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Climate Change and Occupational Health: Can We Adapt?

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POLICY BRIEF

Climate Change and Occupational Health: Can We Adapt?

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BRIEF HIGHLIGHTS

- *In many settings, people have demonstrated capacity for substantial adaptation to regular exposure to extreme temperatures.*
- *Workers laboring outdoors and away from air conditioning may not be able to avoid adverse health effects of extreme temperatures.*
- *Hot days have more severe effects in warmer climates than in cooler climates.*
- *Avoiding exposure to extreme temperatures appears to be easier for workers when extreme temperatures are rare.*
- *The adverse effects of high temperatures on workers may grow as high temperatures become more common.*

For additional details, see the full working paper, *Climate Change and Occupational Health: Are There Limits to Our Ability to Adapt?* #19-299, at https://research.upjohn.org/up_workingpapers/299/.

The greenhouse gases accumulating in the earth's atmosphere are poised to raise global temperatures considerably in a relatively short period of time. While using air conditioning and limiting outdoor exposure may help mitigate the adverse effects of high temperatures, these approaches are not feasible in all situations. In particular, the hundreds of millions of workers around the world exposed to outdoor temperatures as part of their jobs may face additional adaptation challenges relative to the rest of the population. Despite considerable attention devoted to understanding the impact of temperature on a variety of outcomes and behaviors, little is currently known about the effect of temperature on workers' health.

I assess the effect of temperature on occupational health by combining worker injury and illness reports with weather information at daily frequencies. I find that both high and low temperatures have adverse effects on occupational health. In contrast to research on temperature and mortality, I find no evidence that the ability to adapt to high temperatures has led to hot days having less severe effects on occupational health in warm climates. Instead, I find that hot days have more severe effects in warm climates, which suggests that avoidance practices may be easier when extreme temperatures are rare. In essence, construction workers in states like Michigan and Wisconsin can avoid working or avoid doing their most dangerous work on the rare day above 95°F degrees. But in states like Arizona or Texas, days over 95°F are common, and working on these days cannot be avoided.

To determine how avoiding extreme temperatures may relate to the differential occupational health effects I find, I examine the effect of temperature on weekly hours worked in temperature-exposed jobs. The results indicate that high temperatures reduce hours more in cooler climates, and low temperatures reduce hours more in warmer climates. This pattern is consistent with greater difficulty in avoiding temperature extremes helping explain why hot days are more harmful to occupational health in warm climates.

These findings highlight that the ease of adapting to high temperatures varies across settings. Much research finds that people in warm climates have been able to adapt to regularly being exposed to high temperatures. The ability to adapt means that using current estimates of the effects of temperature likely overstates some costs of climate change. But my study suggests that workers who labor outdoors may face additional challenges in adapting to high temperatures relative to the rest of the population. The adverse effects of high temperatures on workers may grow as high temperatures become more common.

Construction workers in Michigan and Wisconsin can avoid their most dangerous work on the rare day when the temperature soars above 95°F. But in Arizona or Texas, days over 95°F are common, and working on these days cannot be avoided.

Possible Effects of Temperature on Occupational Health and Unknown Capacity for Mitigation

Extreme temperatures can push the body's core temperature outside of healthy ranges. High temperatures can increase heart and respiratory rates, reduce blood pressure, and damage internal organs, which can lead to sunstroke, syncope, cramps, exhaustion, and fatigue, as well as acute cardiovascular and respiratory failure. As fatigue is often a contributing factor for injuries, high temperatures also have the potential to increase injury rates. Cold temperatures cause veins and arteries to narrow, blood to become more viscous, and the body to lose heat, which depletes energy. The direct adverse effects of cold temperatures include frostbite and hypothermia. As cold weather causes muscles to tighten and restricts blood flow, cold temperatures can lead to muscle strains and sprains as well as other injuries. At temperatures below 32°F, ice may form, which may increase the prevalence of falls or motor vehicle accidents.

While both high and low temperatures have adverse health effects, people have demonstrated a substantial capacity to adapt to their climates. Research has found that hot days have less severe effects in warmer climates than in cooler climates, largely because the higher frequency of hot days in warmer climates has led to greater investments in air cooling technology in these places.

