



Original article

Effects of cryotherapy on muscle damage markers and perception of delayed onset muscle soreness after downhill running: A Pilot study



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ABSTRACT

Objective: To investigate the effects of cryotherapy on markers of muscle damage, as well as the perception of muscle soreness caused by eccentric exercise after downhill running.

Methods: Ten participants (age = 26 ± 5 year, height = 173 ± 8 cm and body mass = 70 ± 4 kg) performed two running trials on a treadmill tilted -6.6%, separated by one-week period. Cryotherapy (~15 °C for 30 minutes) was conducted after one of the trials of exercise. Blood samples were analyzed for markers of muscle damage (creatin kinase – CK; lactate dehydrogenase – LDH; calcium – [Ca²⁺]). Perception of muscle soreness was quantified using an analogical scale of pain. Data were collected before, 24 and 48 h after the trials with and without the use of cryotherapy.

Results: Cryotherapy significantly reduced muscle soreness and was able to reestablish homeostasis in CK, LDH and [Ca²⁺].

Conclusion: Use of cryotherapy after exercise with eccentric contractions was effective to reestablish the level of biochemical markers of muscle damage and reduce muscle soreness and pain perception in subjects submitted to downhill running.

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Efectos de la crioterapia en los marcadores de daño muscular y en la percepción de mialgia de aparición tardía tras carrera en bajada

RESUMEN

Objetivo: Investigar los efectos de la crioterapia en los marcadores de daño muscular, así como la percepción de mialgia causada por ejercicio excéntrico tras carrera en bajada.

Método: Diez participantes (edad = 26,0 ± 5,0 años, altura = 173,0 ± 8,0 cm y masa corporal = 70,5 ± 4,0 kg) realizaron dos ensayos de carrera en tapiz rodante con una inclinación de -6.6%, separados por un periodo de una semana. Se llevó a cabo una sesión de crioterapia (~15 °C) tras cada uno de los ensayos. Se analizaron muestras de sangre para determinar los marcadores de daño muscular (creatin kinasa-CK; deshidrogenasa láctica-DHL; calcio - [Ca²⁺]). La percepción de dolor muscular fue cuantificada usando una escala analógica de dolor. Los datos se tomaron antes, 24 h y 48 h después de los ensayos con y sin el uso de crioterapia.

Resultados: La crioterapia disminuyó significativamente el dolor muscular y fue capaz de reestablecer la homeostasis en CK, DHL y [Ca²⁺].

Palabras clave:

Inflamación

Recuperación post-ejercicio

Fatiga

Daño muscular

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Conclusión: El uso de crioterapia tras ejercicio con contracciones excéntricas fue efectivo para reestablecer el nivel de los marcadores bioquímicos de daño muscular y reducir la mialgia y la percepción de dolor en sujetos sometidos a carrera en bajada.

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Efeito da imersão em água gelada no dano muscular e dor tardia após a corrida de downhill: um estudo piloto

R E S U M O

Palavras-chave:

Inflamação
Recuperação pós-exercício
Fadiga
Dano muscular

Introdução: O dano muscular é frequentemente observado em indivíduos envolvidos em atividades físicas que envolvam contrações excêntricas. Nestas situações, a crioterapia é utilizada para reduzir o dano muscular e a sensação de dor. No entanto, poucos estudos investigaram o efeito da imersão em água gelada em marcadores de dano muscular, bem como a percepção de dor após exercício excêntrico.

Método: Dez homens ($26,0 \pm 5,0$ anos de idade, $173,0 \pm 8,0$ cm de estatura, $70,5 \pm 4,0$ kg de massa corporal). Os voluntários completaram dois corridas (teste e controle) separadas por sete dias, em um percurso declinado ($-6,6\%$) em esteira. Em uma das tentativas realizou-se imersão em água gelada ($\sim 15^\circ\text{C}$, 30 minutos). O dano muscular foi estimado mediante os níveis sanguíneos de (creatina quinase-CK; lactato desidrogenase-LDH e cálcio- $[\text{Ca}^{2+}]$). A percepção de dor muscular foi estimada usando uma escala analógica. Todas as medidas foram realizadas antes, 24 e 48 horas pós-exercício.

