REST HUB
Recovery Ready

Cold Water Immersion: Is it worth the plunge?

Cold water immersion (CWI) is commonly implemented to accelerate recovery. When applied immediately post-exercise, CWI can positively benefit recovery status and subsequent neuromuscular performance; however, debate exists as to whether repeated use attenuates muscular hypertrophy and strength adaptations.

Where possible, prescribers should be aware of existing research, with consideration given to the exercise modality, participant cohort (i.e., novice vs. recreationally active vs. athletic), CWI protocol/s, and the training goal (i.e., acute vs. chronic). While investigations continue in high-performance athlete cohorts, current evidence identifies several considerations to promote the effective integration of CWI into a periodised training and recovery plan.

The following provides a snapshot of important considerations when prescribing CWI for recovery [ⓘ]; highlights potential benefits associated with its application [✓]; and acknowledges instances where CWI should be used cautiously or in consultation with a qualified practitioner [?].

	ⓘ	✓	?
Exercise type	There are many contributing factors and mechanisms responsible for muscular adaptation. Consider the following prior to prescribing CWI: > The goal of the session (e.g., hypertrophy vs. strength vs. endurance capacity etc.). > Intended levels of resultant perceived fatigue or soreness. > Training history: typically, as athletes become accustomed to resistance exercise, less exercise-induced muscle damage occurs, suggesting muscle damage is not the primary mechanistic driver to muscular adaptation in elite athletes.	**Endurance:** CWI may provide small additional short-term training-induced endurance improvements (i.e., aerobic skeletal muscle adaptations) and may be applied within a periodised endurance training program to assist recovery and subsequent performance. **High impact or eccentric loading:** Exercise tasks involving high levels of eccentric muscle contractions or physical contact may result in increased levels of muscle damage and perceived soreness. CWI may assist in reducing post-exercise soreness.	**Resistance:** CWI may attenuate training-induced adaptations in type II muscle fibers following acute skeletal muscle fiber hypertrophy sessions; the application of CWI may limit muscle protein synthesis via its vasoconstrictive action, reducing blood flow. Therefore, if the exercise goal is strength or hypertrophy related, the inclusion of post-exercise CWI should be re-considered.
Training Phase	When athletes experience high training loads and limited recovery over an extended period, a state of non-functional overreaching may develop. Appropriate recovery periodisation (including CWI) reduces the likelihood of this occurring and assists to positively manage responses to changes in training load. Consider the following prior to programming CWI: > Desired training outcome/s (e.g., training quality vs. quantity). > Individual capacity or tolerance for higher training loads. > Current physiological state, and whether CWI may accelerate recovery processes and enhance subsequent training quality.	**In-season:** CWI may be increased following, or in readiness for, priority sessions, particularly when subsequent training requires high levels of skill or quality. Medium- to long-term CWI use after resistance exercise during an in-season phase provides little risk of attenuating inflammatory adaptive responses in athletes and may be used to provide moderate reductions in muscle damage. **Specific preparation & taper:** As pre-competition events or competition approaches, CWI may minimise perceived fatigue or muscle soreness, and enhance parasympathetic nervous system function, optimising performance outcomes when the maintenance of high-intensity or high-quality training is often important.	**Pre-season & general preparation:** When a slower physiological recovery is considered acceptable and the resulting performance impact is negligible, CWI may be strategically applied following technical/skill-based sessions. As above, during periods of strength or hypertrophy training, the nonessential application of CWI may reduce muscle protein synthesis, potentially negating muscular adaptation.
Competition	To establish the effectiveness of CWI and optimise recovery outcomes during competition, consider the following prior to use: > Performance requirements. > Recovery goals. > Accessibility and logistics. > Timing between competitive efforts. > Timing/prioritisation for late event finish times.	CWI can help maintain or improve subsequent neuromuscular performance, therefore, when competition is frequent, CWI may optimise performance outcomes. In team sports, post-competition CWI may reduce perceptions of soreness and fatigue, potentially assisting subsequent performance.	While CWI can be effective between competitive efforts on the same day, if there is insufficient time between CWI and subsequent warm up to provide adequate rewarming, reductions in core and muscle temperature may impair performance. When competition runs late into the night, the implementation of CWI may be logistically impractical or delay the onset of sleep.
Injury	Ensure adequate consultation with relevant medical practitioners regarding any acute or chronic injury. An athlete's injury history should be considered prior to CWI use and protocols adjusted as required.	CWI can reduce acute oedema and inflammation. When appropriately and strategically periodised, the inclusion of CWI throughout an athlete's rehabilitation program may accelerate their return to performance.	Caution is advised for specific injuries that may be more responsive to thermoneutral (e.g., pool) or hot water immersion (HWI, e.g., spa), compared to CWI.
Environmental conditions	The application of CWI may differ depending on the environmental conditions. The following may be considered when implementing post-exercise CWI in relation to the environmental conditions: > The appropriateness of CWI use and potential alternatives. > Required protocol adjustments (e.g., immersion temperature, duration, and application) to achieve the anticipated recovery and performance outcomes; aligned with any logistical constraints. > Individual thermal responses and tolerance. Prior to use in competition, core temperature monitoring is encouraged to assess the time course of responses and enable the provision of individualised recommendations.	**Thermally challenging environmental conditions:** In the event of heat illness, CWI is the preferred strategy for rapid cooling. When exercising in thermally challenging environmental conditions, CWI can reduce physiological strain, improve thermal comfort, and assist recovery and subsequent performance.	**Cool/cold environmental conditions:** Typical post-exercise CWI practices may increase thermal discomfort or decrease compliance. The use of contrast water therapy (i.e., alternating between HWI and CWI), thermoneutral immersion, or HWI may be suitable alternatives. If essential, consider adjusting the temperature, duration, or application (e.g., intermittent vs. continuous) of CWI, prior to immersion depth. This maximises the effects of hydrostatic pressure (amplified by whole body (head out) immersion) that influence a range of post-exercise physiological variables and may improve recovery and performance outcomes.
Individual factors	Consider individual factors such as: age, sex, body composition, body surface area to mass ratio, and any relevant impairments before prescribing CWI. The potential impact of historical CWI experiences and associated beliefs should also be acknowledged and addressed via appropriate consultation and education.	Athletes typically report improvements in perceived recovery status via reductions in soreness or fatigue following CWI. In sports involving a high skill component, reducing perceived fatigue via the use of CWI may optimise training quality.	An athlete's prior experiences (e.g., too cold, too long, forceful application) and any associated perceptual responses (e.g., stress, anxiety, fear) may impact their desire or capability to participate in the present or future CWI sessions.

