NATIONAL SAFETY COUNCIL

Position/Policy Statement
Extreme Temperatures

Policy/Position

Occupational heat stress and cold stress are serious workplace issues affecting thousands of indoor and outdoor workers each year. In addition to serious illness, exposure to excess heat or cold can result in a serious work-related injury, illness, or fatality. The National Safety Council (NSC) supports employer, government, and researcher actions to prevent and/or mitigate heat and cold-related illness, injuries, and exposures. NSC believes:

1. The Occupational Safety and Health Administration (OSHA) should develop and establish an enforceable performance-based federal heat-related illness standard. At a minimum that standard should include:
    a. Establishment of a series of heat indices that can be used as permissible exposure limits (PELs) in different parts of the country
    b. Provide information on how to prepare for heat waves and how to recognize and respond to heat-related illness, and how to protect workers from heat-related illness
    c. Require employers to conduct an assessment of both the outdoor and indoor work environment for the impact of heat employees, and based upon the assessment, establish a plan to protect workers from experiencing a heat-related illness. Elements of the plan should include:
        i. Establish a heat acclimatization plan for new and returning workers
        ii. Designate a site competent person to oversee the heat-related illness prevention program
        iii. Determine the heat index for the work environment
        iv. Use the hierarchy of controls to reduce the risk of heat-related illness
        v. Train managers and workers on the hazards of heat and the heat illness prevention program
        vi. Provide medical surveillance for employees covered by the heat prevention program
        vii. Establish an emergency action plan in the event of a heat related incident

2. U.S. OSHA should develop and establish an enforceable federal cold stress standard that requires employers and their workers to assess cold-related working conditions and based on that assessment will require employers to:
    a. Establish a written cold stress prevention program and emergency action plan for workers experiencing cold-related illness

b. Designate a site competent person to oversee the cold-related illness prevention program
c. Use the hierarchy of controls to reduce the risk of cold-related illness
d. Train managers and workers on the hazards of cold and the cold-related illness prevention program
e. Provide medical monitoring and equipment monitoring for employees

3. All employers should establish a written heat-related illness prevention program and emergency action plan to respond to and report any signs/symptoms of heat-related illness. The written program should include:
    a. An assessment of both outdoor and indoor work environment for the impact of heat on their employees and based upon the assessment, establish a heat-related illness prevention program and implement an emergency action plan for workers experiencing a heat-related illness
    b. A designated site or organizational competent person to oversee the program
    c. An established heat index based upon temperature, humidity, and the amount of direct sunshine that would trigger the program implementation
    d. A formal acclimatization plan for new employees and current employees at the start of hotter months as well as a formal acclimatization plan for returning workers such as those who had extended absences and need to undergo re-acclimatization.
    e. Ensured access to nearby potable water, scheduled and frequent rest periods during the workday, shade for outdoor work environments, and air circulation for indoor work environments
    f. Worker training on heat-related illness prevention, recognition, and reporting
    g. Medical monitoring programs, with consideration to preplacement and periodic medical evaluations
    h. An emergency response plan for any heat-related events such as first aid and emergency action plan (EAP)

4. All employers should establish a written cold stress prevention program and emergency action plan. The written program should include:
    a. Worker training on cold-related illness prevention, recognition, and reporting
    b. Ensured access to warm liquids, warm areas for use during break periods, and wind-protective clothing based on wind speed, and prompt medical attention to workers who show signs of cold-related illness or injury
    c. Schedules designed to reduce the time workers spend in the cold environment and reduce the physical demands during cold exposure
    d. Medical monitoring to ensure worker health and protection

5. More federal funding and research to be allocated to:
    a. Developing improved and accessible technology for employers to determine heat risk for their employees. This should include the development of apps and wearables.
    b. Assessing the extent of long-term changes in temperature and the impact on heat-exposure hazards for workers, especially with regard to severity, prevalence, and distribution.

6. Employers should develop and implement cold stress prevention and cold-related injury emergency action plans.

7. City, county, and state health departments and emergency services should be encouraged to build systems that ensure complete and accurate reporting of heat-related illness and cold-related illness once parameters of what constitutes an event are established. Local health departments should report findings for federal data collection and analytics, including if a person was at work when the event occurred. Health departments and emergency services should implement heat response plans that include:
    a. Identifying at-risk neighborhoods and populations
    b. Opening cooling centers during heat waves
    c. Using data to guide public health policy and action to protect communities, especially among disproportionately affected populations.

Background

Heat Stress

Heat is the leading weather-related killer in the United States,[1] causing approximately 700 heat-related deaths (work-related and non-work related) in the United States on average each year.[2] A 2021 study found that hotter temperature increases workplace injuries significantly, including increased risk of traumatic injuries like falling from height, causing approximately 170,000 additional injuries nationwide and 20,000 additional injuries per year in California alone.[3] From 1992 to 2017, exposure to excessive environmental heat at the workplace killed 815 U.S. workers and seriously injured almost 70,000 U.S. workers.[4] In South Asia, the annual number of fatal cases of occupational heat stress is projected to increase from 14,000 in 1975 to 23,000 in 2030, and to 41,000 by 2050.[5]