Resultados: A imersão em água gelada diminuiu significativamente a dor muscular e auxiliou no reestabelecimento da homeostase da CH, LDH e Ca^{2+} .

Conclusão: A imersão em água gelada após exercício excêntrico foi efetiva em reestabelecer os níveis bioquímicos de marcadores musculares e diminuiu a percepção de dor.

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Introduction

The physiological mechanism of the delayed onset muscle soreness (DOMS) after exercise is not well elucidated.¹ The DOMS is more frequent and of greater magnitude after exercises with a predominance of eccentric contractions.¹ Among the reasons for this association between DOMS and eccentric exercise is the fact that eccentric actions promote greater tension to the contractile apparatus with greater accumulation of metabolites and structural damage in tissues.^{1–3} The structural damage to the sarcolemma and Z lines of sarcomeres are often measured by markers such as creatine kinase (CK) and lactate dehydrogenase (LDH).⁴

DOMS is largely observed among sportsmen, and it may have deleterious effects on human performance.⁵ The performance degradation associated with DOMS results of mechanisms such as the loss of homeostasis of calcium (Ca^{2+})⁶ and local elevation of inflammatory substances like histamine, kinins and prostaglandins.⁷ These inflammatory substances stimulate pain receptors types III and IV.^{5,7,8} Thus, the effect of DOMS on performance rely on an increased sensitivity to touch changing characteristics of skin sensibility, increased muscle stiffness and reduced range of motion.^{3,9}

Several strategies have been used in order to speed up recovery after exercise reducing the period and magnitude of DOMS; some examples are laser therapy,¹⁰ massage,¹¹ contrast (heat and cold immersion) and immersion cryotherapy;¹² this last one is the most popular due to the low cost and easy use by sportsmen. The vasoconstriction of blood vessels, capillaries, and lymphatics supported by cryotherapy¹³ reduces the spread of fluid in the interstitial spaces, thereby minimizing inflammation, pain, edema, and muscular spasms.^{14–16}

Although cryotherapy is applied to reduce the DOMS, changes in inflammatory markers show divergent outcomes.^{12,17} Ingram

et al.,¹² Bailey et al.,¹⁷ Eston and Peters¹⁵ reported no change in the concentration of CK after cryotherapy, while Rise et al. observed reduction in the concentration of CK, myoglobin and C-reactive protein after immersion in cold water. Part of the incongruence concerning these studies results from the variety of methods used, such as different water temperatures, immersion time, intensity and type of exercise performed.¹⁹

The influence of cryotherapy on DOMS is evaluated in real sports context,¹⁸ simulations,^{12,17,20,21} isokinetic dynamometry evaluations,¹⁵ after a series of maximum eccentric contractions,^{11,19,22} vertical jumps from a higher level²⁴ and plyometrics.²⁵

Regarding the use of running protocols, Hausswirth et al.²⁰ compared the effects of the application of whole-body cryotherapy, infrared and passive recovery in a well-trained runners group on different grounds (flat, uphill and downhill). These authors concluded that whole-body cryotherapy promotes faster recovery in comparison to other methods. However, it is known that trained people in modalities that require predominant eccentric contractions are more resistant to the damage caused by these types of contractions,²⁶ which leads us to question if the application of post-eccentric exercise cryotherapy could significantly affect damage markers and pain perception in physically active people. Nevertheless, few studies²⁷ have sought a significant evaluation related to the effects of application of cryotherapy on markers of muscle damage and muscle soreness after downhill running in people considered to be physically active. As a result of the increasing number of street racing fans and the diversity of ground characteristics, studies with this perspective are necessary since the runners are exposed to situations of greater demand for eccentric contractions. Thus, the objective of this study was to investigate the effects of application of cryotherapy on markers of muscle damage, as well as the perception of muscle soreness caused predominantly by eccentric exercise after downhill running.

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