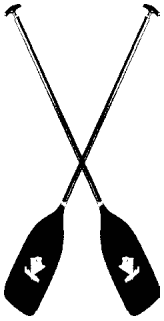


The Paddler's COLD War

What you need to know about hypothermia and cold-water immersion, two potential killers!

Hypothermia

Hypothermia is a drop in body temperature to below 95 degrees Fahrenheit. The body's thermostat is set at around 98.6 degrees, the optimal temperature for all the body's life-sustaining chemical reactions. When the core temperature varies more than a few degrees up or down, cellular metabolism becomes unhinged and the organ systems start to malfunction. To stay at around 98.6 degrees, the body must balance heat production and heat losses.

Routes of heat loss

• *Radiation* is the transfer of heat from the body to cooler objects by electromagnetic waves. Normally, radiation accounts for 50 to 70 percent of body heat loss.

• *Conduction* is the direct transfer of heat from the body to a cooler medium. Conductive heat losses are minimal in air but are substantial during cold-water immersion. Because water has a specific heat 4,000 times greater than air and thermal conductivity 25 times greater, your body will cool more than a hundred times faster in water than in air of the same temperature.

• *Convection* is heat loss secondary to the disruption of the thin layer of warm air or water next to the skin. As the body gives off heat, it warms a small strip of air or water next to the skin. When exposed to wind or moving water, this thin skip is disturbed, and a new skip is heated at the expense of body heat. This is the basis of the windchill factor: the increased cooling of skin when exposed to wind. (The amount of heat loss varies with the square of the wind velocity.)

• *Evaporation* of water from the skin and lungs accounts for 30 percent of body heat loss in the cold and a much higher percentage when the skin is wet and exposed to high winds.

Causes and predisposing factors

• *Exposure.* You don't have to be paddling in an ice field to become hypothermic. Cool temperatures, low humidity, high winds, and inadequate or wet clothing all can lead to hypothermia in any season and at any latitude.

• *Age.* Because of their high surface-area-to-mass ratio, children lose a lot of body heat through radiation. Infants have poorly developed shivering mechanisms and little fat to insulate them. Elderly people are predisposed to hypothermia because they have less fat and muscle to insulate them from the cold, and their cardiovascular systems don't respond as well to cold stress.

• *Immersion.* Cold water pulls heat from the body like a magnet.

• *Trauma and immobility.* If you break your leg in a paddling accident, you won't generate much heat through exercise, and you'll have a tough time getting out of your wet clothes.

• *Drugs and alcohol.* Alcohol is a general anesthetic. It may blind you to the fact that you are becoming hypothermic and prevent you from donning warm clothes or seeking shelter. It dilates the vessels in the skin, giving you that warm glow after a couple of drinks. But that glow comes at the expense of heat loss, as warm blood from the core perfuses the cold shell. Alcohol also may inhibit shivering. Alcohol and other drugs impair your judgment and coordination, which opens the door to mistakes and injury.

The signs and symptoms of hypothermia

• *Mild hypothermia (90 to 95 degrees Fahrenheit).* The victim is usually shivering, and his skin is cool to the touch. His speech is slurred, he moves slowly, and he complains of feeling weak and fatigued. He may be confused and apathetic, and have difficulty handling normal tasks requiring minimal coordination.

• *Severe hypothermia (below 90 degrees Fahrenheit).* The victim's skin is cold to the touch, blue and mottled. He may become dejected and lose the will to live. As the core temperature drops below 90 degrees, he becomes progressively more confused and lethargic until he lapses into a coma. He stops shivering. He may hallucinate and act inappropriately, such as taking off his clothes or jumping out of a boat. His pulse and respirations slow, and lethal heart rhythms may develop. He becomes profoundly weak and tired, his muscles become rigid and he stops moving.

Detecting hypothermia

Hypothermia has an insidious onset and is not easy to diagnose. You have to watch for it when conditions are windy, cold and wet. Shivering is the most obvious sign of hypothermia, but you should also suspect it in anyone who has been exposed to the cold, wind, and water, and is sluggish or confused or has difficulty handling simple tasks. You can take the victim's temperature; however, most clinical thermometers don't register below 96 degrees.

Immersion hypothermia

Falling into freezing water is not synonymous with instant death. Any member of the Polar Bear Club can tell you that. But if you remain in the water more than an hour or so, you'll develop hypothermia, lose consciousness, and drown.