Across the contiguous United States, hot summer temperatures have become more common and heat waves have become more frequent and intense,[6] and these trends are expected to continue.[7] Days with high temperatures between 85 and 90 degrees Fahrenheit led to a 5 to 7 percent increase in same-day injury risk.[8] A day above 100 degrees Fahrenheit leads to a 10 to 15 percent increase in same-day injury risk.[9] Much of the U.S. South has already seen the

[1] https://www.epa.gov/sites/default/files/2016-08/documents/print_heat-deaths-2016.pdf
[2] Vaidyanathan A, Malilay J, Schramm P, Saha S. Heat-related deaths—United States, 2004–2018. MMWR Morb Mortal Wkly Rep 2020;69:729–34. https://doi.org/10.15585/mmwr.mm6924a1external icon PMID:32555133external icon
[3] https://ucla.app.box.com/s/14m6pj1algt7rwb8ihq4lyqjhm2ueejj
[4] https://www.google.com/url?client=internal-element-cse&cx=013738036195919377644:6ih0hfrgl50&q=https://www.bls.gov/iif/sqt/fatal-heat-exposure.xlsx&sa=U&ved=2ahUKEwjv2e6747XyAhWWFlkFHdIiCkMQFjAAegQICRAB&usg=AOvVaw0kLkRnTTzTiqU4esVYma8u
[5] https://climatechip.org/sites/default/files/publications/TP2014_4_Occupational_Heat_Stress_WHO.pdf
[6] https://www.epa.gov/sites/default/files/2016-08/documents/print_heat-deaths-2016.pdf
[7] Ibid
[8] https://ucla.app.box.com/s/14m6pj1algt7rwb8ihq4lyqjhm2ueejj
[9] Ibid

number of days above 90 degrees Fahrenheit double since 1980,[10] and it is expected to experience at least 50 more days above 90 degrees Fahrenheit per year by 2040-2050.[11]

Heat waves in major U.S. cities are three times more common than they were in the 1960s,[12] and the average annual heat wave season is 47 days longer than it was in the 1960s.[13] During May and June 2021, the Department of Health and Human Services (HHS) Region 10 (Washington, Oregon, Idaho, Alaska) had 3,504 heat-related illness emergency department visits, with heat-related illness emergency department visits in June more than seven times higher than that in June 2019.[14]

In a warm to hot environment, especially when physically active, the human body relies on its ability to get rid of excess heat (i.e., heat dissipation) to maintain a healthy internal body temperature. Heat dissipation happens naturally through sweating and increased blood flow to the skin. Workers cool down more rapidly if the environmental heat and physical activity (metabolic heat) are reduced. Wearing personal protective equipment (PPE) for protection from other hazards like chemical or biological exposures and some types of clothing can also increase the total heat burden the worker experiences.[15] If heat dissipation does not happen quickly enough, the internal body temperature keeps rising and the worker may experience symptoms that include thirst, irritability, a rash, cramping, heat exhaustion, or heat stroke. Heat-related illness can manifest in several conditions:

Heat Stroke - Heat stroke is the most severe form of heat-related illness. It occurs when the body cannot control its temperature such that temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.[16] When heat stroke occurs, body temperature can rise to 106°F or higher within 10 to 15 minutes.[17] Workers suffering from heat stroke experience mental dysfunction such as unconsciousness, confusion, disorientation, slurred speech, and/or death.[18] Heat stroke can cause death or permanent disability if emergency treatment is not given.[19] Symptoms of heat stroke include: [20]

- Confusion, altered mental status, slurred speech
- Loss of consciousness (coma)
- Hot, dry skin or profuse sweating
- Seizures
- Very high body temperature
- Death if treatment is delayed

Heat Exhaustion - Heat exhaustion is the body's response to an excessive loss of water and salt, usually through excessive sweating. Workers most prone to heat exhaustion are those who

[10] Reidmiller, DR, CW Avery, DR Easterling, KE Kunkel, KLM Lewis, TK Maycock, BC Stew-art, Donald J Wuebbles, David W Fahey, and Kathy A Hibbard (2018), "Impacts, risks, and adaptation in the united states: Fourth national climate assessment, volume."USGlobal Change Research Program, Washington, DC, USA.
[11] Ibid
[12] https://www.epa.gov/climate-indicators/climate-change-indicators-heat-waves
[13] Ibid
[14] https://www.cdc.gov/mmwr/volumes/70/wr/mm7029e1.htm?s_cid=mm7029e1_w
[15] https://www.cdc.gov/niosh/topics/heatstress/heat_burden.html
[16] https://www.cdc.gov/niosh/topics/heatstress/heatrelillness.html
[17] Ibid
[18] https://www.osha.gov/heat-exposure
[19] https://www.cdc.gov/niosh/topics/heatstress/heatrelillness.html
[20] Ibid

are over the age of 65, overweight, working in a hot environment, and have underlying medical conditions, especially high blood pressure or take certain medications.[21] Symptoms of heat exhaustion include: [22]

- Headache
- Nausea
- Dizziness
- Weakness
- Irritability
- Thirst
- Heavy sweating
- Elevated body temperature
- Decreased urine output

Rhabdomyolysis – Rhabdomyolysis is a complex medical condition that can occur after prolonged physical exertion in the heat, resulting in the rapid breakdown, rupture, and death of muscle.[23] When muscle tissue is injured in this manner, electrolytes and large proteins are released into the bloodstream that can cause irregular heart rhythms, seizures, and damage the kidneys.[24] Rhabdomyolysis can range from mild disease with little to no symptoms to medical emergencies. Prompt identification of rhabdomyolysis is important in preventing long term complications.[25] Symptoms of rhabdomyolysis may include: [26]