Two factors, however, complicate mitigation efforts for workers, especially those laboring outside. First, since air conditioning, of course, doesn't work outdoors, there are currently no widely available technological solutions to protect workers from extreme hot temperatures. Second, workers may find it more difficult to avoid temperature extremes than nonworkers: construction workers, police, and letter carriers, among others, often have fixed schedules that require them to work outside regardless of the elements. Thus, it is unclear that workers will be able to mitigate the adverse health effects of extreme temperatures.

Approach and Findings of Study

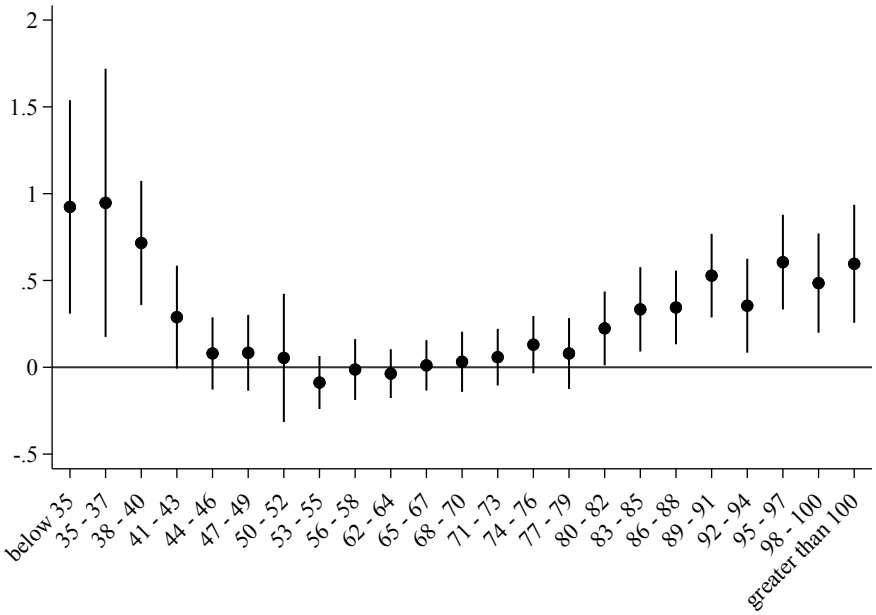
To assess the effects of temperature on occupational health, I construct two data sets with occupational health outcomes matched to weather information. The first draws on workers' compensation administrative data from Texas and consists of daily metropolitan-area claim rates matched to daily weather data from the National Climatic Data Center. To consider the effects of temperature on occupational health for climates outside of Texas, a relatively hot state, I also use data on injuries and illnesses from the mining industry that measure daily injury rates for various outdoor, above-ground mining sites across the United States, along with the weather experienced at the site each day.

After controlling for seasonality and fixed differences across metropolitan areas, I estimate the effect of temperature on occupational health measures through plausibly random, short-run fluctuations—abnormally hot or cold days. Using the Texas data set, I find evidence that both high and low temperatures are detrimental to workers' health (see Figure 1). A day with a high temperature of between 86°F and 88°F increases claim rates over the next three days by 2.1 to 2.8 percent relative to a day with a high temperature of between 59°F and 61°F. A day with a high temperature of over 100°F increases three-day claim rates by 3.5 to 3.7 percent. Cold temperatures are at least as injurious. A day with a high temperature of under 35°F increases three-day claim rates by 3.4 to 5.8 percent relative to a day with a high temperature of between 59°F and 61°F.

While extreme temperatures have long been thought to affect occupational health through creating conditions in which illnesses can arise, the impact of temperatures on injuries has received little attention beyond speculation. However, the estimates from the current study indicate that all of the increased claims from low temperatures and approximately 80 percent of the increased claims from high temperatures are for injuries. Focusing solely on illnesses typically thought of as temperature-related may thus severely understate the total effect of temperature on workers' health.

Focusing solely on temperature-related illnesses severely understates the total effect of temperature on workers' health by neglecting temperature's large effects on injury rates.

Figure 1 The Effect of Temperature on Workers' Compensation Claims per 100,000 Workers



NOTE: The graph displays estimates of the effect of temperature on workers' compensation (WC) claim rates along with 95-percent confidence intervals. All estimates are relative to when daily high temperatures are between 59°F and 61°F. The sample includes 154,968 observations, where each observation is a metropolitan area-day. The underlying workers' compensation claim data are from Texas between 2006 and 2014 and contain 1,916,590 individual claims.

