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**Body
Cooling
AND Sleep
IN Athletes**

By Regina Patrick, RPSGT, RST

When athletes obtain optimal sleep, their mood, fatigue, mental and physical performance, recovery, and cognition improve while their risk of injury decreases.¹⁻⁴ However, incorporating sleep as part of an athlete's training regimen is often overlooked. Additionally, obtaining sufficient sleep can be difficult as athletes travel to tournaments — especially if it involves traveling across time zones. The change in time disrupts an athlete's circadian rhythm, which can contribute to sleepiness and fatigue, and negatively impact an athlete's performance. A recent study by the American Academy of Sleep Medicine (AASM) demonstrated that baseball players' performance decreased as the season progressed due to frequent travel (i.e., disruptions in the sleep-wake schedule).⁴ Improving sleep could potentially improve performance and prevent injury in athletes, and in recent years, scientists have used partial body and whole-body cooling as a way to do this. Some results have been promising.

In sports medicine, the use of cool temperatures as a therapy, such as to relieve inflammation and reduce muscle soreness, has traditionally involved applying ice packs to the effected part of the body or submerging one's body in a cold-water bath. Greater pain relief could presumably be accomplished by using extremely cold temperatures. With this in mind, in the 1970s, rheumatologist Toshima Yamauchi in Japan was the first to use the technique of whole-body cryotherapy (from the Greek *kryos* meaning "cold" plus therapy) to relieve pain in people with arthritis.^{5,6} He found that this technique resulted in more relief than ice baths, and the technique was soon adopted by athletes to relieve pain and soreness.

Cryotherapy involves exposing the body to extremely cold temperatures of -148°F to -220°F (-100°C to -140°C) for two to five minutes. During the extreme cooling, blood vessels on the surface of the skin contract, thereby reducing blood flow to inflamed areas. On leaving the cryotherapy chamber, vessels very quickly expand (which brings more oxygenated blood to injured tissues) and levels of anti-inflammatory substances increase, which may decrease pain and soreness.

In cryotherapy, cold temperature exposure takes place in a cryotherapy chamber. The

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chamber can be a vertical, cylindrical tank that surrounds the whole body, except for the head (i.e., an open cryotherapy chamber), for partial body cooling or a tank that a person can fully walk into (i.e., closed cryotherapy chamber) for whole-body cooling.

In an open cryotherapy chamber, liquid nitrogen (-220°F/130°C) is sprayed into the chamber via ports. The liquid nitrogen quickly vaporizes because the human body is substantially hotter. However, because the vapor is at subzero temperatures, the body is surrounded in a cold nitrogen fog. In a closed cryotherapy chamber, liquid nitrogen is not sprayed into the chamber. Oxygenated air within the chamber is instead cooled by other means to a temperature of -148°F to -220°F (-100°C to -140°C).

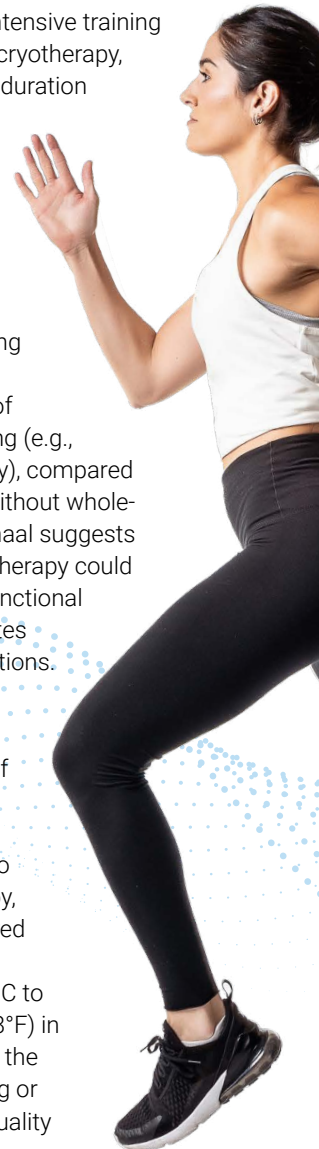
A closed cryotherapy chamber provides uniform cooling over the skin because a person's whole body is exposed to the cold air. In an open cryotherapy chamber, the lower extremities tend to be colder than the upper extremities because nitrogen vapor escapes around the head, which is exposed to ambient room temperature. While in a cryotherapy chamber, a person wears minimal clothing — socks, gloves and underwear — and in the closed chamber, a headband and mask — to protect the ears, nose and mouth from frostbite.

