

Cold Environments - Health Effects & First Aid

What are the health effects of exposure to cold?

Cooling of body parts may result in various cold injuries – non-freezing injuries, freezing injuries - and hypothermia which is the most serious. Non-freezing cold injuries include chilblain, immersion foot and trenchfoot. Frostnip and frostbite are freezing injuries.

Toes, fingers, ears and nose are at greatest risk because these areas do not have major muscles to produce heat. In addition, the body will preserve heat by favouring the internal organs and thus reducing the flow of blood to the extremities under cold conditions. Hands and feet tend to get cold more quickly than the torso because:

- they lose heat more rapidly since they have a higher surface area-to-volume ratio, and
- they are more likely to be in contact with colder surfaces than other parts of the body.

If the eyes are not protected with goggles in high wind chill conditions, the corneas of the eyes may freeze.

The most severe cold injury is hypothermia which occurs from excessive loss of body heat and the consequent lowering of the inner core temperature (internal temperature of the body). Hypothermia can be fatal.

For more information on the general effects of working in the cold as well as how the body adapts to cold, please see [Cold Environments - General](#).

For information on exposure limits and prevention of injury while working in the cold, please see [Cold Environments - Working in the Cold](#).

What are examples of 'nonfreezing' cold injuries?

Chilblains are a mild cold injury caused by prolonged and repeated exposure for several hours to air temperatures from above freezing (0°C or 32°F) to as high as 16°C (or about 60°F). In the affected skin area there will be redness, swelling, tingling, and pain.

Immersion foot occurs in individuals whose feet have been wet, but not freezing cold, for days or weeks. It can occur at temperatures up to 10°C (50°F). The primary injury is to nerve and muscle tissue. Symptoms include tingling and numbness; itching, pain, swelling of the legs, feet, or hands; or blisters may develop. The skin may be red initially and turn to blue or purple as the injury progresses. In severe cases, gangrene may develop.

Trenchfoot is "wet cold disease" resulting from prolonged exposure in a damp or wet environment from above the freezing point to about 10°C (50°F). Depending on the temperature, an onset of symptoms may range from several hours to many days but the average is three days. Trenchfoot is more likely to occur at lower temperatures whereas an immersion foot is more likely to occur at higher temperatures and longer exposure times. A similar condition of the hands can occur if a person wears wet gloves for a prolonged period under cold conditions described above. Symptoms are similar to an immersion foot.

What are examples of 'freezing' injuries?

Frostnip is the mildest form of a freezing cold injury. It occurs when ear lobes, noses, cheeks, fingers, or toes are exposed to the cold and the top layers of a skin freeze. The skin of the affected area turns white and it may feel numb. The top layer of skin feels hard but the deeper tissue still feels normal (soft).

Frostnip can be prevented by wearing warm clothing and foot wear. It is treated by gentle rewarming (e.g., holding the affected tissue next to unaffected skin of the victim or of another person). As for all cold-induced injuries, never rub the affected parts - ice crystals in the tissue could cause damage if the skin is rubbed. Do not use very hot objects such as hot water bottles to rewarm the area or person.

Frostbite is a common injury caused by exposure to extreme cold or by contact with extremely cold objects (especially those made of metal). It may also occur in normal temperatures from contact with cooled or compressed gases. Frostbite occurs when tissue temperature falls below the freezing point (0°C/32°F), or when blood flow is obstructed. Blood vessels may be severely and permanently damaged, and blood circulation may stop in the affected tissue. In mild cases, the symptoms include inflammation of the skin in patches accompanied by slight pain. In severe cases, there could be tissue damage without pain, or there could be burning or prickling sensations resulting in blisters. Frostbitten skin is highly susceptible to infection, and gangrene (local death of soft tissues due to loss of blood supply) may develop.

What first aid can I do if someone has frostbite?

First aid for frostbite, as well as immersion or trench foot, includes:

- Check for signs of hypothermia and seek medical attention. If necessary quickly transport the victim to an emergency care facility.
- Treat the person gently and monitor breathing.
- If possible, move the victim to a warm area.
- Remove wet clothing, and gently loosen or remove constricting clothing or jewellery that may restrict circulation.
- Warm the person by wrapping them in blankets or by them putting on dry clothing. Cover the head and neck. Warm the person slowly. Avoid direct heat which can burn the skin.

