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Commentary

An Evidence-Based Approach to Utilizing Cold Therapies for Post-Exercise Recovery

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Abstract: Whilst cold therapies such as cold-water immersion are regularly used in practice, the practical application does not always align with best practices. In this commentary, we highlight the key components of the British Association of Sport and Exercise Sciences (BASES) Expert Statement on the use of cooling therapies for post-exercise recovery and provide additional discussion on the empirical evidence and rationale that informed our perspective. We developed a series of specific questions to ensure that cold therapy recovery protocols are context-specific and tailored to the needs of the individual athletes. These questions, which cover the WHEN, WHAT, and HOW of cold therapy, were central to the development of the Expert Statement. This was presented as a decision tree to ensure that key messages could be concisely disseminated across a range of sporting environments and populations (e.g., gyms, locker rooms, and treatment rooms), supporting and informing decision-making for those wanting to use cold therapy to assist their recovery in line with previously published peer-reviewed work. Discussion points included the suitability of cooling therapies in some contexts, how athletes' choice of cooling mode should be largely driven by practicalities (e.g., budget and availability), and, lastly, future research directions.

Keywords: cold therapies; recovery; real-world application

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1. Introduction

Each year, the British Association of Sport and Exercise Scientists (BASES) produces a series of Expert Statements with the aim of providing concise, evidence-based guidance on a series of topics identified to be of interest to those working in applied practice. We recently produced an expert statement that focused on the use of cold therapies in post-exercise recovery [1]. The motivation behind the Expert Statement and this subsequent commentary was to provide evidence-based recommendations/guidance to applied practitioners when using cold therapies for recovery. Whilst cold therapies such as cold-water immersion (CWI) are regularly used in practice, the practical application does not always align with best practice [2]. In this commentary, we highlight the key components of the BASES Expert Statement and provide additional discussion on the empirical evidence and rationale that informed our perspective on the use of cooling therapies for post-exercise recovery.

Regular training and competition can compromise physiological function, directly impacting sporting performance and/or reducing the capacity to train at the desired intensity. For the modern athlete, it is essential that recovery can be achieved quickly and optimally so that the required levels of performance can be maintained (or improved) across

the competitive annual cycle [3]. Cold therapies are often used to maintain and/or improve multiple facets of physical and mental recovery in elite and recreational sports and are typically administered in the hours immediately after exercise. It has been suggested that to effectively return the human body to homeostasis following exercise, an individualized [4] or periodized approach [5] to recovery should be taken. We developed a series of specific questions, to ensure that cold therapy recovery protocols are context-specific and tailored to the needs of the individual athletes. The questions were based on the following themes: individual preferences, the current athletic training phase, the mode and intensity of training, environmental conditions (e.g., heat), and other mitigating factors (e.g., travel, nutrition, and sleep). These questions, which cover the WHY, WHEN, and HOW of cold therapy, were central to the development of the expert statement. This was presented as a decision tree (Figure 1) to ensure that key messages could be concisely disseminated across a range of sporting environments and populations (e.g., gyms, locker rooms, and treatment rooms), supporting and informing decision-making for those wanting to use cold therapy to assist their recovery in line with previously published peer-reviewed work.