Into the drink—what happens

If you go into the cold waters of far northern latitudes, your first reaction will be a huge, involuntary gasp; then you'll hyperventilate for a minute or so. If you are under water when you gasp, you may aspirate a large amount of water into your lungs and asphyxiate. (You can short-circuit the gasp reflex by entering the water slowly if you are abandoning a sinking vessel.) If you have a weak heart, the shock of the cold water may cause it to go into a lethal arrhythmia. Sudden death on entry into cold water is called the immersion syndrome. It's quite rare.

Hyperventilation causes a sharp decline in the amount of carbon dioxide in the blood, and this causes constriction of the cerebral blood vessels. Inadequate blood flow to the brain may lead to confusion, loss of coordination, fainting, and drowning. The excessive respiratory stimulation lowers your breath-holding ability from a normal average of 60 seconds in air to only 15 to 25 seconds in 15-degree water—not good if you're trapped under a capsized boat.

During cold-water immersion (as in hypothermia in general), circulation to the skin and muscles shuts down while blood flow to the brain and vital organs in the chest and abdomen increases. This is a mixed blessing in cold water because the muscles become stiff and weak. Anyone immersed in icy water for more than five minutes will have difficulty swimming, donning a personal flotation device (PFD), climbing a ladder, or hanging onto a line. He'll lose fine-motor control and may be unable to operate signaling devices or inflate a PFD or life raft.

After 15 to 20 minutes in freezing water, the core starts to cool as heat is conducted to the cold shell. The victim becomes confused and lethargic. He may jump off an overturned boat, attempt to swim to a distant shore, or take off his PFD. Intense cold may destroy his will to live. On the plus side, as the core temperature drops, the brain's metabolism slows and it becomes more tolerant of hypoxia (deficient oxygen). Some people have been successfully resuscitated after being submerged for more than 40 minutes in cold water.

The great escape—heat loss in cold water

The big difference between hypothermia in air and immersion hypothermia is that cold water sucks the heat out of your body like a vacuum cleaner. You may take all day to become hypothermic normally on a 40-degree day, but only an hour and-a-half in 40-degree water.

Different parts of the body cool at different rates. The digits and limbs cool most rapidly because of their high surface-to-volume ratio. The head dissipates heat readily because of its high blood flow and poor insulation. The front and sides of the chest are poorly insulated and cool rapidly. The groin and neck are heat sieves because large blood vessels lie just under the skin.

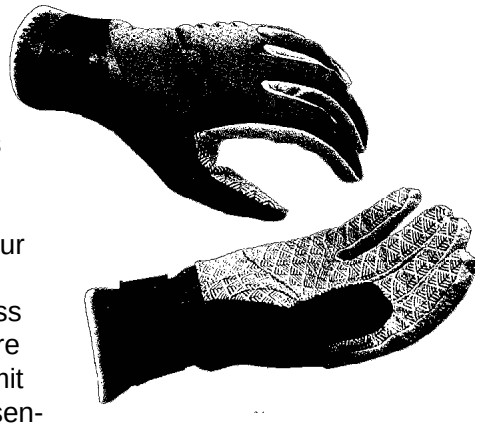
Here are the factors that determine your cooling rate in water, in order of importance:

1. *Water temperature.* The colder the water, the faster you will cool.

2. *Body fat.* Have you ever wondered why whales and seals don't become hypothermic? Their bodies are insulated by thick layers of blubber (fat), which has a very poor bloody supply and is an excellent insulator. Researchers have shown that doubling the skin-fold thickness halves the cooling rate. This is one situation where you can feel good about being fat—that blubber may save your life.

3. *Clothing.* Insulated clothing designed to trap small pockets of air near the skin is of no value in water. Water quickly saturates the clothing and obliterates the air pockets. Small layers of warm water are flushed away as soon as they form. However, multiple layers of heavy clothing can increase survival time in cold water by 30 to 40 percent. Wet garments (i.e., wet suits, insulated coveralls, and thermal flotation jackets) limit the flow of water between skin and clothing, and can greatly increase survival time. Float coats reduce cooling by 40 to 50 percent and double survival time. Dry garments (i.e., survival suits) employ impermeable neck, wrist, and ankle seals and a watertight zipper to keep water out. Snug-fitting, vest-type PFDs provide some protection.

4. *Sea state.* It can be tough to keep your mouth out of the water in rough seas. Wind and spray accelerate cooling.