- Loosley cover the affected area with a sterile dressing. Place some gauze between fingers and toes to absorb moisture and prevent them from sticking together.
- If the person is alert, give them warm liquids to drink.
- DO NOT attempt to rewarm the affected frostbite area on site (but do try to stop the area from becoming any colder) - without the proper medical care, tissue that has been warmed may refreeze and cause more damage.
- DO NOT rub area or apply dry heat.
- DO NOT allow the victim to drink alcohol or smoke.

What is hypothermia?

In moderately cold environments, the body's core temperature does not usually fall more than 1°C to 2°C below the normal 37°C because of the body's ability to adapt. However, in intense cold without adequate clothing, the body is unable to compensate for the heat loss and the body's core temperature starts to fall. The sensation of cold followed by pain in exposed parts of the body is one of the first signs of mild hypothermia.

As the temperature continues to drop or as the exposure time increases, the feeling of cold and pain starts to diminish because of increasing numbness (loss of sensation). If no pain can be felt, serious injury can occur without the victim's noticing it.

Next, muscular weakness and drowsiness are experienced. This condition is called hypothermia and usually occurs when body temperature falls below 33°C. Additional symptoms of hypothermia include interruption of shivering, diminished consciousness and dilated pupils. When body temperature reaches 27°C, coma (profound unconsciousness) sets in. Heart activity stops around 20°C and the brain stops functioning around 17°C.

What are the signs of hypothermia?

Stage	Core Temperature	Signs and Symptoms
Mild Hypothermia	37.2-36.1°C (99 - 97°F)	Normal, shivering may begin.
Moderate Hypothermia	36.1-35°C (97 - 95°F)	Cold sensation, goose bumps, unable to perform complex tasks with hands, shivering can be mild to severe, hands numb.
	35-33.9°C (95 - 93°F)	Shivering, intense, muscles incoordination becomes apparent, movements slow and laboured, stumbling pace, mild confusion, may appear alert. Use sobriety test, if unable to walk a 9 meter (30 foot) straight line, the person is hypothermic.
	33.9-32.2°C (93 - 90°F)	Violent shivering persists, difficulty speaking, sluggish thinking, amnesia starts to appear, gross muscle movements sluggish, unable to use hands, stumbles frequently, difficulty speaking, signs of depression, withdrawn.

Severe Hypothermia	32.2-30°C (90 - 86°F)	Shivering stops, exposed skin blue or puffy, muscle coordination very poor, inability to walk, confusion, incoherent/irrational behaviour, but may be able to maintain posture and appearance of awareness
	30-27.8°C (86 - 82°F)	Muscle rigidity, semiconscious, stupor, loss of awareness of others, pulse and respiration rate decrease, possible heart fibrillation.
	27.8-25.6°C (82 - 78°F)	Unconscious, a heart beat and respiration erratic, a pulse may not be obvious.
	25.6-23.9°C (78 - 75°F)	Pulmonary edema, cardiac and respiratory failure, death. Death may occur before this temperature is reached.

What first aid can I do for hypothermia?

Hypothermia is a medical emergency. At the first sign, find medical help immediately. The survival of the victim depends on their co-workers ability to recognize the symptoms of hypothermia. The victim is generally not able to notice his or her own condition.

First aid for hypothermia includes the following steps:

- Seek medical help immediately. Hypothermia is a medical emergency. Quickly transport the victim to an emergency medical facility.
- Ensure that wet clothing is removed.
- Place the victim between blankets (or towels, newspaper, etc.) so the body temperature can rise **gradually**. Body-to-body contact can help warm the victim's temperature slowly. Be sure to cover the person's head.
- Hot water bottles, chemical hot packs, or electric blankets may be used with caution. Wrap in a towel before applying and warm the centre of the body slowly (DO NOT warm the arms or legs directly).
- DO NOT rewarm the person too quickly (e.g., do not use a heating lamp or soak in a hot bath).
- Give warm, sweet (caffeine-free, nonalcoholic) drinks unless the victim is rapidly losing consciousness, unconscious, or convulsing.
- Perform CPR (cardiopulmonary resuscitation) if the victim stops breathing. Continue to provide CPR until medical aid is available. The body slows when it is very cold and in some cases, hypothermia victims that have appeared "dead" have been successfully resuscitated.

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