- Muscle cramps/myalgia/pain
- Abnormally dark (tea or cola-colored) urine
- Weakness
- Exercise intolerance

Heat Syncope - Heat syncope is a fainting episode or dizziness that usually occurs with prolonged standing or sudden rising from a sitting or lying position.[27] Dehydration and lack of acclimatization can both contribute to heat syncope. Symptoms of heat syncope include: [28]

- Fainting (short duration)
- Dizziness
- Light-headedness during prolonged standing or suddenly rising from a sitting or lying position

Heat Cramps - Heat cramps usually affect workers who sweat a lot during strenuous activity.[29] This sweating depletes the body's salt and moisture levels, causing painful cramps.[30] Heat cramps may also be a symptom of heat exhaustion. Symptoms of heat cramps include: [31]

- Muscle cramps
- Pain or spasms in the abdomen, arms, or legs

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[21] Ibid
[22] Ibid
[23] Ibid
[24] https://www.cdc.gov/niosh/topics/heatstress/heatrelillness.html
[25] John M. Sauret, MD and George Marinides, MD and Gordon K. Wang, MD Am Fam Physician 2002 Mar 1;65(5):907-913
[26] https://www.cdc.gov/niosh/topics/heatstress/heatrelillness.html
[27] Ibid
[28] Ibid
[29] Ibid
[30] Ibid
[31] Ibid

Heat Rash - Heat rash is a skin irritation caused by excessive sweating during hot, humid weather.[32] Heat rash may look like a red cluster of pimples or small blisters as sweat gets trapped under the skin or can present as an itchy bumpy red rash. Heat rash on darker skin may look gray or white and not red. Heat rash may appear around the neck, upper chest, groin, in breast folds, and elbow creases or can be more diffuse. Complications of heat rash can be secondary cutaneous infections.[33]

Working both indoors and outdoors can place workers at risk for heat-related illness during any season if the conditions are right, not only during heat waves.[34] Industries in which workers have suffered heat-related illness include but are not limited to:[35]

- Outdoors - Agriculture, construction (especially, road, roofing, and other outdoor work), landscaping, mail and package delivery, oil and gas well operations, for example.
    - While construction workers are only 6 percent of the American workforce, they account for 36 percent of all occupational heat-related deaths.[36]
- Indoors - Bakeries, kitchens, and laundries (sources with indoor heat-generating appliances), electrical utilities (particularly boiler rooms), fire service, iron and steel mills and foundries, truck driving, manufacturing with hot local heat sources, like furnaces (e.g., paper products or concrete), and warehousing, for example.
    - A well-insulated truck can become dangerously hot in the summer heat when the air conditioner is turned off.[37]

There are environmental and occupational risk factors for heat-related illness, including heavy physical activity, warm or hot environmental conditions, high humidity, exposure to radiant heat, lack of acclimatization, and wearing PPE or clothing that holds in body heat.[38] Heat also increases the risk of workplace injuries, such as those caused by sweaty palms, fogged-up safety glasses, and dizziness.[39] Claims for many injuries not typically considered heat-related rise on hotter days including injuries caused by falling from heights, being struck by a moving vehicle, or mishandling dangerous machinery.[40]

Personal risk factors (e.g. pre-existing health conditions and lifestyle) also relate to and can contribute to heat-related illness.

- Workers who are more susceptible to heat-related illness can have personal risk factors that include medical conditions, lack of physical fitness, and previous episodes of heat-related illness. Measurement of heart rate, body weight, or body temperature (physiologic monitoring) can provide individualized data to aid decisions about heat controls.[41]

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[32] Ibid
[33] Ibid
[34] https://www.osha.gov/heat-exposure
[35] Ibid
[36] https://www.politico.com/news/2021/08/08/osha-climate-change-effects-workforce-heat-impact-501744?nname=playbook&nid=0000014f-1646-d88f-a1cf-5f46b7bd0000&nrid=0000014e-eede-d0b3-a35f-ffff0fcd0000&nlid=630318
[37] https://www.drivinghealthy.org/eatingandlivinghealthy/focus-on-wellness/heat-smart/
[38] https://www.osha.gov/heat-exposure
[39] https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf?id=10.26616/NIOSHPUB2016106
[40] https://ucla.app.box.com/s/14m6pj1algt7rwb8ihq4lyqjhm2ueejj
[41] https://www.osha.gov/heat-exposure

- Heat disorders occur more frequently among obese and overweight individuals.[42]
- Drugs including cocaine, alcohol, and prescription drugs impact heat-related illness. Some adults may also be using prescription drugs that affect their capability to thermoregulate or that block nerve impulses,[43] both of which increase vulnerability to thermal extremes.