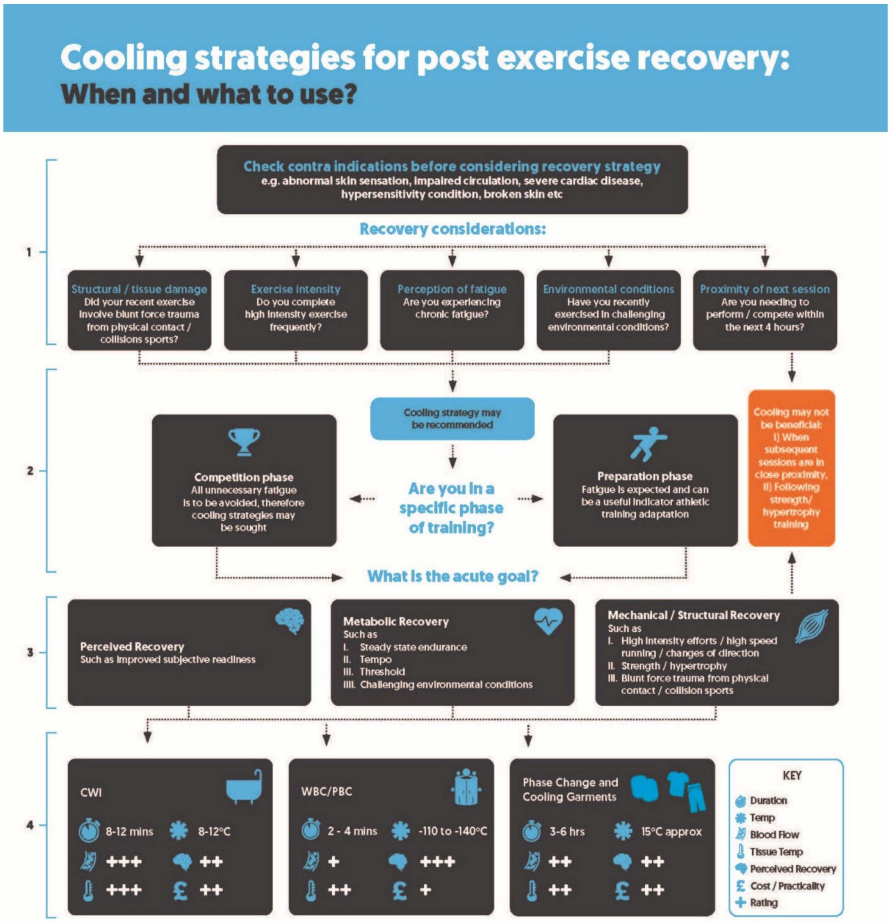

Figure 1. Decision tree to assist in the application of post-exercise cooling strategies [1] (first published in *The Sport and Exercise Scientist*, Issue 70, Winter 2021. Published by the British Association of Sport and Exercise Sciences—www.bases.org.uk, accessed on 1 August 2024). CWI: cold water immersion, WBC: whole-body cryotherapy, PBC: partial-body cryotherapy.

2. WHY Cold Therapies Can Assist Post-Exercise Recovery

The principal purpose of cold therapies is the removal of heat from the body, largely by way of reductions in core and tissue temperatures and alterations in blood flow [6]. These mechanisms have long been thought to assist in recovery from exercise and protection against secondary tissue damage by reducing temperature and blood flow at the site of muscle damage, suppressing metabolic demand and limiting the inflammatory response [7].

The efficacy of cold therapies is further seen in a reduction in pain through analgesic benefits via a reduction in sensory nerve conduction velocity [8]. Ultimately, a plethora of evidence exists to support cold therapy's efficacy in reducing pain and enhancing the return to play/training [9–11].

3. WHEN Can Cold Therapy Be Useful?

Importantly, and regardless of the circumstances, cooling therapies are not suitable for individuals with contraindications. For example, this is particularly important when athletes have a history of cardiovascular disorders, high blood pressure or arrhythmias, kidney disease, a history of seizures, Raynaud's syndrome, bleeding disorders, disorders exacerbated by cold exposure, or any other contraindications [12]. Therefore, all athletes should seek guidance from a physician prior to undertaking any therapeutic cooling.

Step 1 in the decision tree identifies fundamental questions that evaluate whether cold therapy should be the preferred recovery strategy or whether alternative approaches may be more suitable. Indeed, previous research tells us that cooling therapies are particularly beneficial in circumstances in which the environmental conditions are extreme [13], of a particularly high intensity or damaging nature [14], or the perception of fatigue is high [9]. On the other hand, it is just as important to recognize times at which cooling therapies are less useful and should even be avoided; for example, if an athlete has a subsequent training session or competition within the next few hours, it is widely agreed that warm muscles perform better than cold muscles [15].

If it is decided that cooling therapies may be useful, Step 2 in the decision tree (Figure 1) directs the reader to consider the current phase of training that the athlete is in. A plethora of work suggests that cooling therapies are of particular benefit when athletes are undertaking a series of training bouts over consecutive days. The recovery mechanism may be a reduction in pain or the increase/maintenance of mobility; the corollary is that the athlete can work more consistently during each training session, thereby maximizing their net training stimulus for adaptation [9]. In a practical sense, following a particularly difficult, intense, or muscle-damaging session, cooling therapies might offer a greater recovery to allow the athlete to return to training the following day and produce a similar training stimulus for adaptation, whether that is due to a reduced perception of pain or enhanced/maintained mobility or performance [9]. However, one contentious point of interest is the contradiction existing between endurance training adaptations and resistance training adaptations. Work in the past decade has strongly emphasized a paradox whereby post-exercise cold therapies might enhance endurance-based adaptations, yet for resistance-based adaptations, there seems to be a dampening effect [4]. Often translation of this science into practice is miscommunicated or exaggerated across social media.

Much of the research undertaken on endurance athletes suggests that post-exercise cooling (particularly CWI) is associated with an acute augmentation of molecular signals that drive processes such as mitochondrial biogenesis and angiogenesis [4,16], two key processes when training towards a more endurance-based phenotype. Although these changes have not been seen to develop into long-term functional changes, there is nothing to suggest that post-exercise cooling has any deleterious effects on long-term endurance-based adaptations.

There is concern that post-exercise cold water immersion (CWI) may attenuate key adaptations to resistance training, such as hypertrophy. While empirical data support this, it is incorrect to suggest that post-exercise cooling eliminates all resistance-based adaptations. An important caveat is that positive adaptations to resistance training are still observed with CWI; they are just smaller than those observed in active recovery controls. There is further evidence to show that functional changes in strength or power are not affected [17–20]. More recently, others have suggested that the magnitude of the effect that CWI has on strength adaptations is moderated by the timing and nature of the intervention; for example, avoiding the use of CWI in close proximity to a strength-based session seems to prevent any dampening effect [4]. A recent meta-analysis also found that dampening of

strength gains was only observed when individual limbs were cooled, whereas there were no detrimental effects when whole-body immersion was used [21].

