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PHYSIOLOGICAL EFFECTS OF COLD WATER IMMERSION AFTER EXERCICES

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Abstract

Aim. The aim of the present study was to assess the effects of cold water immersion (CWI) after training on the recovery of physical performance, muscle damage, and muscle soreness in professional soccer players. At the same time, we want to investigate the benefits of water immersion in football, focusing on its potential to improve pain management and prevent injuries.

Methods. We searched the following computerized databases: PubMed, Web of Knowledge, Google Scholar, and the websites of the Federation Internationale de Football Association (FIFA). The aim of this research was to specify the elements of recovery in football performance based on scientific studies and practical experience.

Results. Some studies suggest that immediate immersion post-exercise is more beneficial, while others propose a delayed approach.

Conclusions. Numerous studies have explored the effects of cold water immersion (CWI) in sports. Overall, CWI has been found to effectively reduce muscle soreness and accelerate recovery after intense exercise. It works by constricting blood vessels, reducing inflammation, and potentially minimizing muscle damage. However, there is some variability in individual responses, and the optimal timing and duration of CWI remain subjects of debate. While CWI appears promising for short-term recovery, its long-term impact on performance gains requires further investigation. Athletes and practitioners should consider individual preferences and the specific demands of their sport when incorporating CWI into their recovery strategies. Studies suggest that immediate post-macth immersion, ideally within the first hour, is more effective. The key aspects of procedure is water temperature, commonly ranging from 10 to 15 degrees Celsius, and immersion duration, often between 10 to 20 minutes.

Keywords: football, recovery, water immersion, muscle soreness

Introduction

Players may undergo cold water immersion, also known as ice baths or cryotherapy, to help reduce muscle soreness and inflammation after intense training sessions or matches. This practice is believed to aid in quicker recovery and improve overall performance. However, individual responses to such methods can vary, and it's essential for teams to carefully monitor and tailor these recovery strategies based on the players' needs and health considerations. The use of cold temperatures may promote quicker recovery than applying heat. The application of heat can increase edema and the inflammatory response, which are both counterproductive to recovery (Wilcock IM., et al., 2006). Conversely, cold exposure can induce numerous positive physiological changes including analgesia, edema reduction through reduced fluid diffusion, vascular permeability, and decreased localized vasoconstriction, as well as reduced acute inflammatory responses resulting from muscle damage (Swenson C., et al., 1996). The cold water immersion (CWI) procedure after training involves submerging the body, typically limbs, in cold water to exploit its physiological effects on recovery. Studies suggest that immediate post-exercise immersion, ideally within the first hour, is more effective. Key aspects include water temperature, commonly ranging from 10 to 15 degrees Celsius, and immersion duration, often between 10 to 20 minutes. This induces vasoconstriction, reducing muscle blood flow, which aids in minimizing inflammation and muscle soreness. Despite its benefits, individual responses and the specific nature of the training should influence the decision to incorporate CWI. Fine-tuning the procedure based on personal preferences and sport-specific demands enhances its effectiveness in optimizing post-training recovery.

Methods

We searched the following computerized databases: PubMed, Web of Knowledge, Google Scholar, and the websites of the Federation Internationale de Football Association (FIFA). The aim of this research was to specify the elements of recovery in football performance based on scientific studies and practical experience.

Physiological benefits of Cold Water Immersion

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Cryotherapy, either in the form of cold water immersion (CWI) is becoming an increasingly popular recovery strategy employed by athletes (Hohenauer, Taeymans, Baeyens, Clarys, & Clijsen, 2015).

Changes in physiological mechanisms resulting from a decrease in muscle and/or skin temperature include: reduced inflammation, analgesia, reductions in cardiovascular strain, decreased blood flow, reduced tissue metabolism, increased removal of muscle metabolites as well as neuromuscular, cardiovascular and hormonal changes (Ihsan, Watson, & Abbiss, 2016). The main effects of acute cold exposure on human body physiology are shown in Figure 1.