Lower-wage workers are more likely to work in dangerous occupations, to live and work in places with greater heat exposure, and to experience larger marginal increases in risk on hotter days.[44] As a result, heat-related injuries are far greater for these groups. [45] The annual effect is five times larger for someone from the bottom quintile of the residential income distribution, than for someone from the top quintile of the residential income distribution. [46]

Race/ethnicity, age, and gender may also impact the effect of heat on an individual. Jobs at the highest risk of heat-related illness and death are disproportionately held by workers of color. Latinos/Latinas experience elevated rates of heat-related mortality and experience underreporting of morbidity and mortality due to the number of undocumented workers in at-risk occupations such as agriculture and construction.[47]

Studies also show that the effect of heat on injuries is significantly larger for men relative to women, but that women face additional risk when pregnant.[48] Older adults also face a higher risk of suffering from heat disorders.[49] The majority (83.1%) of heat stress hospitalizations among the general population occur among persons aged older than 35 years, and especially among persons aged older than 65 years (approximately 43.0%).[50]

Cold Stress

More than 19,000 Americans have died from cold-related causes since 1979, with U.S. death rates in winter months 8 to 12 percent higher than in non-winter months.[51] Between 2006 and 2010, 63% of all weather-related deaths were attributed to exposure to excessive natural cold, hypothermia, or both.[52]

Below freezing conditions combined with inadequate clothing and temperatures in the 50's coupled with rain and/or wind can bring about cold stress.[53] Cold stress occurs when the body and skin temperatures decline.[54] When the body is unable to warm itself, serious cold-related

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[42] https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf

[43] Sarofim, M.C., S. Saha, M.D. Hawkins, D.M. Mills, J. Hess, R. Horton, P. Kinney, J. Schwartz, and A. St. Juliana, 2016: Ch. 2: Temperature-Related Death and Illness. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. U.S. Global Change Research Program, Washington, DC, 43–68.

[44] https://ucla.app.box.com/s/14m6pj1algt7rwb8ihq4lyqjhm2ueejj

[45] Ibid

[46] Ibid

[47] R. C. Luginbuhl, D. N. Castillo, and K. A. Loringer, "Heat-Related Deaths Among Crop Workers—United States, 1992–2006," Morbidity and Mortality Weekly Report 57, no. 24 (2008): 649–653, esp. 651

[48] https://ucla.app.box.com/s/14m6pj1algt7rwb8ihq4lyqjhm2ueejj

[49] Serafin WE [1996]. Drugs used in the treatment of asthma. In: Hardman JG, Limbird LE, Molinoff PB, Ruddon RW, Gillman AG, eds. Goodman & Gilman's The pharmacologic basis of therapeutics. 9th ed. New York: McGraw-Hill.

[50] https://www.cdc.gov/mmwr/preview/mmwrhtml/ss6313a1.htm

[51] https://www.epa.gov/climate-indicators/climate-change-indicators-cold-related-deaths

[52] https://www.cdc.gov/nchs/data/nhsr/nhsr076.pdf

[53] Ibid

[54] https://ehs.research.uiowa.edu/occupational/cold-stress

illnesses and injuries may occur, including permanent tissue damage and death.[55] Four factors contribute to cold stress: cold temperatures, high or cold wind, dampness and cold water. [56] A cold environment forces the body to work harder to maintain its core temperature. Cold-related illness can manifest in several conditions:

Hypothermia - Prolonged exposure to cold temperatures causes the body to lose heat faster than it produces heat, eventually using up the body's stored energy. This process results in hypothermia or abnormally low body temperature. [57] A body temperature that is too low affects the brain causing disorientation or uncoordinated movement. Thus, a person may not know or understand the effect on their body and mind and will be unable to do anything about it. [58] Symptoms of hypothermia include:[59]

- Early Symptoms
    - Shivering
    - Fatigue
    - Loss of coordination
    - Confusion and disorientation
- Late Symptoms
    - No shivering
    - Blue skin
    - Dilated pupils
    - Slowed pulse and breathing
- Loss of consciousness
    - Death

Cold water immersion is similar to cold stress, but it causes a specific type of hypothermia called immersion hypothermia. Immersion hypothermia develops much more quickly than standard hypothermia because water absorbs heat from the body 25 times faster than air. [60]

Frostbite - Frostbite is an injury to the body that is caused by freezing, most commonly affecting the nose, ears, cheeks, chin, fingers, or toes.[61] Frostbite causes a loss of feeling and color in the affected areas which can permanently damage body tissues, and severe cases can lead to amputation.[62] In extremely cold temperatures, the risk of frostbite is increased in workers with reduced blood circulation and among workers who are not dressed properly. [63] Symptoms of frostbite include:[64]

- Reduced blood flow to hands and feet (fingers or toes can freeze)
- Numbness
- Tingling or stinging
- Aching
- Bluish or pale, waxy skin

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[55] Ibid
[56] Ibid
[57] https://www.cdc.gov/niosh/topics/coldstress/coldrelatedillnesses.html
[58] Ibid
[59] Ibid
[60] https://www.cdc.gov/niosh/topics/coldstress/coldwaterimmersion.html
[61] Ibid
[62] Ibid
[63] Ibid
[64] Ibid

Workers in industries that use liquid nitrogen and dry ice are potentially at risk for frostbite as a result of handling and using these materials.[65] Wearing protective clothing such as insulated gloves and aprons and face protection for handling these materials and avoiding other types of clothing like open-toed shoes, dresses, or shorts provide protection.

