



Effect of ThermaCare HeatWraps and Icy Hot Cream/Patches on Skin and Quadriceps Muscle Temperature and Blood Flow



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Abstract

Objectives: The purpose of this study was to compare the effects of over-the-counter treatments—ThermaCare HeatWraps (chemical reaction to produce heat above the skin), Icy Hot Patch, and Icy Hot Cream (topically applied menthol)—on skin and deep tissue temperature.

Methods: This was a longitudinal crossover study. On each of 3 days, a ThermaCare HeatWrap, Icy Hot Cream, or Icy Hot Patch was applied randomly over the quadriceps muscle in 15 healthy volunteers with normal body mass. Skin and muscle temperature and blood flow were measured by laser flowmetry every 15 minutes for 2 hours.

Results: After 2 hours, mean temperature decreased by 2.1°C (7.0%; $P = .02$) in skin and 1.0°C (2.9%; $P = .01$) in muscle with Icy Hot Cream. Icy Hot Patch decreased skin and muscle temperature by 1.7°C (5.4%; $P = .03$) and 1.3°C (3.8%; $P = .01$), respectively. In contrast, ThermaCare raised skin and muscle temperature by 7.8°C (25.8%; $P = .001$) and 2.7°C (7.7%; $P = .002$), respectively; both were significantly warmer with ThermaCare vs either Icy Hot product (all $P < .007$). Icy Hot products produced a net decrease in skin blood flow (Cream: 56.7 flux [39.3%; $P = .003$]; Patch: 19.1 flux [16.7%; $P = .045$]). Muscle blood flow decreased with

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the Patch (6.7 flux [7.0%; $P = .02$]). After a period of fluctuations, Icy Hot Cream produced a net increase vs baseline of 7.0 flux (16.9%; $P = .02$). ThermaCare more than doubled blood flow in skin (83.3 flux [109.7%; $P = .0003$]) and muscle (25.1 flux [148.5%; $P = .004$]).

Conclusions: In this group of 15 healthy volunteers, ThermaCare HeatWraps provided the greatest degree of tissue warming and increase in tissue blood flow.

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Introduction

Dull, diffuse muscle pain that occurs after unaccustomed exercise is a well-recognized clinical phenomenon known as *delayed-onset muscle soreness* (DOMS).¹ Delayed-onset muscle soreness is particularly common in sedentary individuals who have initiated a new exercise program, but it can also occur in athletes who have acutely intensified their level of exercise. Delayed-onset muscle soreness-related pain typically begins about 8-10 hours after intense exercise and peaks at 24-72 hours.¹⁻³ Delayed-onset muscle soreness-related pain may be accompanied by muscle stiffness, tenderness to palpation or movement, reduced mobility/flexibility, and decreased muscle strength.^{1,3} The pain and soreness typically subside within 5-7 days of the initial insult,³ but associated muscle weakness may persist for up to 2 weeks.¹

An optimal therapeutic strategy for relief of DOMS would be one that provides analgesia while promoting healing of damaged muscle tissue. Although many DOMS mechanisms have been proposed (lactic acid accumulation,^{3,4} muscle spasm,^{4,5} connective tissue^{4,6} or muscle damage,^{4,7,8} enzyme shifts,^{4,9,10} inflammation,^{4,7,11} production of reactive oxygen species¹²), most are controversial or refuted.^{4,13} However, muscle damage leading to DOMS remains a viable theory.⁴ Intense exercise has been associated with elevated plasma concentrations of various biomarkers indicative of stress or muscle damage (eg, heat shock proteins 27 and 70, lactate dehydrogenase, creatinine phosphokinase, and myoglobin).¹⁴⁻¹⁷

Both topical and deep heat modalities have been shown to reduce pain associated with DOMS.¹⁸ Although untreated DOMS is reduced considerably 72 hours after exercise with an active warm-down,¹⁹ heat application provides faster relief of symptoms. In subjects with moderate DOMS, Mayer et al²⁰ found that low-level heat wraps resulted in significantly greater pain relief 24 hours postexercise in comparison with cryotherapy using a standard gel-filled cold pack ($P = .026$). As an extension of these findings, we have

previously reported that applying low-level heat wraps for 8 hours immediately after exercise reduces muscle soreness observed at 24 and 48 hours.²¹

Various “heat products” are available over the counter (OTC) that promise to provide pain relief for conditions such as DOMS. What is not readily known, however, is the degree to which these options transfer heat to tissues and increase blood flow, which is a parameter that is relevant to the process of tissue healing. ThermaCare HeatWraps, Icy Hot Patches, and Icy Hot Cream are examples of OTC products that promise to relieve pain.

ThermaCare HeatWraps are lightweight, air-activated, single-use products that deliver continuous, low-level, dry heat reaching 40°C within 30 minutes of application.^{22,23} ThermaCare HeatWraps have previously been shown to result in deep heating of tissues.^{20,24,25} Icy Hot Patches contain 5% menthol, and Icy Hot Cream contains 10% menthol.^{26,27} Less is known about the effects of Icy Hot products on temperature or blood flow in skin and muscle tissue. It is possible that menthol could have an insulating effect on tissue, reducing heat loss through the skin and resulting in warming. However, it is also plausible that evaporation of menthol would cool the skin, which might induce the hunting response (ie, intermittent periods of vasodilation lasting 5-10 minutes followed by vasoconstriction and then alternating periods of each).²⁸ It is also unknown whether the menthol from these products penetrates deep enough to interact with menthol-sensitive transient receptor potential (TRP) receptors in muscle tissue. In addition to menthol, Icy Hot Cream contains methyl salicylate 30%,²⁷ a prostaglandin inhibitor. Methyl salicylate may contribute to effects on blood flow. For example, it has been reported that an analgesic balm containing methyl salicylate and capsaicin applied to the forearm skin attenuated muscle-contraction-induced increases in blood pressure.²⁹

Although all 3 types of products are sold over the counter and used commonly, a head-to-head comparison of the effects of the 3 types of products on skin and muscle temperature and blood flow has not been made. Although a head-to-head comparison in DOMS is also

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