MAN IN COLD WATER

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Based on research results from
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Scientists at the University of Victoria have been studying the responses of humans to immersion in cold ocean water under conditions simulating boating accidents. The results are being used to find means to increase survival time through knowledge of behaviours in the water that reduce body cooling rate and through design of a lifejacket that offers improved thermal protection.

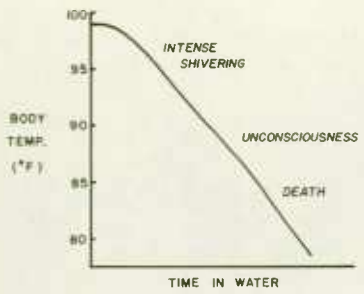
Even a small increase in survival time can mean the difference between being alive or dead when rescue arrives.

All boaters (and others in danger of accidental immersion in cold water) should be aware of the factors that determine body cooling rate and eventual death from hypothermia. Without such knowledge, one is not giving sufficient care to this vital aspect of water safety!

The following 10 questions attempt to focus attention on the major problems and recommendations about cold water survival.

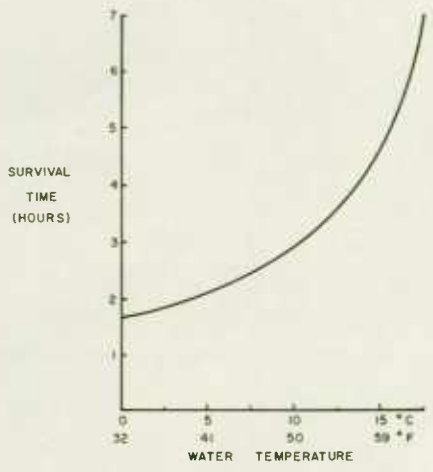
1 What is 'hypothermia' and how does it kill?

Hypothermia means lowered, deep-body temperature. In cold water, the skin and peripheral tissues become cooled very rapidly, but it takes 10 - 15 minutes before the temperature of the heart and brain begin to cool. Intensive shivering occurs in an attempt to counteract the large heat loss. Unconsciousness can occur when the deep-body temperature falls to approximately 90°F (32°C) and heart failure is the usual cause of death when the body 'core' cools to about 85°F (30°C) or below.



2 How long can I survive in cold water?

The accompanying graph shows predicted survival times of average adult humans in water of different temperatures. The figures are based on extrapolation of experimental cooling rates of average men and women who were holding-still in ocean water and wearing a standard life-jacket and light clothing. The graph shows, for example, that predicted survival time is about 2½ - 3 hours in water of 50°F (10°C). Survival time is increased by extra body fat and decreased by small body size. Although women generally possess slightly more fat than men, they cool about 15% faster (on the average) due to their usual smaller body size. Due to even smaller body size, children cool much faster than adults.



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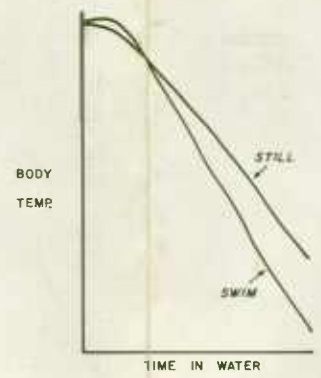
3 Should I swim to keep warm?

No! Although the body produces almost three times as much heat when swimming slowly and steadily (eg side stroke) in cold water compared to holding-still, this extra heat (and more) is lost to the cold water due to more blood circulation to the arms, legs and skin. Results show that the average person swimming in a life-jacket cools 35% faster than when holding-still.



4 How far can I swim?

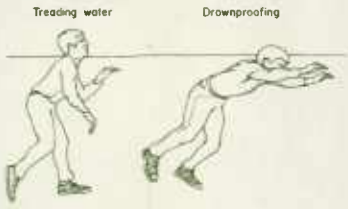
Shore *may* be close enough to reach by swimming despite a faster cooling rate with this activity. Tests conducted so far on people swimming in ocean water of 50°F (10°C) and who were wearing a standard life jacket and light clothing showed that the average person could cover a distance of 0.85 mile before being incapacitated by hypothermia. Therefore, at water temperatures near 10°C, shore should be within one mile before making the decision to swim.

