Coping with the cold

Simon Griffiths caught up with Dr Heather Massey to learn more about what science tells us about acclimatising to natural water conditions

As someone who was once hospitalised with hypothermia, I'm fascinated by the what science can tell us about adapting to and coping with the cold water. I would also prefer to avoid further hospital visits. I was therefore delighted to spend an hour on Zoom with Heather Massey – an expert on these things – and ask her all my questions.

Firstly, I wanted to know if acclimatisation involves an actual physical process or is getting used to the cold primarily a mental adaptation?

Putting aside the initial reaction to cold water for now (we'll return to this later), Dr Massey says there is evidence of physical acclimatization in cold water swimmers. "We call it insulative-hypothermic adaptation as cold swimmers shut down the blood vessels close to the skin more quickly and don't shiver until they reach a novel deep body temperature. As a result, they cool more slowly when swimming."

Shivering is a defence mechanism that generates heat in an attempt to protect the core. However, for swimmers, it has two disadvantages. Firstly, it is difficult to swim effectively while shivering. Secondly, shivering is energy intensive and will quickly burn through energy reserves that could have been used for swimming.

Delaying shivering until the core reaches a cooler temperature means an adapted swimmer feels comfortable in cold water for longer and conserves energy for swimming.

Note the dangerous downside to this adaptation: shivering only kicks in closer to the point of hypothermia than would happen in non-acclimatised people. The more acclimatised you are, the less likely you are to notice that you're dangerously cold and possibly close to hypothermia. Swimmers therefore are not the best judges of their thermal state as, feeling comfortable despite cooling down, they may stay in the water longer than they should.

Also, somewhat counter-intuitively, Dr Massey says that when stationary in cold water, acclimatised swimmers cool more quickly than someone that is not acclimatised. So, if you're an acclimatised swimmer, just keep swimming!

Size matters

The next question I had was: how important is acclimatisation in coping with cold water compared to other factors? Dr Massey's reply to this was unequivocal: your body's overall mass and your skin fold thickness are the most important factors.

The process of cooling is fundamentally driven by the laws of physics. Heat flows from warmer objects to cooler ones. A larger object takes longer to cool down than a small one of the same type. You can slow the process through insulative barriers (such as a wetsuit or clothing) but you can't stop it. Large people stay warm for longer than small people simply because they have more mass. Separately, body fat (measured by skin fold thickness) provides an insulative layer. And body shape matters too, specifically your surface area to volume ratio. A shorter, rounder figure is better suited to the cold than a tall lanky one of the same weight.

Interestingly, whether or not muscle provides an insulative barrier depends on its state. Perfused active muscle (ie, muscle that has a good blood supply) is not a good insulator, whereas unperfused muscle is less active and can be a good insulator (until it is being used). Perfused muscle is perfused as it is working. The increased blood flow is required to deliver oxygen and nutrients to the working tissues and remove waste products.

Another factor is your fitness. As well as losing heat through your skin to the water, your body generates heat through exercise. A fitter person can maintain a higher level of energy expenditure (and hence more heat production) than a less fit person. When your rate of heat production matches the rate of heat loss, your body temperature will be stable. Whether fitness is more important than acclimatisation isn't clear, but they are both less relevant than size and skin fold thickness.

What about "brown fat"? It's something we're asked about from time to time.

"We don't have the tools to test this empirically in our laboratory," says Dr Massey, "but current research evidence suggests it's not likely to be a big factor."

Unlike white fat, which makes up most of our body fat, brown fat has the capability to generate heat. However, it only makes a very small percentage of our total fat, and any heat it does produce is likely to be swamped by metabolic heat generated by your muscles as you exercise or shiver.

How to acclimatise

When you step into cold water (often defined as water below 15 degrees Celsius), your skin immediately begins to cool. This triggers an involuntary response in your body that results in gasping for breath, an elevated heart

rate and possibly a sense of panic. This is known as "cold water shock" and can lead to drowning. The effect typically lasts a couple of minutes. Both scientific studies and regular observation of swimmers tell us that you can significantly reduce your cold water shock response through repeated exposure to cold water. Around five or six immersions over a few weeks will be sufficient. The adaptation is water temperature specific. Repeated immersions at 15 degrees won't help you much for 10 degrees.

Interestingly, adapting to the initial cold water response does not appear to give you any acclimatisation benefit to longer duration exposures. This was tested in an experiment that Dr Massey was involved in, which required immersing volunteers in 12 degree water for varying time periods up to 90 minutes while monitoring their core body temperature with a rectal thermometer – an experiment I'm very relieved I didn't sign up for.

However, unlike the cold water shock response, the adaptation is not specific to the water temperature but to the temperature your core drops to. To adapt to cold water, you have to stay in long enough for your core to cool. In colder water, your temperature will drop more quickly, so 20 minutes exposure in April might result in the same core temperature cooling as an hour in June when the water is warmer. Once your core drops below the temperature to which it has adapted to, the normal defence mechanisms (primarily shivering) will kick in. If this happens, you should immediately leave the water, dress warmly and shelter from the wind.

Above: Repeated exposure to cold water will reduce your cold water shock response

Below left: Team Outdoor Swimmer at the UK Cold Water Swimming Championships

How long?

I was curious to know how long it takes to acclimatise – how many exposures and what frequency of exposure – and how long does acclimatisation last once you stop swimming in cold water? Science doesn't yet have answers to this. And, as Dr Massey explained, it would be difficult to design a suitable experiment as any testing of subjects would provide an additional adaptation stimulus. Other factors are also tricky to control for. A subject's weight, for example, might fluctuate over the study period.

Dr Massey's best guess is that the acclimatisation methods derived through trial and observation by Channel swimmers are probably pretty good – frequent, regular exposure of an increasing duration over a period of several months.

We know that the cold water shock adaptation is retained for a significant period of time. Studies show that we retain about 50% of the reduction on cold shock response over a 14 month period. Observation and anecdotal evidence suggest that acclimatisation may also be retained from one season to the next and that it may strengthened over a number of years of continuous swimming. We also know (although it's not been measured) that acclimatisation can be detrained if the stimulus isn't maintained.

In brief, your body adapts to the stimulus you provide it

Expert advice

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