Recommended Reading

Mujika I, Halson S, Burke L, Balagué G, Farrow D. An integrated, multifactorial approach to periodization for optimal performance in individual and team sports. Int J Sports Physiol Perform. 2018 May 1;13(5):538-561. doi: 10.1123/ijspp.2018-0093.

Stephens J, Halson S, Miller J, et al. Cold-water immersion for athletic recovery: One size does not fit all. Int J Sports Physiol Perform. 2017 Jan;12(1):2-9. doi: 10.1123/ijspp.2016-0095.

Broatch J, Petersen A, Bishop D. Post-exercise cold water immersion benefits are not greater than the placebo effect. Med Sci Sports Exerc, 2014 Nov;46(11), 2139-47. doi: 10.1249/MSS.0000000000000348.

Broatch J, Petersen A, Bishop D. The influence of post-exercise cold-water immersion on adaptive responses to exercise: A review of the literature. Sports Med. 2018 Jun;48(6):1369-1387. doi: 10.1007/s40279-018-0910-8.

Horgan B, West N, Tee N, et al. Effect of repeated post-resistance exercise cold or hot water immersion on in-season inflammatory responses in academy rugby players: A randomised controlled cross-over design. Eur J Appl Physiol. 2024 Apr 13. doi: 10.1007/s00421-024-05424-3.

Horgan B, West N, Tee N, et al. Acute inflammatory, anthropometric, and perceptual (muscle soreness) effects of postresistance exercise water immersion in junior international and subelite male volleyball athletes. J Strength Cond Res. 2022 Dec 1;36(12):3473-3484. doi: 10.1519/JSC.0000000000004122.

Horgan B, Halson S, Drinkwater E, et al. No effect of repeated post-resistance exercise cold or hot water immersion on in-season body composition and performance responses in academy rugby players: A randomised controlled cross-over design. Eur J Appl Physiol. 2023 Feb;123(2):351-359. doi: 10.1007/s00421-022-05075-2.

Ihsan M, Watson G, Abbiss C. What are the physiological mechanisms for post-exercise cold water immersion in the recovery from prolonged endurance and intermittent exercise? Sports Med. 2016 Aug;46(8):1095-109. doi: 10.1007/s40279-016-0483-3.

Ihsan M, Abbiss C, Gregson W, Allan R. Warming to the ice bath: Don't go cool on cold water immersion just yet!: Comment on: 1) Arthur J. Cheng. Cooling down the use of cryotherapy for post-exercise skeletal muscle recovery. Temperature. 2018; 5(2): 103-105. doi: 10.1080/23328940.2017.1413284. 2) Cheng et al. Post-exercise recovery of contractile function and endurance in humans and mice is accelerated by heating and slowed by cooling skeletal muscle. Journal of Physiology. 2017; 595(24): 7413-7426. doi: 10.1113/JP274870. Temperature (Austin). 2020 Feb 20;7(3):223-225. doi: 10.1080/23328940.2020.1727085.

Machado A, Ferreira P, Micheletti J, et al. Can water temperature and immersion time influence the effect of cold water immersion on muscle soreness? A systematic review and meta-analysis. Sports Med. 2016 Apr;46(4):503-14. doi: 10.1007/s40279-015-0431-7.

Rossi F, de Freitas M, Zanchi N, Lira F, Cholewa J. The role of inflammation and immune cells in blood flow restriction training adaptation: A review. Front Physiol. 2018 Oct 9;9:1376. doi: 10.3389/fphys.2018.01376.