Cryotherapy

Introduction

Cold therapy is a common method to help reduce pain and swelling in a more comfortable way. In this review, we'll focus on two types of cold therapy that have gained attention lately: whole-body cryotherapy and partial-body cryotherapy. These treatments aim to provide both physical and mental benefits for people in the fields of medicine, health, and sports.
During cryotherapy, people wear minimal clothing and are exposed to very cold air, usually at -110°C or lower, for a short period, typically 1 to 4 minutes. Even though scientists are getting more interested in these methods, we still lack information about the specific equipment and techniques used. Furthermore, there's no clear guide on how the temperature, duration, number of sessions, and the desired results are connected.

The goal of this review is to compare the effects of whole-body and partial-body cryotherapy, especially when it comes to the skin temperature. We also want to classify the different methods used during the treatment based on the results they aim to achieve. It's important to note that there's not enough information available about the actual temperatures inside the cold therapy cabin or chamber during treatment, and the methods used can vary widely in the scientific literature.

In the past, people in ancient Greece, Persia, and the Roman Empire used cold treatments like snow, icy water mixtures, and cold water to help with various illnesses. Nowadays, in Nordic countries, many people practice something called "winter swimming," which means taking a chilly dip in cold water during the winter to stay healthy. These winter swimmers believe it helps them get sick less often and cope better with daily stress (Huttunen, Rintamäki and Hirvonen, 2001).

Today, we're still exploring the benefits of cold therapy in the fields of medicine, health, and sports. In this review, we'll mainly look at two newer cold therapy methods: whole-body cryotherapy (WBC) and partial-body cryotherapy (PBC). These methods involve exposing a person to extreme cold for a short time in a special cold chamber or cabin, known as a cryochamber or cryo-cabin. The goal is to help improve both the body and the mind.

The two most investigated domains are improvements in mental and physical health and improvements in recovery after physical exercise (Bleakley and Hopkins, 2010) (Guillot *et al.*, 2013).

A good way to check how well different cryotherapy and cryostimulation methods work is by looking at how they affect your skin temperature. When your skin gets really cold, it wakes up the temperature sensors in your skin and tells your body's temperature control center in the brain, called the hypothalamus, that things are chilly. This makes some special nerve fibers in your body get active, which makes your small blood vessels squeeze tight, and it slows down how quickly your nerves send signals (Herrera *et al.*, 2010).

This can also make your core (deep inside your body) and muscle temperatures change a bit, but not a lot. After a short cold treatment, these temperatures don't drop by a lot right away (Costello *et al.*, 2014)

In the past, researchers studied people who swim in cold water during the winter to see how it affects their well-being (Huttunen, Rintamäki and Hirvonen, 2001) These studies found that getting used to the cold water made people feel less stressed and tired and improved their mood and memory. Winter swimmers also said they felt more lively, full of energy, and active after four months of winter swimming (Huttunen, Rintamäki and Hirvonen, 2001).

After seeing these positive effects of cold exposure in winter swimmers, whole-body cryotherapy (WBC) and partial-body cryotherapy (PBC) were later used in the world of sports. Researchers found that these cold treatments could help athletes recover better after exercising.

lthough it's not entirely clear, the way cold therapy helps with pain relief, reducing inflammation, and improving recovery after exercise seems to be linked to a few things. When you're exposed to cold, it can act like a natural painkiller, and it also helps lower the amount of oxidative stress and inflammation in your body (Pournot *et al.*, 2011) (Leppäluoto *et al.*, 2008) (Hausswirth *et al.*, 2013) (Hausswirth *et al.*, 2011)

The cold also slows down how your nerves send signals and reduces the production of a chemical called acetylcholine. But, at the same time, it revs up your body's sympathetic system, releasing a chemical called noradrenaline and causing your blood vessels to get narrower (vasoconstriction). This can all work together to help ease pain and reduce soreness in your joints and muscles (Leppäluoto *et al.*, 2008). Noradrenaline is produced in both your peripheral nerve endings and a part of your brain (brainstem nuclei) (Pertovaara *et al.*, 1991)

Furthermore, in animal studies, when a substance called noradrenaline was given in the spine or when humans received injections of a drug that stimulates certain receptors, it helped reduce pain (Pertovaara *et al.*, 1991) (‘Epidural clonidine study 1989)

Noradrenaline travels in the bloodstream and can reach the spinal cord through the arteries that supply the back part of the spinal cord, where nerve endings from the skin that transmit pain signals end. So, when you're exposed to cold, it can cause an increase in noradrenaline, which might be one way it reduces pain in the spinal cord.

What's more, many studies have found that cold exposure can decrease the amount of oxidative stress (harmful substances in the body) and increase the body's ability to defend against them (Dugué *et al.*, 2005) (Lubkowska *et al.*, 2010) (Lubkowska *et al.*, 2011) (Lubkowska, Dołęgowska and Szyguła, 2012). It can also reduce inflammation by lowering the production and release of substances that cause inflammation and increasing the production and release of substances that fight it (Miller *et al.*, 2010) (Lubkowska *et al.*, 2011).