After undergoing partial or whole-body cryotherapy, athletes report improved sleep and recovery. For example, Schaal and colleagues⁷ investigated whether daily whole-body cryotherapy during periods of intensive training could prevent exercise and sleep-related signs of overreaching (i.e., a short-term decrease in performance resulting from increased training stress). In their study, elite synchronized swimmers underwent intensive training periods, after which, some underwent daily whole-body cryotherapy while others did not. Swimmers wore a wrist actigraph nightly to monitor sleep the night after training with and without whole-body cryotherapy.

Schaal found that for intensive training sessions not followed by cryotherapy, swim speed decreased, sleep latency and fatigue increased from the baseline values, and sleep duration and sleep efficiency significantly decreased from baseline values. For intensive training sessions followed by cryotherapy, sleep latency, fatigue, duration and efficiency did not change significantly from the baseline values.

Based on these findings, whole-body cryotherapy during intensive training periods helped to decrease symptoms of functional overreaching (e.g., reduced sleep quantity), compared to intensive training without whole-body cryotherapy. Schaal suggests that whole-body cryotherapy could be used to alleviate functional overreaching by athletes preparing for competitions.

Bouzigon and colleagues⁸ examined recovery and quality of sleep in professional male and female basketball players who underwent cryotherapy, which was administered for three minutes at temperatures of -110°C to -150°C (-166°F to -238°F) in the morning and/or in the evening after a training or match session. The quality



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of sleep was assessed subjectively (using a version of the Spiegel Sleep Questionnaire). The athletes reported improved sleep quality for the nights that followed whole-body cryotherapy compared to the nights not preceded by whole-body cryotherapy. Even if the sleep duration was short after cryotherapy, the athletes reported having a deeper, quieter and less disturbed sleep. Bouzigon suggests that the improvement of the quality of sleep during competition and heavy training periods may enhance athletes' recovery, which potentially could result in less fatigue before the matches and decrease the risk of injury. Nighttime training sessions tend to worsen sleep in athletes (e.g., increased awakenings). With this in mind, Douzi and colleagues⁹ examined the effect of whole-body cryotherapy exposure on sleep quality after evening training among healthy, physically active men. The evening training session involved 25 minutes of continuous running followed by intermittent running. Thirty minutes after the training session, the men underwent whole-body cryotherapy or passive recovery (i.e., the control condition; the participant rested in room temperature). Each night after the training session with or without cryotherapy, the number of movements were recorded with actigraphy. The next morning, the athlete's sleep quality and perceived pain were assessed subjectively (using the Spiegel Sleep Quality Perception Questionnaire and the visual analog scale, respectively). Douzi found that, after whole-body cryotherapy, the number of movements during the night were significantly lower, subjective sleep quality was significantly improved and pain was significantly reduced compared to the control condition. Based on heart rate variability, they also determined that the athletes had an increased amount of slow-wave sleep. Douzi concluded that three minutes of whole-body cryotherapy in the evening after evening training improves subjective and objective sleep quality in physically active subjects, which may result from greater pain relief.

Despite such encouraging findings, some scientists urge caution. Based on a review of the literature on the efficacy and effectiveness of whole-body cryotherapy, Bleakley and colleagues¹⁰ found that, although whole-body cooling improves subjective recovery and muscle soreness, it does not improve functional recovery (i.e., recovery to a preinjury level). For example, strength, power and muscle soreness were not significantly different between athletes with exercise-induced muscle damage who did and did not undergo cryotherapy in the included studies.

