor Market Inequality. IZA Discussion Paper No. 14560, Available at SSRN: https://ssrn.com/abstract=3892588 or http://dx.doi.org/10.2139/ssrn.3892588;https://www.nber.org/system/files/working_papers/w19725/w19725.pdf; Moussa El Khayat and others, "Impacts of Climate Change and Heat Stress on Farmworkers' Health: A Scoping Review," *Frontiers in Public Health* (10) (2022), available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8861180/.

[8] Shipley, J. (2021, August 17). Heat is killing workers in the U.S. — and there are no federal rules to protect them. *NPR*. Available at: https://www.npr.org/2021/08/17/1026154042/hundreds-of-workers-have-died-from-heat-in-the-last-decade-and-its-getting-worse

[9] Howard JT, Androne N, Alcover KC, Santos-Lozada AR. Trends of Heat-Related Deaths in the US, 1999-2023. *JAMA*. 2024;332(14):1203–1204. doi:10.1001/jama.2024.16386

Figure 1. Annual death rates related to outdoor work in California and the neighboring states of Arizona, Nevada, and Oregon, 2001-2020



To move beyond this descriptive analysis of state-level data, we compared differences in death rates before and after the adoption of a heat standard in counties with a heat standard against the same differences in counties without a heat standard. The basic idea is to use the evolution of death rates in Arizona, Nevada, and Oregon as a counterfactual for what would have happened to death rates in California if that state did not adopt a heat standard.

Our analysis controlled for differences across counties as well as regional trends in death rates over time. This approach allowed us to assess how the potential effect of a heat standard on death rates varied in each year after the adoption of a heat standard. It also enabled a clear assessment of different trends in death rates between counties with a new heat standard and counties without a heat standard, confirming that death rates in California's neighboring states represent a reasonable counterfactual for California.

We estimated our model separately for each of California's two heat standards, analyzing the five years before and five years after each policies' implementation. To estimate the effect of California's first heat standard (2006), we estimated our model from 2001 through 2011. To estimate the effect of California's revised heat standard (2015), we estimated our model from 2010 through 2020.

Our difference-in-differences analysis found a negative effect of California's revised heat standard (2015) on deaths related to outdoor work. We found that after one year of implementation, California's revised heat standard decreased county-level death rates by 0.37 deaths per 100,000 residents. The average effect over 5 years was a decrease of 0.35 deaths per

100,000 residents. This effect is statistically significant ($p < .05$) and substantively important, representing a 43 percent decrease in deaths relative to the average county that reported deaths related to outdoor work from 2001 through 2020. In a county the size of Los Angeles, our results suggest that California's 2015 heat standard saved the lives of roughly 35 workers each year.[10]

In contrast, we found that California's original heat standard (2006) failed to decrease deaths related to outdoor work. The average effect over 5 years was a decrease of 0.04 deaths per 100,000 residents, but this effect was far from statistical significance ($p = 0.77$).

Overall, we found that heat standards have the potential to reduce deaths related to outdoor work, but that ensuring enforcement is key. As discussed above, California's 2006 heat standard included several loopholes that enabled employers to skirt the spirit of the law. While this original heat standard was an important step forward, we found that that it failed to reduce deaths relative to California's neighboring states. In contrast, California's 2015 revised heat standard closed many of these loopholes and dramatically reduced deaths by 43 percent.

Discussion

California's heat standard was passed in the wake of a deadly heat wave in 2005, then revised in 2015. These much-needed updates improved the protections offered to workers and, crucially, the enforcement of the regulations.

First, the revised standard extends the regulatory scope to include walled buildings associated with outdoor work (CAL/OSHA passed a separate indoor heat standard in 2024). Buildings such as sheds, garages, huts, and packing houses can be dangerous, especially where temperatures inside are known to exceed the outdoor ambient temperature.

Second, although the 2006 standard mandated access to potable drinking water, the revised version adds important specificity. The water must be "fresh, pure, suitably cool, and provided to employees free of charge," and as close as possible to the worksite. Similarly, the previous standard required employers to provide shade from the sun when it was hotter than 82 degrees. The new version lowers the threshold temperature to 80 degrees and requires that the shaded area must comfortably accommodate all workers scheduled for breaks at any given time. Shade access also helps employers to monitor workers for signs of heat distress, an additional requirement in the new standard. The new legislation allows workers to take five-minute rest periods as needed if they feel overheated.