Trench Foot – Also known as immersion foot, trench foot is an injury of the feet resulting from prolonged exposure to wet and cold conditions.[66] Because wet feet lose heat 25 times faster than dry feet, trench foot can occur at temperatures as high as 60 degrees Fahrenheit if the feet are constantly wet.[67] To prevent heat loss, the body constricts blood vessels to shut down circulation in the feet, causing skin tissue to die because of lack of oxygen and nutrients and due to the buildup of toxic products.[68] Symptoms of trench foot include: [69]

- Reddening of the skin
- Numbness
- Leg cramps
- Swelling
- Tingling pain
- Blisters or ulcers
- Bleeding under the skin
- Gangrene (the foot may turn dark purple, blue, or gray)

Chilblains - Chilblains are caused by the repeated exposure of skin to temperatures just above freezing to as high as 60 degrees Fahrenheit. The cold exposure causes permanent damage to the capillary beds (groups of small blood vessels) in the skin such that redness and itching will return with additional exposure.[70] The redness and itching typically occurs on cheeks, ears, fingers, and toes. Symptoms of chilblains include: [71]

- Redness
- Itching
- Possible blistering
- Inflammation
- Possible ulceration in severe cases

Cold temperatures can also worsen pre-existing medical conditions such as cardiovascular and respiratory diseases.[72] Death rates from heart attacks increase as temperatures drop as a result of the way cold affects blood circulation, blood vessels, and other factors.[73] Cold-related conditions can also worsen preexisting musculoskeletal injuries.[74] People who have previously experienced frostbite, sedentary workers, and those with poor circulation may be especially

[65] https://www.cdc.gov/mmwr/preview/mmwrhtml/su6101a1.htm
[66] https://www.cdc.gov/niosh/topics/coldstress/coldrelatedillnesses.html
[67] Ibid
[68] Ibid
[69] Ibid
[70] Ibid
[71] Ibid
[72] https://www.epa.gov/climate-indicators/climate-change-indicators-cold-related-deaths
[73] Ibid
[74] Ibid

susceptible to cold-related illness.[75] Ice, sleet, and snow also contribute to cold-related occupational injuries. In 2017, there were 20,460 ice, sleet, and snow-related injuries.[76] Certain population groups are at higher risk of cold-related illness. People who work outdoors during winter months, such as agricultural workers, construction workers, ski resort workers, and electricity and pipeline utility workers, face higher risks of exposure to cold.[77] For outdoor workers, what constitutes cold stress can also vary across different areas of the country. In regions where workers are unaccustomed to winter weather, near freezing temperatures are considered factors for cold stress.[78] According to the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV), workers should be protected from exposure to cold so that the deep core temperature does not fall below 96.8°F (36°C) and to prevent frostbite to body extremities.[79]

Older adults, infants, people with pre-existing medical conditions, homeless people, those with inadequate winter clothing or home heating, people taking medications or using drugs (especially alcohol) are also more susceptible to cold effects.[80] There is a substantial increase in the death rate for persons aged 75–84, and an even larger increase in the rate for persons aged 85 and over. [81] Non-Hispanic black persons also have increased risk of cold-related mortality compared with non-Hispanic white persons,[82] and cold-related mortality is increased for counties in the lower three income quartiles.[83]Cold-related death rates in the lowest median household income quartile were approximately two times as high as those for counties in the highest quartile.[84]

Unusually cold winter temperatures have become less common across the contiguous 48 states in recent decades.[85] As this trend continues, winter warming is expected to reduce the number of direct cold-related deaths, but the decrease is projected to be smaller than increases in heat-related deaths.[86]

Employer Action

Heat Stress

OSHA conducted a study of its citations issued between 2012 and 2013 that included 20 cases of heat-related illness or death of workers.[87] They found that cases were more prevalent when employers had no heat-related illness prevention program, or programs were deficient, and that

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[75] https://www.cdc.gov/niosh/docs/wp-solutions/2019-113/pdfs/2019-113.pdf?id=10.26616/NIOSHPUB2019113
[76] https://www.bls.gov/opub/ted/2019/ice-sleet-and-snow-related-occupational-injury-and-illness-rate-down-in-2017.htm
[77] Sarofim, M.C., S. Saha, M.D. Hawkins, D.M. Mills, J. Hess, R. Horton, P. Kinney, J. Schwartz, and A. St. Juliana. 2016. Chapter 2: Temperature-related death and illness. In: The impacts of climate change on human health in the United States: A scientific assessment. U.S. Global Change Research Program. https://health2016.globalchange.gov.
[78] https://www.cdc.gov/niosh/docs/wp-solutions/2019-113/pdfs/2019-113.pdf?id=10.26616/NIOSHPUB2019113
[79] Ibid
[80] https://www.epa.gov/climate-indicators/climate-change-indicators-cold-related-deaths#ref4
[81] https://www.cdc.gov/nchs/data/nhsr/nhsr076.pdf
[82] Ibid
[83] Ibid
[84] Ibid
[85] https://www.epa.gov/climate-indicators/climate-change-indicators-cold-related-deaths
[86] Sarofim, M.C., S. Saha, M.D. Hawkins, D.M. Mills, J. Hess, R. Horton, P. Kinney, J. Schwartz, and A. St. Juliana. 2016. Chapter 2: Temperature-related death and illness. The impacts of climate change on human health in the United States: A scientific assessment. U.S. Global Change Research Program. https://health2016.globalchange.gov.
[87] https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf?id=10.26616/NIOSHPUB2016106

acclimatization was the program element most commonly missing and most clearly associated with worker death.[88] NSC strongly recommends employers assess both the indoor and outdoor work environment for the potential impact of heat on their employees and based on that assessment, establish a written heat-related illness prevention program or procedure, including acclimatization and an emergency action plan for employers to respond to and report any signs/symptoms of heat-related illness.