Researchers and practitioners alike should note the potential for post-exercise CWI to dampen resistance-based training adaptations. These data highlight the nuanced association between CWI and post-exercise adaptation, emphasizing the importance of taking a periodized and individualized approach. None is more important than the next step of the decision tree: what is the acute goal? If it is improvement in strength and hypertrophy, then perhaps post-exercise cooling should be carefully (re)considered (orange box, Figure 1). However, if the acute goal is to return to training and competition at the same level (if not better) then a plethora of data exists to support cold therapies improving metabolic and perceived recovery, much of which has been explained in detailed reviews outlined previously [9,22–24].

4. HOW Should Cold Therapy Be Used?

There is discordance in the literature on the most appropriate methods of application. Within the BASES Expert Statement, a series of reviews, meta-analyses, and original articles were used to inform practitioners on HOW to use cold therapies to promote recovery in their athletes. Indeed, our previous work highlighted the lack of agreement in protocols used between coaches, athletes and practitioners, with practitioners often utilizing temperatures and durations that more closely align with the empirical data [2].

Ultimately, the purpose of using cold therapies is to reduce core, skin, or tissue temperatures to a suitable level so that the purported physiological mechanisms of action take place. For example, Vromans and colleagues identified that a significant reduction in muscle tissue temperature can be achieved by utilizing a CWI protocol with a ratio of 1:1.1 for temperature to duration [25]. Figure 1 herein summarizes the current evidence regarding the most commonly used (and perhaps appropriate) temperature and duration of cold therapies to assist in post-exercise recovery. Specifically, CWI recommended exposure is 8–12 min at 8–12 °C, and WBC and PBC recommended exposure is 2–4 min at −110–140 °C. Meanwhile, phase change and cooling garment exposure is recommended for 3–6 h at approximately 15 °C.

5. Translation of Science to Practice and Real-World Scenarios

The use of cooling therapies for recovery purposes can be an effective approach when used in an appropriate way. One of the major challenges facing practitioners is the practical implementation of such methods in the real world. As outlined in the present article, there are several barriers to implementing such methods. These include but are certainly not limited to budget availability, athlete preference, and practical barriers. It is important to note that cooling therapies would be of most benefit to athletes who are regularly exposed to exercise stress.

In terms of budget, the use of cooling therapies for recovery is generally low-cost for practitioners to implement. There are different levels of cost depending on the budget availability. For example, if practitioners are looking to use cold water immersion, then at a basic level a simple tub filled with cold water and ice would provide some form of cooling stimulus. If the budget would allow for further spending, then an organization may look to purchase a temperature-controlled cold water bath, which would allow for more consistent administration of cold water immersion protocols. Whole-body cryotherapy (WBC) has emerged in recent years as a popular cooling therapy method for recovery due to its dry application and perceived benefits reported by athletes [12,26]. WBC does present a cost issue, particularly if an organization is looking to purchase/rent a system including upkeep costs. Again, if the budget allows and athlete buy-in for this method is high, then it may justify the cost.

Athlete preference plays a key role in which cooling therapy is adopted by practitioners as part of the recovery protocols. Some athletes have a genuine fear of the cold, particularly cold water immersion, and this must be factored in when creating recovery protocols.

Athletes also have a personal preference relating to perceived placebo effects relating to particular cooling therapies [2,6]. There are practical challenges faced by practitioners when administering cooling therapies in real-world scenarios. For example, if a team plays away from home, then they may be limited in terms of equipment available to administer cooling therapies. This may then limit the options available for athletes to choose from. This is where having practical options, such as wearing phase change material packs on the team bus, is of great benefit to ensure that athletes stick to a cooling therapy-based recovery protocol.

There is still significant ambiguity within the current research literature around when cooling therapies should be administered within training frameworks. Clearly, it makes sense to administer therapies following competition during the in-season phase. However, during a typical microcycle, in which the training load varies, there is currently a lack of evidence in the literature around when it is best to administer cooling therapies or when it is best to let the body recover either naturally or via other methods. An example of this notion is that cold water immersion might enhance endurance adaptation but dampen resistance adaptation, as highlighted earlier in the present commentary. This may lead practitioners to administer cooling therapies following different types of training sessions using a recovery periodization-type framework. Whilst there is some evidence both for and against these notions, there is no clear empirical evidence using higher-order evidence (e.g., randomized control trials) to support their application.

6. Conclusions

In summary, the authors hope the present commentary helps to provide scientific discussion around the practical use of cooling therapies for recovery purposes. Below is a summary of the key discussion points raised:

- Cooling therapies will be of most benefit to athletes who are regularly exposed to exercise stress, with strong mechanistic effects seen for the perception of pain, fatigue, and metabolic recovery.
- Athletes undertaking multiple sessions in proximity (e.g., within 4 h) and/or strength/hypertrophy training may not benefit from post-exercise cooling, as it could be detrimental to adaptation and/or performance.
- Athletes' choice of cooling mode should be largely driven by practicalities (e.g., budget and availability) and athlete preference.
- There is a need for future research using large, multi-centre randomized controlled trials comparing CWI vs. WBC/PBC vs. PCM.

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