With the mining data, I test for heterogeneous effects of temperature based on a site's temperature norms. Whereas adaptation and acclimation hypotheses would predict that the adverse effects of a hot day would be smaller in warmer climates, the estimates from the mining analysis suggest that a hot day has more detrimental effects on occupational health in warmer climates than in cooler climates (see Figure 2).

These results provide strong evidence that extreme temperatures affect occupational health. While people have been able to adapt to high temperatures through air conditioning, many workers have not been as fortunate. Instead, finding that hot days are more harmful in warmer climates suggests that the potential for workers to avoid extreme temperatures may be more limited in places where such temperatures are common.

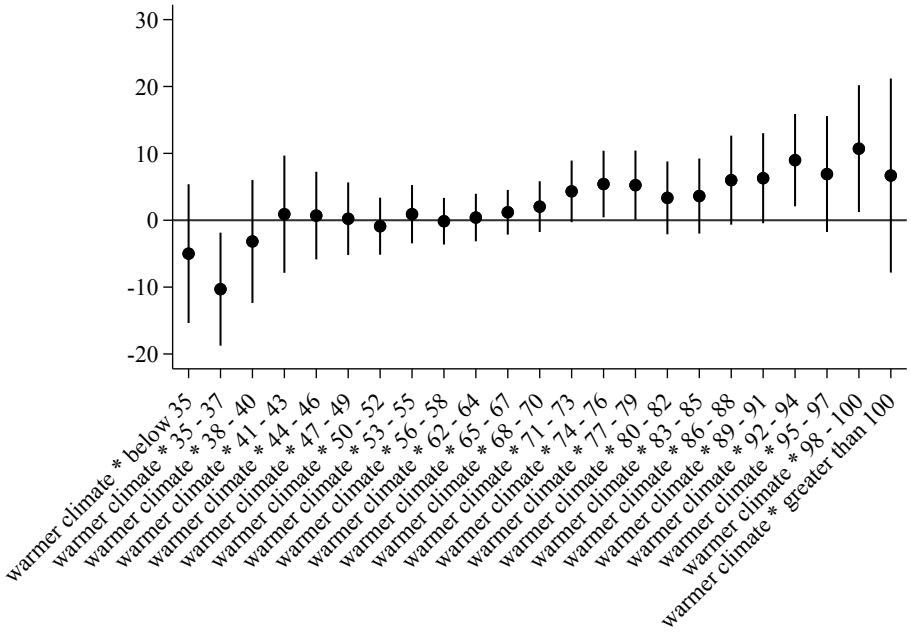
I explore this possibility using data on weekly hours worked from the monthly Current Population Survey. Again controlling for seasonality and fixed differences across metropolitan areas, I find that hot (or cold) days have different impacts on work hours for temperature-exposed workers depending on whether the prevailing climate is warmer or cooler. An additional day above 90°F decreases weekly hours worked more in cooler climates than in warmer climates, while an additional day with a high below 40°F decreases weekly hours worked more in warmer climates than in cooler climates. Thus, workers may better be able to avoid rare extreme temperatures than common extreme ones.

Implications

These results are relevant for assessing the costs of climate change, as they indicate that the health effects of extreme temperatures extend beyond the commonly hypothesized illnesses to also include injuries. Although research has shown that people

Workers who labor outdoors may face additional challenges in adapting to high temperatures relative to the rest of the population.

Figure 2 The Differential Effect of Temperature on Injuries per 100,000 Workers for Sites in Warmer Climates



NOTE: The graph displays estimates of the effect of temperature on WC claim rates, along with 95-percent confidence intervals, for warmer-climate areas relative to colder-climate areas, and relative to the base differential between areas when the daily high temperatures are between 59°F and 61°F. The sample includes 2,615,672 site-days. The underlying injury data come from Mining Safety and Health Administration logs between 2006 and 2014 and contain information on 13,013 injuries.

can adapt to warmer climates—suggesting that current estimates of damages from high temperatures likely overstate some costs of climate change—the results from this study highlight that workers who have to be outside as part of their jobs may face additional challenges in adapting to high temperatures.

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