Fifty to seventy percent of most outdoor fatalities occur in the first few days of working in warm or hot environments because the body needs to build a tolerance to working in the heat over time through heat acclimatization. Lack of acclimatization is a major risk factor for fatal outcomes.[89] Acclimatized workers are less likely to suffer heat-related illnesses compared to workers who have not been acclimatized.[90] An effective heat acclimatization program gradually increases worker exposure to heat and metabolic workload over a seven to fourteen day period with cooling off and fully rehydrating between shifts.[91] Acclimatization also typically requires at least two hours of heat exposure per day which can be broken into two, one-hour periods.[92] If a worker stops heat exposure for a few days, acclimatization will be maintained, but after about a week away from working in the heat, acclimatization will be lost.[93] Employees who eat regular meals such that food replaces electrolytes lost in their sweat experience better acclimatization.[94] NSC strongly recommends that employers have a formal acclimatization plan for employees working in hot environments.

In addition to acclimatization, NSC recommends employers ensure access to nearby potable water, scheduled, and frequent rest periods during the work day. Shade should be provided for outdoor work environments and for rest periods. Air circulation for indoor and outdoor work environments is also critical during work and with rest periods. Employers often rely on the use of fans, which can be beneficial. Fans, however, should be used in conjunction with advice from a safety and health professional. They may be of limited value if the air speed becomes too great or if the air temperature is greater than approximately 95 °F, as increasing air motion may actually increase heat stress.

Heat-related illness can occur in vehicles, and NSC recommends employers establish effective maintenance programs to ensure air conditioning and cooling units in work vehicles, including commercial long haul trucks with sleeper berths, are operable and reliable.

Workers in the heat for less than 2 hours and/or involved in moderate work activities should drink 1 cup (8 oz.) of water every 15–20 minutes.[95] During prolonged sweating that last several hours, workers should drink sports drinks that provide balanced electrolytes.[96]

Employers must also train their employees to recognize symptoms of heat-related illness and to report signs and symptoms of heat-related illness not only for themselves but also for their

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[88] Ibid
[89] https://www.osha.gov/heat-exposure
[90] Ricketts, M. (2020, June). The Case of the OVERHEATED CONSTRUCTION WORKER. https://www.assp.org/docs/default-source/psj-articles/mtricketts_0620.pdf?sfvrsn=f248bd47_2.
[91] https://www.cdc.gov/niosh/mining/UserFiles/works/pdfs/2017-124.pdf
[92] Ibid
[93] Ibid
[94] Ibid
[95] https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf?id=10.26616/NIOSHPUB2016106
[96] Ibid

coworkers. Effective training includes training on recognition of symptoms and risk, proper hydration, including hydration before and after work, care and use of heat-protective clothing and equipment, effects of various factors (e.g., drugs, alcohol, obesity, etc.) on heat tolerance, the importance of acclimatization, hydration, reporting symptoms, and giving or receiving appropriate first aid.[97] Additionally, employees should be trained about personal risk factors for heat-related illness including underlying health conditions or certain medications may impact risks. Employers should provide all policies and training materials in languages that employees understand and also have accessible thermometers available at the worksite.

NSC recommends employers establish a medical surveillance/monitoring program to help identify potential risks for heat-related illness, including preplacement and periodic medical evaluations, as well as a plan for monitoring workers on the job.[98] Employers should work with a licensed healthcare provider to conduct a comprehensive exam and confidential medical history examination as well as a physical examination.[99] This should include an assessment of the use of therapeutic drugs, over-the-counter medications, supplements, alcohol, or caffeine that may increase the risk of heat injury or illness.[100] An assessment of obesity should include the worker's ability to wear and use PPE.[101] Providing appropriate PPE includes not only ensuring proper PPE for body size, but also ensuring PPE is appropriate for heat conditions by providing auxiliary body cooling and protective clothing (e.g., water-cooled garments, air-cooled garments, cooling vests, and wetted over garments).[102]

Cold Stress

In both indoor or outdoor environments where cold stress is possible, employers and workers should be aware of symptoms of cold-related illness and injury in themselves and their coworkers, and be prepared to immediately notify their supervisor, provide first aid, and seek prompt medical assistance (e.g., call 911). To best prepare workers, cold stress training should be provided in a language and vocabulary workers understand and should include information about:[103]

- Worker risk
- Prevention
- Symptoms
- The importance of monitoring yourself and coworkers for symptoms
- Treatment
- PPE

Employers should also provide workers with warm liquids, warm areas for use during break periods, wind-protective clothing based on air velocities, and prompt medical attention to workers who show signs of cold-related illness or injury.[104] Employers should also add allowances for cold weather clothing (cold weather safety boots, gloves, face coverings, thermal inner wear), and should consider new technology, such as battery-heated jackets. NSC also recommends that employers reduce the time workers spend in the cold environment. This may

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[97] Ibid
[98] https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf?id=10.26616/NIOSHPUB2016106
[99] Ibid
[100] Ibid
[101] Ibid
[102] Ibid
[103] https://www.cdc.gov/niosh/docs/wp-solutions/2019-113/pdfs/2019-113.pdf?id=10.26616/NIOSHPUB2019113
[104] Ibid

involve scheduling cold jobs for warmer parts of the day and, when practical, scheduling maintenance and repair jobs in colder areas for warmer months. NSC also recommends employers reduce the physical demands of workers to prevent cold stress by using relief workers or rotating extra workers in and out of work for long, demanding jobs.