5. *Behavior.* When you swim or tread water, two undesirable things happen: Warm blood from the core flows into the muscles and you lose your shell insulation, and water moving over your body increases convective heat losses. You will cool up to 50 percent faster if you exercise in the water. Most people can't swim more than a half mile in 50-degree water, so trying to swim for shore is rarely a wise move. Your best bet is to get as much of your body out of the water as possible. Climb up on the hull of your boat if it is still afloat. Evaporative heat loss may make you feel colder out of the water, but you will cool much more slowly than you would in the water. If you can't get out of the water, limit skin exposure to the water by assuming the HELP (Heat Escape Lessening Posture) position (ed note: fetal position). If you are with a group of people, huddle together and maximize upper body contact.

6. *Body type.* Children and tall, thin adults cool relatively quickly because of their high surface-to volume ratio. Big people cool more slowly than little people.

7. *Shivering.* Shivering helps to retard core cooling, but it generally stops at 86 degrees.

8. *Sex.* Women have a higher percentage of body fat than men, but they are smaller. The net result is equivalent cooling rates for men and women.

9. *Fitness.* Fit people are stronger and have more stamina. But they also have less fat so the survival value of fitness is moot.

10. *Alcohol.* Alcohol may be the reason you enter the water in the first place. If you’re three sheets to the wind you’ll probably drown. Moderate amounts of alcohol don’t affect the cooling rate in cold water.

Cold-water survival

The good news about cold-water immersion is that you will survive longer than you think. That's also the bad news. Floating in a fetal position in ice water is not one of life's great pleasures. But as cold as you might feel on the outside, your core won't start to cool for at least 15 or 20 minutes, even in ice water. But once it does, your core temperature will plummet like a sinking ore carrier until, after an hour and 15 minutes, it reaches 86 degrees. At that point, you will very likely lose consciousness and drown, or die of an irregular heart beat. The average, thinly dressed person can survive for two and a half hours in 50-degree water, and for up to 12 hours in 68-degree water.

Rescue and first aid

The person who goes into the water and is retrieved quickly, and is alert, shivering, and able to assist in his

rescue, will be only mildly hypothermic. Get him to shore and have him put on dry clothing, wrap himself in a blanket, and sip a hot drink. He'll be back in action in an hour or so.

Some years ago, 16 Danish fishermen jumped into the icy waters of the North Sea when their trawler sank in a storm. They were in the water for a couple of hours before being rescued. They walked across the deck of the rescue vessel and went down into the galley to warm up. Every one of them died of hypothermia.

If the victim has been in the drink for more than 20 to 30 minutes, is lightly dressed, and has been swimming or treading water, assume that he is profoundly hypothermic. Especially if he's blue, stuporous, and not shivering. Approach him as though he were a contact mine. His heart is cold and irritable—if you handle him roughly, you can precipitate ventricular fibrillation. If you allow him to move under his own power or try to rewarm him, he may suffer from "afterdrop" (a sudden drop in core temperature when cold, venous blood surges back to the heart from cold muscles). Have someone get in the water to assist him.

Hypothermia causes hypotension (low blood pressure), but this is balanced somewhat by the hydrostatic squeeze on the parts of the victim's body that are immersed. His blood pressure may plummet like a sounding line if he is suddenly removed from the water, and he may collapse and die. Keep him as horizontal as possible while hoisting him from the water, and place him in a supine position once you get him out of the water.

Treatment

1. *Check the ABCs.* Check her respirations and pulse and make sure she has a good airway. If she is pulseless and not breathing, start CPR; continue until you are exhausted or are relieved by rescue personnel. Hypothermia victims have been successfully resuscitated after 3 hours of CPR. Do not perform CPR if she has any pulse and respirations, no matter how feeble. If she is found floating face down, treat her as a near-drowning victim.
2. *Examine her from head to toe.* Her pupils may be fixed and dilated, but hypothermia victims aren't dead until they are "warm and dead."
3. *Prevent further heat loss.* Take her into the cabin, remove her wet clothing, gently dry her skin, and cover her with blankets or a sleeping bag.
4. *Apply hot packs* to her neck, armpits, trunk, and groin, or have two people get undressed from the waist up, get into bed with her and maintain close chest-to-chest contact. Be careful not to burn her skin, and do not apply heat to any other areas.
5. *Administer warmed (i.e. 104-degree) intravenous fluids, if possible.*
6. If she is alert, *offer a hot nonalcoholic drink* and something to eat. The drink won't warm her, but it may boost her spirits.
7. *Have someone call the Coast Guard* while you are attending to the victim.

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