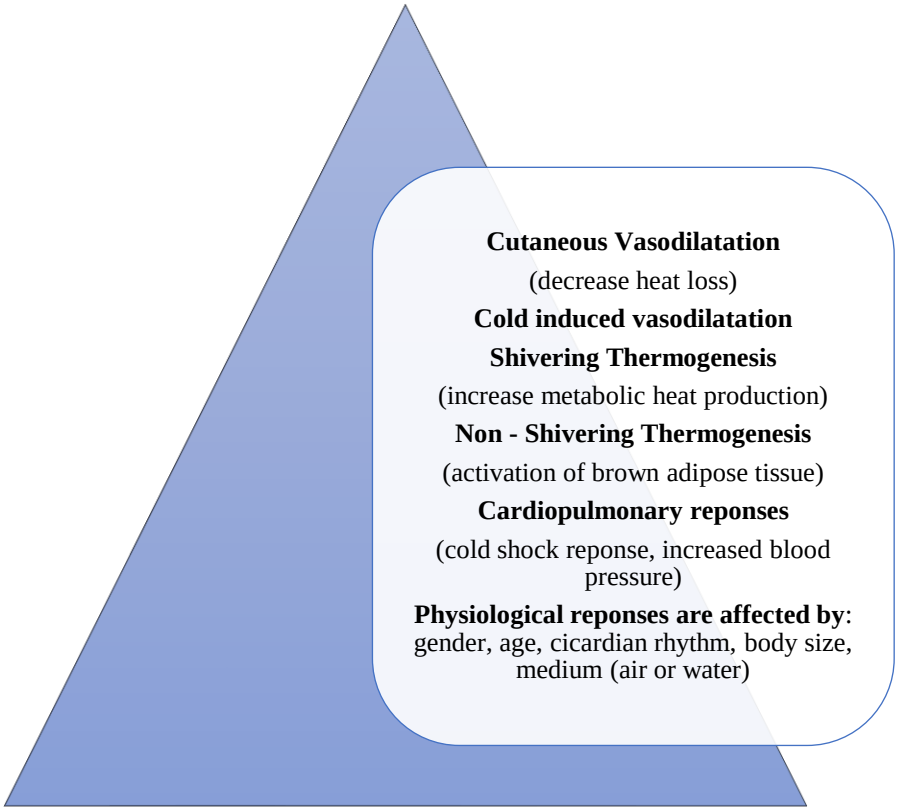

Fig. 1 Physiological responses to cold water immersion (CWI)
source: Esperland D., et al., (2022)

Benefits of Cold Water Immersion in Football

CWI has become the most popular recovery strategy in soccer due to its ease of implementation and low cost, but despite its high use, the results of its benefits remain unclear.

Although the mechanisms related to the benefits of CWI are not completely understood, it has been suggested that the decrease in muscle temperature causes a reduction in the metabolic rate, reactive oxygen species (ROS) production, and the inflammatory process, which may minimize secondary muscle damage (White, G. E. & Wells, G. D. 2013).

Cold water immersion (CWI) research in football often investigates its impact on inflammation, which is a key concern given the high physical demands of the sport. Inflammation is a natural response to the muscle damage caused by intense exercise, such as playing a football match.

Studies involving CWI often measure blood levels of biomarkers associated with inflammation, such as C-reactive protein (CRP), interleukin-6 (IL-6), and creatine kinase (CK). Some research has found that CWI can reduce the elevation of these markers after intense exercise, suggesting a dampening effect on the inflammatory response. CWI may help reduce the extent of muscle damage by limiting the inflammatory response and the associated secondary damage that can occur after the initial exercise-induced muscle trauma. For the 48 h recovery of muscle damage, CWI do not provide conclusive evidence that they can be used as techniques to enhance functional and perceptual recovery after a soccer match (Tiago M.C., et al., 2021).

Delayed onset muscle soreness reduction (DOMS): is partly caused by inflammation, and CWI has been shown to help reduce the severity and duration of DOMS in football players, which may be indicative of its effects on the inflammatory process.

