

# Cold-Related Injury

## Traveler Summary

### Key Points

- Travelers who participate in outdoor, cold weather activities (especially at high altitudes, winter camping, or boating) are most at risk for *hypothermia* or *frostbite*.
- *Hypothermia* occurs when the body's core temperature drops below 35°C (95°F) and usually manifests as shivering, fatigue, clumsiness, and confusion. Further drop in temperature may result in blue skin, weak pulse, abnormal pulse and breathing, and loss of consciousness. *Frostbite* occurs when skin is frozen, with symptoms of pain, numbness, swelling, and white, hard skin.
- Failure to recognize symptoms and move the person to a warm dry area can lead to death in cases of hypothermia.
- Prevention methods include dressing appropriately in loose layers, with waterproof outerwear or wet- or drysuits. At temperatures below -15°C (5°F), protect the face and peripheral skin. Numb, painful or pale extremities should be exercised. If possible, warm the affected hand or foot in the armpit of a fellow traveler.
- Seek dry, warm shelter upon getting cold or wet. Treatment of frostbite involves thawing the frozen body part(s) in water heated to 37-39°C (98.6-102°F) until the involved body part takes on a red or purple appearance. However, do not thaw unless the area can be kept thawed.

### Introduction

When travel plans include outdoor activities in a chilly environment, especially at high altitudes or if rain is expected, travelers should take extra precautions to avoid hypothermia and other cold-related conditions.

### Cold Adaptation

Humans are poorly adapted to cold. The body gains radiant heat from a warm or hot environment (sunlight or indoors) and generates heat through metabolism (e.g., digestion, exercise, or shivering). Heat is lost when a person is subjected to a cold environment (e.g., exposure, water or rain, or evaporative cooling); it is retained by insulation (shelter and suitable clothing). Blood vessel constriction and dilation contribute to heat retention or heat loss.

### Cold-Related Injury

**Hypothermia** is a dangerous drop in the body's core temperature, from 37°C (98.6°F) to less than 35°C (95°F). When exposed to cold temperatures, the body begins to lose heat faster than it can be produced. Hypothermia can occur even on days that seem mild, especially if the weather is wet and windy. Many hypothermia deaths have occurred in weather that is -1°C to 10°C (30-50°F). The primary effects of reduced body temperature are decreased resting metabolism and inhibition of brain and nervous system function. Heart output falls and abnormal heart rhythms develop when the core body temperature drops below 30-32°C (86-90°F).

Even mild hypothermia, 32-35°C (90-95°F) affects the brain, causing confusion or lack of coordination. Hypothermia is particularly dangerous because a person may not know it is happening and thus will not take steps to prevent it. Initial symptoms include shivering, fatigue, loss of coordination, stumbling, loss of awareness, and confusion.

Core body temperatures below 32°C (90°F) result in cessation of shivering, blue skin, dilated pupils, weak pulse, abnormal heart rhythm and breathing, and loss of consciousness.

Treatment for hypothermia involves the prevention of further heat loss by using insulation and a vapor or waterproof barrier. Move the victim into a warm room or dry shelter. Once under shelter, remove or cut off wet clothing, and wrap the victim in dry blankets. Do not stand or walk the victim, but also do not lie the victim on the cold ground. Severe cases need more vigorous management. Warm the center of the body first (armpits, chest, neck, head, and groin) using an electric blanket if available, warm water bottles, or skin-to-skin contact in a sleeping bag or under layers of dry blankets, clothing, towels, and so forth. Consumption of warm sugary food or drinks may help if the victim is able to swallow. If shivering stops, the victim becomes unconscious, an abnormal heart rhythm develops, or the core body temperature falls below 30°C (86°F), move the victim to a flat surface and immediately take him/her to a medical center, preferably where extra-corporeal life support (warming and oxygenating the blood outside the body) is available.

The low metabolic rate associated with hypothermia is protective. Therefore, when treated properly, individuals may be successfully resuscitated after prolonged severe hypothermia. A determination of death should not be made until the body has been appropriately warmed.

**Burial in an avalanche** is likely to be complicated by suffocation and trauma as well as by hypothermia. Immediate cardiopulmonary resuscitation (CPR), if indicated while awaiting medical evacuation, may be lifesaving.

**Immersion hypothermia** occurs when skin temperature falls below 12°C (54°F) for prolonged periods, usually because the victim has been immersed in cold water (e.g., falling through the ice on a lake or into the sea in winter). This decrease in skin temperature may result in paralyzed nerves and muscles, hypothermia, and drowning. To treat, extract the victim from the water, dry him or her, dress in warm clothing, and follow the procedures described above.

**Frostnip and frostbite:** Frostnip is the formation of ice crystals over cold-exposed skin (usually the cheeks, ears, and nose) and does not cause tissue death if the skin is rewarmed. Frostbite is an actual freezing of body tissues with the formation of ice crystals, leading to death of the tissue, most commonly of the fingers, toes, and nose. Symptoms include pain, numbness, swelling, itching, and white, hard skin. Frostbite is typically preventable but often not improved by treatment.

Treatment of frostbite involves thawing the frozen body part(s) in water heated to 37-39°C (98.6-102°F). Maintain the water at this temperature (checking with a thermometer) until the involved body part takes on a red or purple appearance and becomes soft and pliable to the touch, usually after 30 minutes of soaking. However, do not thaw unless the area can be kept thawed. For example, if a hiker must walk to obtain help, do not start the warming process. Refreezing the injured area causes damage that is worse than the original frostbite. Freezing and thawing are very painful, and strong analgesics may be needed. Do not manipulate blisters. Removal of dead tissue is generally delayed until there is a clear division from viable tissue, which usually takes 1 to 3 months from the time of initial exposure.

## Risk Factors

Risk factors for developing hypothermia include:

- Wet skin or clothing
- High altitude, where weather conditions may change abruptly
- Wind: A still air temperature of 5°C (41°F) equates to a wind chill of -1°C (31°F) if the wind speed is 40 kph (25 mph).
- Immersion in cold water
- Body size and shape (small and/or thin people are at greater risk)
- Advanced age, especially when coupled with immobility, malnutrition, or illness (including dementia)
- Consumption of drugs that impair consciousness or cause dilatation of the blood vessels, especially alcohol

## Prevention

To prevent hypothermia, dress appropriately. Wear layers of loose, soft clothing; pockets of air between the layers create additional insulation. Two or three thin woolen pullovers are more effective than a single thick pullover. Add or remove layers if the weather changes or the level of activity changes. Carry a jacket and pants made from a waterproof, breathable fabric, such as GORE-TEX. Take along water-resistant shoes or boots, a hat, and mittens or gloves. Seek dry shelter upon becoming cold or wet. Avoid swimming in water below 21°C (70°F) unless wearing a wet suit.

At high altitudes and during winter expeditions, mountaineers should wear appropriate clothing, have the necessary equipment (such as quality boots and mittens), use a competent guide, and have training on how to handle cold weather.

Watch for symptoms of hypothermia in others.

To prevent frostbite, maintain a good blood flow by keeping warm and staying hydrated. At temperatures below -15°C (5°F), protect the face and peripheral skin from moisture, wind, and cold. Evaluate the occurrence of any numbness or pain. Numb or pale extremities should be exercised. If possible, warm the affected hand or foot in the armpit of a fellow traveler.

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