[10] To further test the robustness of our results, we performed a series of sensitivity analyses. Most importantly, we estimated negative binomial regression models that controlled for changes in county-level weather, including average temperature and number of days above 90 degrees. To adjust for these relatively time-invariant county-level measures of heat, these models include state fixed effects instead of county fixed effects. The results from these tests were substantively similar and statistically significant, suggesting that California's 2015 heat standard was associated with a 30% decrease in deaths related to outdoor work.

The new standard also specifies how workers are monitored as they are introduced to hot work environments, a process known as acclimatization, and requires employer training to identify signs of heat distress among the workforce. For certain industries—agriculture, construction, landscaping, and transportation or delivery—the new standard increases enforcement mechanisms when temperatures exceed 95 degrees Fahrenheit. These protocols include an effective means of communicating between supervisors and workers, a more thorough monitoring regimen, such as a buddy system on the job, and in the case of agricultural workers, ten-minute mandatory breaks every two hours. When accidents do happen, the revised standard calls for employers to plan a more timely and thorough emergency medical response, a stipulation absent from the 2006 standard.[11]

These 2015 improvements to the older standard translated into better health and safety outcomes for workers, as our research findings show.

"High heat makes everyday mistakes like slips, trips, and falls more likely, and everyday hazards more deadly," says Jordan Barab, former Deputy Assistant Secretary for OSHA at the Department of Labor. "Though we often miss heat effects when giving a cause of death or injury, heat standard legislation can be effective ways to protect workers from that."

Not all heat standards are created equal or adequately address the dangers facing the labor force as does the one in California. Barab, for example, refers to the recent Nevada heat standard as "much ado about little" because it lacks a specified temperature threshold to trigger enforcement mechanisms.[12] And even in California, where the law is relatively strong, Governor Gavin Newsom vetoed legislation that would have made it easier for laborers to file workers' compensation claims when they develop a heat-related injury and the employer fails to comply with the heat standard.[13] Conversely, employers are incentivized to break the law, if obeying it exceeds the cost of the paltry fines that OSHA typically imposes on the occasions when it finds violations.[14]

Conclusion

Extreme heat poses an increasing threat to worker safety that needs urgent political action. Unions have long led the movement for safer working conditions and are necessary to enforce any federal or state legislation or regulation that safeguards workers in hot environments. As the

[11] Weiner, Peter H and Ira J Klein (2015). *Revisions to California's heat Illness Prevention Standard to take effect on May 1, 2015 | Paul Hastings LLP*. https://www.paulhastings.com/insights/client-alerts/revisions-to-californias-heat-illness-prevention-standard-to-take-effect-on-may-1-2015
[12] Barab, J. (2024, December 17). *Nevada's Heat Standard: Much Ado About Little*. Confined Space. https://jordanbarab.com/confinedspace/2024/12/17/nevadas-heat-standard-much-ado-about-little/
[13] Plevin, R. (2024, September 30). Newsom vetoes bill intended to enforce heat rules for farmworkers - Los Angeles Times. *Los Angeles Times*. Available here: https://www.latimes.com/california/story/2024-09-28/gavin-newsom-vetoes-bill-intended-to-enforce-heat-safety-rules-for-california-farmworkers
[14] Constible, Juanita. (2023b, March 14). *California lessons for federal & state workplace heat rules*. For: National Resources Defense Council. Available here: https://www.nrdc.org/bio/juanita-constible/california-lessons-federal-state-workplace-heat-rules

planet warms at an alarming pace, we need commonsense rules that are rigorous and enforceable to protect workers and save lives.

This research shows that targeted legislation can make a life-or-death difference. The revised California heat standard, with more specific and enforceable regulations, achieved a 43 percent decrease in deaths relative to the average county that reported deaths related to outdoor work from 2001 through 2020. The health and economic costs associated with working in extreme heat demand that we pass federal legislation to protect workers. Luckily, commonsense protections—water, shade, and rest—are easy for management to execute and effective at improving working conditions, especially when they are enforced.