Employers should ensure active monitoring equipment and workers, especially those with increased cold stress risk and should also encourage workers to monitor one another. If using an external heat source powered by petroleum products to counter the cold, employers should also be sure to monitor for carbon monoxide, regardless of working indoors or outdoors. Other recommendations for employers specific to indoor cold work environments include:[105]

- Install equipment to reduce drafts and condensation
- Provide warm water and/or dry air heaters outside cold rooms so that workers can warm their hands
- Minimize air velocity and make sure air velocity does not exceed 200 feet per minute
- Utilize preventative maintenance on a regular schedule and make repairs if heating systems are not working properly
- Rotate employees to different tasks after every break
- Minimize work requiring manual dexterity in cold rooms
- Provide glove alternatives for workers inside cold rooms (e.g., glove liners or fingerless gloves to wear under plastic gloves)

Workers should avoid exposure to extremely cold temperatures when possible. When cold environments or temperatures cannot be avoided, workers should follow these recommendations to protect themselves from cold stress:[106]

- Wear appropriate clothing, especially clothing that protects the ears, nose, face, hands and feet in extremely cold weather
    - Wear several layers of loose clothing to provide better insulation and tight clothing reduces blood circulation
    - Be aware that some clothing may restrict movement resulting in a hazardous situation
    - Footwear should be waterproof and insulated
    - Wear a hat, as it will keep the whole body warmer by reducing the amount of body heat that escapes from the head
    - Avoid wearing wet clothes
- Carry cold-weather gear, such as extra socks, gloves, hats, a jacket, blankets, a change of clothes, and a thermos of hot liquid
- Move into warm locations during work breaks and limit the amount of time outside on extremely cold days
- Avoid touching cold metal surfaces or cold wet surfaces with bare skin
- Include a thermometer and chemical hot packs in first aid kits
- Stay hydrated by drinking warmed fluids, as warm beverages may help increase body temperature
- Stay well nourished by snacking on high carbohydrate foods

[105] Ibid
[106] Ibid

- Learn how to apply cold-related illness training in monitoring signs and symptoms for themselves and others and report concerns to supervisors and medical staff immediately

Research and Technology

The National Institute for Occupational Safety and Health (NIOSH) recommends employers use the Wet Bulb Globe Temperature that measures temperature, humidity, wind speed, sun angle, and cloud cover to assess potential heat stress. However, the National Oceanic and Atmospheric Administration (NOAA) criticizes this measurement for not providing an accurate picture of heat stress in local environments and being expensive for employers to purchase.[107] The National Weather Service (NWS) is conducting research to find more accurate and suitable technology. New technologies such as wearable sensors are especially important for difficult-to-track indoor conditions.[108] NWS also monitors temperature and humidity for its heat stress alert system, but it measures the temperature in the shade as opposed to measuring the temperature in the direct sun.[109]

OSHA and NIOSH have also developed a Heat Safety Tool App that provides protective measures employers can implement based on the heat index, which takes into consideration outside air temperature and relative humidity. Simple apps like this can help employers easily identify dangerous heat conditions and implement necessary measures to protect their employees.

Given the variety of federal resources on this topic and potential shortcomings, NSC recommends more federal funding to conduct research and develop accurate technology for employers to determine heat risk for their employees. More research is also needed to assess the impact of holistic temperature changes on heat-exposure hazards for workers, especially with regard to their severity, prevalence, and distribution.[110] Additionally, NWS, NOAA, NIOSH, OSHA, with input from the newly formed National Advisory Committee on Occupational Safety & Health Heat Illness Prevention Work Group, should be brought together to identify control recommendations for heat indices that should include temperature, humidity, radiant heat, and work load of the employee/s. They should also identify different heat indices for different parts of the country taking into account local climates. This information can help state and federal legislators to provide guidance for employers on heat-exposure standards and for employers to prepare resources for more extreme or prevalent heat waves.

Federal Standard

Heat Stress

Recent literature has pointed to a positive relationship between temperature increases and occupational heat strain.[111] In response to the hazard of heat-related illness, several OSHA State

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[107] https://www.politico.com/news/2021/08/08/osha-climate-change-effects-workforce-heat-impact-501744?nname=playbook&nid=0000014f-1646-d88f-a1cf-5f46b7bd0000&nrid=0000014e-eede-d0b3-a35f-ffff0fcd0000&nlid=630318

[108] Ibid

[109] Ibid

[110] https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf?id=10.26616/NIOSHPUB2016106

[111] https://www.researchgate.net/publication/348647152_The_impacts_of_climate_change_on_occupational_heat_strain_in_outdoor_workers_A_systematic_review

Plan States have implemented standards related to exposure to heat-related illness in the work environment including California, Washington, Oregon, and Minnesota. Despite urging from states and NIOSH, OSHA has not issued any federal standard on heat-related illness.[112] Instead, it relies on its broad requirement for employers to ensure workplaces are safe from recognized hazards (the General Duty Clause) and compliance assistance efforts. OSHA announced on September 20, 2021, that it will begin crafting a standard to protect workers from heat. NSC applauds this effort.

