

How Cold Affects the Body:

1. The colder the surrounding temperature is, the greater the potential for body heat to escape. When the skin is exposed to cold, the brain signals the blood vessels in the skin to tighten, and blood flow to the skin decreases. This is the body's attempt to prevent heat inside the body from being carried to the skin where it will be lost. However, due to reduced blood flow to the skin, **the skin temperature falls.**

2. When cold exposure lasts for more than an hour, cooling of the skin and reduced blood flow to the hands leads to **blunted sensations of touch and pain and loss of dexterity.** This can impair ability to perform manual tasks and lead to more severe cold injuries, since symptoms may go unnoticed.

3. Nonfreezing cold injuries can occur when conditions are cold and wet (air temperatures between 32° and 55°F or 0° to 13°C) and the hands and feet cannot be kept warm and dry. The most prominent nonfreezing cold injuries are **chilblain and trench foot.**

a. Chilblain is a nonfreezing cold injury, which, while painful, causes little or no permanent impairment. It appears as red, swollen skin, which is tender, hot to the touch and may itch. This can worsen to an aching, prickly (pins and needles) sensation and then numbness. It can develop in only a few hours in skin exposed to cold.

b. Trench foot is a very serious nonfreezing cold injury, which develops when skin of the feet is exposed to moisture and cold for prolonged periods (12 hours or longer). The combination of cold and moisture softens skin, causing tissue loss and, often, infection. Untreated, trench foot can eventually require amputation. Often, the first sign of trench foot is itching, numbness or tingling pain. Later the trench foot shows a distinct "water-line" coinciding with the water level in the boot. Red or bluish blotches appear on the skin, sometimes with open weeping or bleeding. The risk of this potentially crippling injury is high during wet weather or when troops are deployed in wet areas. Soldiers wearing rubberized or tight-fitting boots are at risk for trench foot regardless of weather conditions, since sweat accumulates inside these boots and keeps the feet wet.

4. **Freezing cold injuries** can occur whenever air temperature is below freezing (32°F, 0°C). Freezing limited to the skin surface is **frostnip.** When freezing extends deeper through the skin and flesh, the injury is frostbite.

a. **Frostnip** involves freezing of water on the skin surface. The skin will become reddened and possibly swollen. Although painful, there is usually no further damage after re-warming. Repeated **frostnip** in the same spot can dry the skin, causing it to crack and become very sensitive. It is difficult to tell the difference between **frostnip** and frostbite. **Frostnip should be taken seriously since it may be the first sign of impending frostbite.**

b. Skin freezes at about 28°F (-2°C). As frostbite develops, skin will become numb and turn to a gray or waxy-white color. The area will be cold to the touch and may feel stiff or wood-like. With frostbite, ice crystal formation and lack of blood flow to the frozen area damages the tissues. After thawing, swelling may occur, worsening the injury.

5. Body temperature falls when the body cannot produce heat as fast as it is being lost. This can result in **Hypothermia**, which is a life threatening condition in which deep body temperature falls below 95°F (35°C).

a. Generally, deep body temperature will not fall until after many hours of continuous exposure to cold air, if the individual is healthy, physically active and reasonably dressed. However, **body temperature can fall even when air temperatures are above freezing if conditions are windy, clothing is wet, and/or the individual is inactive.**

b. Hypothermia can occur rapidly during cold-water immersion (one hour or less when water temperature is below 45°F or 7.2°C). Immersion in water considered even slightly cool (60°F [15.5°C]), can cause hypothermia, if the immersion is prolonged for several hours.

c. **Hypothermia is a medical emergency.** Untreated, it results in death. Hypothermia may be difficult to recognize in its early stages of development. Things to watch for include unusually withdrawn or bizarre behavior, irritability, confusion, slowed or slurred speech, altered vision, uncoordinated movements and unconsciousness. Even mild hypothermia can cause victims to make poor decisions or act drunk (e.g., removing clothing when it is clearly inappropriate).

d. **Hypothermia victims may show no heartbeat, breathing or response to touch or pain when in fact they are not really dead.** Sometimes, the heart beat and breathing of hypothermia victims will be so faint that it can go undetected. If hypothermia has resulted from submersion in cold water, cardiopulmonary resuscitation (CPR) should be initiated without delay. However, when hypothermia victims are found on land, it is important to take extra time searching for vital signs to determine whether CPR is really required. Hypothermia victims should be treated as gently as possible during treatment and evacuation, since rough handling can cause life-threatening disruption in heart rate. Trained medical personnel must evaluate all hypothermia victims, even those who do not appear to be alive.