No adverse events were reported among the studies included in the Bleakley review. However, cryotherapy can have adverse effects — in particular, frostbite (the skin surface freezes at 23°F to 25°F [-5°C to 3.8°C] and serious cellular damage can occur at around 14°F [-10°C]). In 2019, football player Antonio Brown experienced frostbite on the soles of his feet, causing him to miss virtually all of his training camp practices that year.¹¹ The frostbite was attributed to his wearing of improper footwear. Certain physical conditions may increase the risk of adverse events in people undergoing partial or whole-body cooling such as uncontrolled hypertension, coronary disease, arrhythmia, circulatory disorders, Raynaud's phenomenon (i.e., sudden vasoconstriction in response to cold that results in the loss of circulation to the fingers or other areas of the body), cold allergies (i.e., responses to cold such as hives or a burning sensation at a cold-exposed area), pulmonary disease and bronchial obstruction caused by the cold (e.g., cold-induced asthma). Another risk is nitrogen asphyxiation in an open cryotherapy chamber because nitrogen vapor

escapes around a person's head; therefore, the head must be sufficiently out of the chamber and exposed to environmental air to prevent this occurrence.

To date, cryotherapy chambers do not have U.S. Food and Drug Administration (FDA) approval because insufficient evidence exists regarding their safety and effectiveness.¹² The number of studies on the use of whole-body cryotherapy in sports medicine has increased in recent years but remains low among studies on cryotherapy.¹³ More studies are needed to determine the safety, effectiveness and efficacy of cryotherapy in athletes, verify its beneficial effects and determine how to effectively use the therapy itself, especially for improving sleep. ☾



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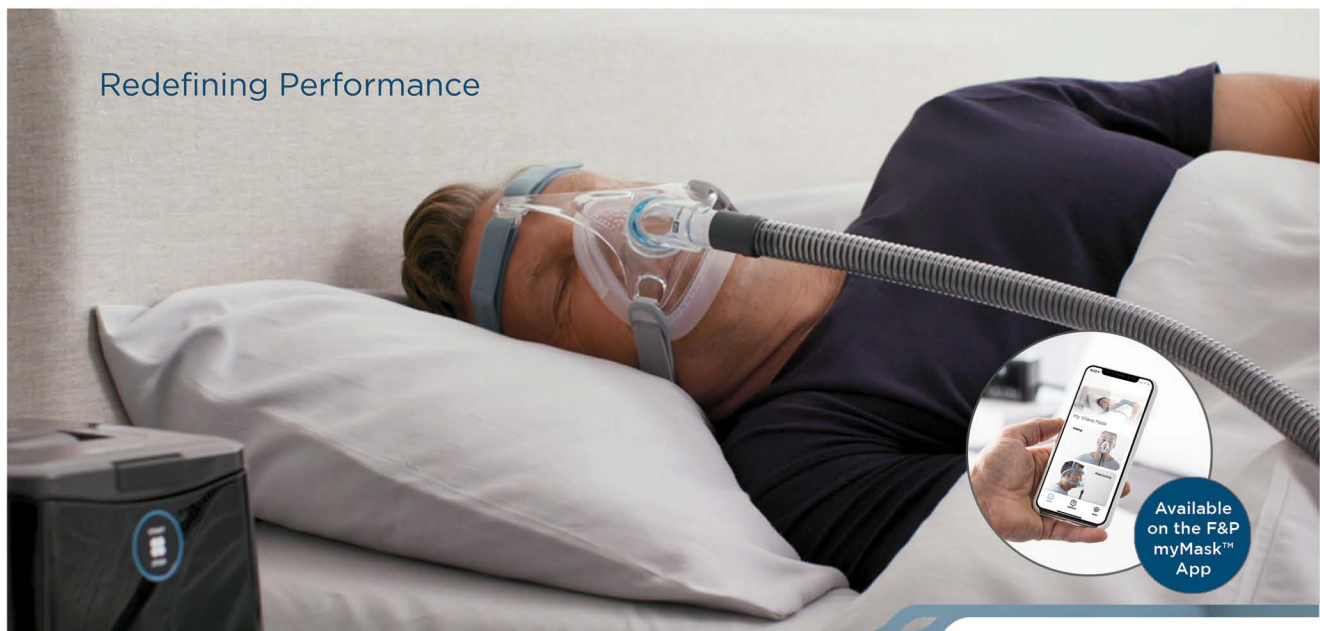
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