As heatwaves have become more frequent and intense and are expected to continue in this direction,[113] NSC urges OSHA to develop an enforceable federal heat-related illness standard that ensures employers and their workers know how to be prepared for heat waves, and know how to recognize and respond to heat-related illness in order to protect workers. NSC recommends that the federal standard would first establish a formal acclimatization plan for new employees and current employees when work enters the start of hotter months. NSC recommends that the federal heat standard also require the use of multiple heat indices that would trigger the implementation of control requirements to:

- Provide shade in outdoor environments, and air circulation in indoor environments
- Provide rest periods in a cool or shaded location that take into consideration metabolic heat load, radiant heat exposure(s), and clothing and nearby potable water
- Have written procedures outlining steps needed to prevent heat-related illness and support acclimatization specific to workplace locations and characteristics
- Designate a competent person to ensure the program is implemented, carried out, and employees are trained and protected
- Encourage reporting by employees of any signs and symptoms of a heat-related illness
- Respond to signs/symptoms of heat-related illness
- Establish a medical monitoring/surveillance program
- Train employees on heat-related illness
- Develop an emergency action plan
- Utilize recognized alert limits/exposure limits to trigger action.

Cold Stress

OSHA also does not have a specific federal standard that covers working in cold environments. Similar to heat stress, it relies on existing OSHA standards including personal protective equipment and training as well as the General Duty Clause. NSC recommends OSHA develop a federal standard that covers working in cold environments.

In the absence of a federal standard, OSHA in coordination with NIOSH and the NWS should develop a cold index/cold indices to be used with guidelines that an employer can use to implement as part of their cold stress program. Employers with employees potentially exposed to cold stress should develop a cold stress prevention program that includes the following elements:

[112] https://www.politico.com/news/2021/08/08/osha-climate-change-effects-workforce-heat-impact-501744?nname=playbook&nid=0000014f-1646-d88f-a1cf-5f46b7bd0000&nrid=0000014e-eede-d0b3-a35f-ffff0fcd0000&nlid=630318

[113] https://www.epa.gov/sites/default/files/2016-08/documents/print_heat-deaths-2016.pdf

- Establish a formal acclimatization plan for new employees and current employees when work enters the start of colder months, or they are working in a cold environment
- Designates a competent person to implement the program
- Ensure access to a warm area, scheduled and frequent rest periods during the workday where employees can retreat to the warm area
- Train workers on cold stress prevention, recognition, and reporting
- Establish a medical surveillance program, including preplacement and periodic surveillance evaluations
- Establish an emergency response plan for any cold stress related events

Health Department and Emergency Services Action

Heat Stress

During the height of the northwest heatwave, June 25–30, 2021, emergency department visits were 69 times higher than that during the same days in 2019, peaking at 1,090 heat-related illness emergency department visits on June 28, 2021. With the sizeable public health impact and the continued prevalence of heat waves to come, NSC recommends health departments and emergency services such as Fire and Rescue Services, Emergency Management Services (EMS), and ambulance services develop and implement heat response plans that include identifying at-risk neighborhoods and populations, opening cooling centers during heatwaves, developing accurate systems for data collection and analysis using a variety of sources (e.g., workplace complaints, worker surveys, workers' compensation claims, medical records, death certificates, etc.). They should use these data to guide public health policy and action to protect their communities from heat-related illness and deaths, especially among disproportionately affected populations.

Incomplete hospital and regulatory records in addition to heat exacerbating chronic medical conditions make tracking workers who suffer heat-related illnesses in the workplace difficult.[114] State governments and Environmental Protection Agency reports indicate that the full range of heat-related illness occurrence can be miscalculated without explicit hospital discharge records.[115] NSC encourages health departments and emergency services to build systems that ensure complete and accurate reporting of heat-related illness. NSC also encourages federal database to collect these records so that can be analyzed and used to better define needs and mechanisms for data collection.

Cold Stress

Lack of consistent diagnostic criteria also contributes to an underestimation of cold-related mortality.[116] Determination that a death is cold-related requires knowledge of the decedent's core body temperature at the time of death or knowledge that the decedent was exposed to cold temperatures. Cold exposure also may not be listed on the death certificate as contributing causes of death for deaths resulting from exacerbation of a preexisting medical condition.[117] NSC encourages health departments and emergency services to build systems that ensure complete and accurate reporting of cold-related illness. NSC also encourages the use of a

[114] https://www.politico.com/news/2021/08/08/osha-climate-change-effects-workforce-heat-impact-501744?nname=playbook&nid=0000014f-1646-d88f-a1cf-5f46b7bd0000&nrid=0000014e-eede-d0b3-a35f-ffff0fcd0000&nlid=630318

[115] https://www.epa.gov/sites/default/files/2016-08/documents/heat-illness_documentation.pdf

[116] https://www.cdc.gov/nchs/data/nhsr/nhsr076.pdf

[117] Ibid

federal database to collect these records so they can be analyzed and used to better define needs and mechanisms for data collection.

This position statement reflects the opinions of the National Safety Council but not necessarily those of each member organization.
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