6. Susceptibility to cold injury (non-freezing, freezing or hypothermia) is affected by many factors.

a. Poorly conditioned soldiers are more susceptible to cold injury. They tire quickly and are unable to stay active to keep warm as long as fit soldiers.

b. Dehydration increases susceptibility to cold injury.

- c. Fat is an excellent insulator against heat loss. Therefore, a very lean person may be susceptible to the effects of cold, if clothing is inadequate or wet and/or the individual is relatively inactive.
 - d. Persons over 45 years of age may be less cold tolerant than younger persons, due to the decline in physical fitness that often occurs with aging. This emphasizes the importance of physical fitness training, particularly for older soldiers.
 - e. Alcohol, and to a lesser extent caffeine, cause the blood vessels in the skin to open which may accelerate body heat loss. Also, alcohol and caffeine both increase urine formation, leading to dehydration, which can further degrade the body's defenses against cold. Most importantly, **alcohol blunts the senses and impairs judgment, so the individual may not feel the signs and symptoms of developing cold injury.**
 - f. Nicotine decreases blood flow to the skin; therefore smoking or chewing tobacco increases susceptibility to frostbite.
 - g. Inadequate nutrition, illness, and injury compromise the body's responses to cold and the ability to recognize and react appropriately to the symptoms or developing cold injury.
 - h. In foxholes or small vehicle crew compartments, movement is very restricted and soldiers must often remain inactive, which can greatly increase risk of cold injury.
 - i. Individuals who have experienced a cold injury in the past are at greater risk of experiencing another cold injury than other soldiers.
 - j. When the face and other exposed skin areas are covered by camouflage paint, it is difficult to see the changes in skin color which signal the early development of frostbite.
7. For a given air temperature, body heat loss is accelerated by wind.
- a. Wind increases heat loss from skin exposed to cold air, in effect, lowering the temperature. The wind-chill index integrates wind speed and air temperature to provide an estimate of the cooling power of the environment and the associated risk of cold injury. The wind chill is the equivalent still-air (i.e., no wind) temperature at which the heat loss through bare skin would be the same as under the windy conditions. Appendix A depicts the Equivalent Chill Temperature for different wind speeds and air temperatures.
 - b. Wind chill temperatures obtained from weather reports do not take into account man-made wind. Man-made winds worsen the wind chill effect of natural wind. Individuals riding in open vehicles or exposed to propeller/rotor-generated wind can be subject to dangerous wind chill, even when natural winds are low.
8. Water will cause body heat loss much faster than air of the same temperature.
- a. When clothing becomes wet due to snow, rain, splashing water, or accumulated sweat, the body's loss of heat accelerates. For example, when air temperature is 40°F (4.4°C), heat loss in wet clothing is double what it is in dry clothing.
 - b. Swimmers and persons working or wading in water can lose a great deal of body heat even when water temperatures are only mildly cool. Individuals working in cold water should be closely watched while entering water, since sudden plunging into cold water can produce irregular heartbeats, gasping and hyperventilation which could cause inhalation of water, heart failure and drowning.
9. **Metal objects and liquid fuels that have been left outdoors in the cold can pose a serious hazard.** They can conduct heat away from the skin very rapidly. Fuels and solvents remain liquid at very low temperatures and become super cooled. Skin contact with fuel or metal at below freezing temperatures can result in nearly instantaneous freezing. Fuel handlers should use great care not to allow exposed skin to come into contact with spilled fuel or the metal nozzles and valves of fuel delivery systems.