5 What if I have no lifejacket or other flotation?

In this unfortunate situation, one is forced to adopt either of the following two 'anti-drowning' behaviours:

Treading water

Continuous movement of arms and legs in certain patterns keeps the head out of the water. Results showed an average cooling rate of subjects treading water that was 34% faster than while holding-still in a lifejacket.



Drownproofing

This procedure involves restful floating with lungs full of air, interrupted every 10 - 15 seconds for raising the head out of the water to breathe. By this procedure, even non-swimmers can avoid drowning for many hours. Unfortunately, this behaviour resulted in a body cooling rate in cold water (10°C) that was 82% faster than while holding-still in a lifejacket! This is mostly due to putting the head (a high heat loss area) into the water along with the rest of the body. In our studies so far, drownproofing appears to be the fastest way to die from hypothermia.

6 What body regions are the critical areas for heat loss?

In addition to the head (which is normally out of the water), certain other body regions have high rates of heat loss while a subject is holding-still in cold water. Infrared pictures show that the sides of the chest (where there is little muscle or fat) is a major route for heat loss from the warm chest cavity. Also, the groin region loses much heat due to large blood and lymph vessels near the surface. If an effort is made to reduce body heat loss, these regions deserve special attention.

7 Why do some people die within minutes of falling into cold water?

Immersion in cold water (especially if sudden) causes immediate major changes in body function. Heart rate and blood pressure rise sharply and occasionally result in heart attacks or ruptured blood vessels. This is more of a danger in older persons. Also, cold shock causes immediate 'hyperventilation' (over-breathing). If one has plunged underwater or is in big waves, the hyperventilation has been known to cause even 'expert swimmers' to aspirate water and 'drown'. In other cases, prolonged hyperventilation can cause changes in blood chemistry that lead to unconsciousness and possible drowning. Therefore, in a small percentage of accidents, *cold* water can kill even without hypothermia.

8 What behaviours will increase survival time?

Based on the heat loss information in question 6, two behaviours were tested that attempted to reduce heat loss from the 'critical areas':

H.E.L.P. (Heat Escape Lessening Posture)

This behaviour involves holding the inner side of the arms tight against the side of the chest over the 'hot' region shown in question 6. Also, the thighs are raised to close-off the groin region. This behaviour was indeed a significant help, resulting in nearly a 50% increase in predicted survival time.

Huddle

'Common sense' would predict longer survival time with huddling. Studies showed that if the huddle is formed so that the sides of the chest of different persons are held close together, a 50% increase in predicted survival time is obtained, similar to that of the H.E.L.P. behaviour.

9 Do different types of 'lifejackets' offer more or less thermal protection?

UVic results have shown that PFDs (Personal Flotation Devices) fall into three categories of thermal protection.

a 'Poor' thermal protection

All kapok lifejackets and loose-fitting foam lifejackets of the vest-type offered no significant protection from cold water.

b 'Fair' thermal protection

A few PFDs of two types offered some thermal protection to the extent of a 50% to 75% increase in predicted survival time. The types were foam vests that possessed good adjustability for close fit to the chest and garment-type 'flotation jackets' that use buoyant and insulative foam between the inner and outer layers of fabric.

c 'Good' thermal protection

Two PFDs of the type that make a deliberate attempt to significantly improve thermal protection showed nearly a four-fold increase in predicted survival time. One was a full 'survival suit' which included foam in the legs. The other was a convertible jacket, the 'UVic Thermofloat' which is modified to allow trapping of water within insulative foam over the major heat loss areas of the body.

10 Does alcohol consumption affect survival time?

Studies during the Second World War showed that the cooling rate is increased by about 20% when 'under the influence'. This is due to less shivering and more blood flow to the body surface. One would die 'happier' but sooner!

SUMMARY

The following table summarizes how a selection of different situations can affect predicted survival time of the average adult* in water of 50°F (10°C):

Situation	Predicted Survival Time (Hours)
NO FLOTATION	
Drownproofing	1.5
Treading Water	2.0
WITH FLOTATION	
Swimming	2.0
Holding-still	2.7
H.E.L.P.	4.0
Huddle	4.0
UVic Thermofloat	9.5

*Clothing worn was cotton shirt, pants, and socks, plus running shoes.