Editorial•In Their Own Word

Cochrane review: whole-body cryotherapy (extreme cold air exposure) for preventing and treating muscle soreness after exercise in adults

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Delayed-onset muscle soreness, or 'DOMS', affects many people after exercise and can impair future performance. It usually peaks one to four days after exercise and several strategies are used to overcome it. The effectiveness and safety of many of these strategies applied and promoted is unknown.

In this Cochrane Review we sought to examine the effects and safety of whole-body cryotherapy, a method of recovery which is gaining popularity in sports medicine (1). The use of extreme cold dry air was initially intended to treat patients with conditions such as multiple sclerosis and rheumatoid arthritis; but elite athletes (including the English and Welsh rugby teams during the 2015 World Cup) use the treatment to alleviate DOMS after exercise and to improve recovery (2).

Whole body cryotherapy involves exposing individuals to extremely cold dry air, which means below -100°C, for two to four minutes in a specialised cabin or chamber (3-5). Therapy typically occurs within 24 hours of the exercise, and is often repeated on the same day or over several days. Users wear minimal clothing, such as shorts for men and shorts and a crop top for women. They might also wear gloves, a woollen headband over their ears, a nose and mouth mask, and dry shoes and socks to reduce the risk of cold-related injury. No guidelines currently exist for clinical effectiveness or for its safe use. The potential for harms from both short and long-term use through a person's sporting career is unknown. Cryotherapy is thought to work through reductions in muscle, skin and core temperature which stimulate cutaneous receptors and excite the sympathetic adrenergic fibres, causing constriction of local blood vessels (3-5). The theory is that this will relieve soreness by reducing muscle metabolism, skin microcirculation, receptor sensitivity and nerve conduction velocity. It might also have a psychological benefit by reducing the subjective feeling of DOMS after exercise.

Eligible studies for this review included randomised, quasi-randomised controlled trials and cross-over studies which evaluated whole-body cryotherapy for the prevention and treatment of muscle soreness after exercise in adults. We included trials completed in laboratory or field settings, as long as at least one group in the trial were treated with whole-body cryotherapy before or after exercise. The review focused on adults undertaking any level of exercise and excluded studies which included children and people who

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were contraindicated for cryotherapy (e.g. vascular problems or Raynaud's disease). All studies were required to have measured the primary outcomes of muscle soreness, subjective recovery or adverse effects. We searched both topic specialist and trial registries, and five bibliographic databases from inception. The study identification strategy also included hand-searched databases, conference proceedings and speaking to experts.

We found four eligible studies. All were randomised trials, with two using a parallel group design and two using a cross-over design. Two reviewers independently assessed the 'risks of bias' (trustworthiness) of all studies. Unfortunately, all four studies had design features that carried a high risk of bias (design flaws for which empirical evidence indicates that they typically report or over inflate favourable results), thus limiting the reliability of the finding.

The four trials were published between 2010 and 2014. The studies were done in laboratory settings in single centres in France, Ireland, Slovenia and Brazil. In total, there were data for 64 trial participants, only 4 of whom were women. The type, duration and intensity of exercise performed varied across studies, but generally had very short period of follow-up. In three studies, the exercise was designed to produce DOMS under laboratory controlled conditions. The other study used a 48 minute simulated trail run on a treadmill.

Two studies used whole body cryotherapy that exposed participants to a temperature of -110°C in a specialised cryotherapy chamber. The other two used partial-body cryotherapy in a cryo-cabin where the head, neck and shoulders were not exposed. These used temperatures of -110°C and between -140 to -195°C.

Meta-analysis was used to pool the data of comparable groups of trials. Taking all the evidence together and comparing the effects of whole body cryotherapy against cooling control intervention or a sham treatment, there was very low quality evidence for lower self-reported muscle soreness at 1, 24, 48 and 72 hours after exercise. However, this was not statistically significant, nor clinically meaningful, and is consistent with no differences or an exaggerated benefit in favour of the control group (6). As the quality of the evidence was graded as very low quality, it may be reasonable to assume that a clinically meaningful benefit was absent. Although we were also interested in adverse effects, none of the trials reported purposefully assessing for these.

In summary, the body of evidence in this review does not support the hypothesis that whole body cryotherapy effectively reduces muscles soreness and or improves subjective recovery, after exercise in physically active young men. There is no evidence on its use in women or elite athletes. It's also important to note that the lack of evidence on adverse events means that one cannot be confident that this exposure to extreme cold air in either the short or long term is without potential harms. Therefore, given the limitations of the evidence, the safety concerns, and the self-limiting nature of most forms of muscle soreness after exercise, claims of benefit and safety are unsupported by current research. This, along with its increasing use in elite and recreational sport, and its costs, means there is an urgent need for high-quality, well-reported research.

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