Another important benefit of whole-body cryotherapy (WBC) and partial-body cryotherapy (PBC) in exercise recovery is that they can help you get better sleep (Bouzigon *et al.*, 2014). This improved sleep quality can be quite helpful for patients.

Interestingly, there have been very few studies that specifically look at how different treatment plans, like how cold it is, how long you're exposed, and how many times you do it, relate to the results you get, except for three studies by Lubkowska and her team (2010, 2011, 2012) that compared the effects of 20 WBC sessions with 10 and 5 sessions.

Whole body cryotherapy for fatigue, muscle aches, and pain

Exercise following cancer treatments such as surgery, chemotherapy and radiotherapy can be challenging. Many patients will have low mood, possibly menopausal side effects such as joint and muscle aches, Iand even modest workouts can sometimes lead to muscle damage and inflammation. You might experience muscle soreness,

swelling, and a temporary loss of muscle strength after exercising hard. When you push yourself, your body releases some substances that can increase inflammation, like C-reactive protein (CRP) and certain proteins called cytokines, such as TNF-α, IL-1β, IL-2, IL-8, and IL-6, into your bloodstream (Chatzinikolaou *et al.*, 2010) (Ostrowski *et al.*, 1999). In response to this, your body releases some other substances, like interleukin 1 receptor antagonist (IL1-ra) and the anti-inflammatory cytokine IL-10, to help control the inflammation.

Whole-body cryotherapy (WBC) is a treatment that can help reduce this inflammation that happens after exercise. A study looked at how WBC could help after a simulated training race. Well-trained runners did a tough 48-minute workout, and then they did four sessions of WBC at -110°C for 3 minutes each, with breaks at -10°C and -60°C in between (Pournot *et al.*, 2011). They did the WBC sessions right after the workout and then at 24 hours, 48 hours, and 72 hours later.

The study found that a single WBC session right after exercise made a big difference. It lowered the increase in IL-1β one hour after exercise, increased IL1-ra one hour and 24 hours after exercise, and limited the rise in CRP from 24 hours to 48 hours after exercise when compared to not doing WBC. This means that WBC helped control the inflammation that happens because of exercise, especially when the muscle damage

was mild to moderate. So, WBC can be a helpful tool in recovering from intense workouts.

In a study with eleven healthy individuals, they found that partial-body cryotherapy (PBC) made things better for them after doing plyometric exercises (Fonda and Sarabon, 2013). They did PBC treatments for six days in a row after their workout, and the first one happened just an hour after they finished exercising. During the sessions, they were exposed to super cold temperatures, ranging from -140°C to -195°C, for three minutes each time.

Here's what they found:

- The individuals who did the PBC felt less pain than the ones who didn't from the first PBC session to the fourth one (up to 72 hours later).
- The PBC group had more power when they did squat jumps right after the first PBC session.
- Their ability to produce maximum force and how quickly they could build up that force improved after the second PBC session (around 24 hours later).

So, PBC seemed to help these individuals recover better after their plyometric exercises, reducing pain and making their muscles work better.

Cryotherapy and Sleep Quality

Getting good sleep is really important to recover and perform your best (Samuels, 2008). Recently, two studies have shown that whole-body cryotherapy (WBC) and partial-body cryotherapy (PBC) can help improve sleep quality.

In the first study, ten elite synchronized swimmers went through a tough training period, and they did fourteen sessions of 3-minute WBC at -110°C, one session each day for two weeks. This study found that the cryotherapy sessions made a positive difference. Athletes taking the cryotherapy had an easier time falling asleep, had better sleep quality, and felt less tired compared to those who didn't have cryotherapy

(SCHAAL *et al.*, 2015) So, it seems that cryotherapy can help athletes get the good sleep they need to recover and perform at their best. It was like they got better sleep.

In the second study, they looked at 27 elite basketball players during international competitions. After just one 3-minute session of partial-body cryotherapy at -130°C, the players felt like their sleep quality improved by 15% (Bouzigon *et al.*, 2014) So, even a single cryotherapy session can help athletes sleep better and feel more refreshed.

Cryotherapy and mental health and well-being

Depression can sometimes be linked to problems in the brain's biology, especially in how the hypothalamic-pituitary-adrenal axis works. The brain's opioid peptide systems, which are like natural pain-relief systems, are important for things like motivation, emotions, relationships, how we respond to stress and pain, and even our eating habits (Nestler *et al.*, 2002)

It looks like whole-body cryotherapy (WBC) can have positive effects on both physical and emotional pain because it activates these natural pain-control systems in our body. This reaction might be helpful in treating mental health issues (Rymaszewska, Ramsey and Chładzińska-Kiejna, 2008)
In some studies, people with spinal pain or joint problems felt better when they did ten sessions of 3-minute WBC treatments. Their overall well-being, quality of life, and mood improved (Szczepańska-Gieracha *et al.*, 2014). So, it seems like WBC could be a useful tool in making people feel better, not just physically, but also emotionally.

Conclusion

While further research is needed to explore the full extent of cryotherapy's potential, the existing evidence supports its role as a valuable tool for individuals seeking pain relief, enhanced well-being, and improved exercise recovery.

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