DOMS commonly peaks between 24 and 48 hours (in some reports up to 72 hours) after exercise and is characterised by muscle shortening, increased passive stiffness, swelling, decreases in strength and power, localised soreness and altered proprioception (Proske U, Morgan DL., 2001).

Some of these studies demonstrated that this recovery strategy reduces subjective ratings of DOMS and perceived exertion, attenuates indirect markers of muscle damage , and accelerates the recovery of functional muscle performance (Machado, A. F. et al 2016).

Cytokine Response: Exercise can trigger an increase in pro-inflammatory and anti-inflammatory cytokines. Studies have shown that cold water immersion (CWI) reduce blood cytokine levels, which may inhibit the development of inflammation after exercise (Roberts L.A., et al., 2014). It's important to note that while CWI might reduce certain markers of inflammation in the short term, the long-term effects are not as well understood. Inflammation is a crucial part of the body's repair process and is necessary for adaptation to training. Moreover, the effectiveness of CWI in reducing inflammation may depend on various factors, including the timing, duration, and temperature of the immersion, as well as individual differences among players.

Research in this area is ongoing, and while CWI can be a useful tool for managing inflammation post-exercise, it should be used thoughtfully within the broader context of a football player's recovery and training program (Nasser N, Zorgati H, Chtourou H, Guimard A., 2023). Sports science practitioners should continue to evaluate the balance between the benefits of reducing acute inflammation for recovery and the potential impact on long-term training adaptations.

Ascensão et al. (2011) showed that 10-min of CWI at 10°C was capable of reducing CK (30-min, 24 h, and 48 h), myoglobin (30-min), and C-reactive protein (30-min, 24 h, and 48 h) when applied immediately after a one-off soccer match compared to thermoneutral water immersion. Conversely, Rowsell et al. (2009) reported no changes over time for any post-match inflammatory markers during a 4-day simulated soccer tournament with either cold or thermoneutral water immersion. This discrepancy between the findings of the aforementioned research likely relates to the combination of the methods used and physical demands encountered during the matches. Cold Water Immersion such as ice baths or cold water pools, can help reduce inflammation and alleviate pain by constricting blood vessels, reducing swelling, and numbing nerve endings.

Cold water immersion techniques and protocols

Temperature and duration: There is no consensus on the optimal temperature and duration for CWI. Numerous articles have reported that CWI can enhance recovery of performance in a variety of sports, with immersion in 10-15 °C water for 5-20 min duration appearing to be most effective at accelerating performance recovery. However, the optimal CWI duration may depend on the water temperature, and the time between CWI and the subsequent exercise bout appears to influence the effect on performance (Versey N.G. et al., 2013).

The timing of CWI in relation to exercise also varies, but it is commonly performed immediately after a match or training session. Studies have recommended the use of cryotherapy within the first 72 hours after muscle damage (Kellett, J.1986). Few studies have explored the effects of multiple CWIs during the first 72 h after a single bout of EIMD on acute recovery and muscle function (Machado, A. F. et al., 2017).

Cryotherapy, especially CWI, is commonly used to attenuate hyperthermia by reducing core temperature following exercise in hot environments (White, G.E., Wells, G.D. 2013).

Conclusion

Conclusions. Numerous studies have explored the effects of cold water immersion (CWI) in sports. Overall, CWI has been found to effectively reduce muscle soreness and accelerate recovery after intense exercise. It works by constricting blood vessels, reducing inflammation, and potentially minimizing muscle damage. However, there is some variability in individual responses, and the optimal timing and duration of CWI remain subjects of debate. While CWI appears promising for short-term recovery, its long-term impact on performance gains requires further investigation. Athletes and practitioners should consider individual preferences and the specific demands of their sport when incorporating CWI into their recovery strategies. Studies suggest that immediate post-macth immersion, ideally within the first hour, is more effective. The key aspects of procedure is water temperature, commonly ranging from 10 to 15 degrees Celsius, and immersion duration, often between 10 to 20 minutes.

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