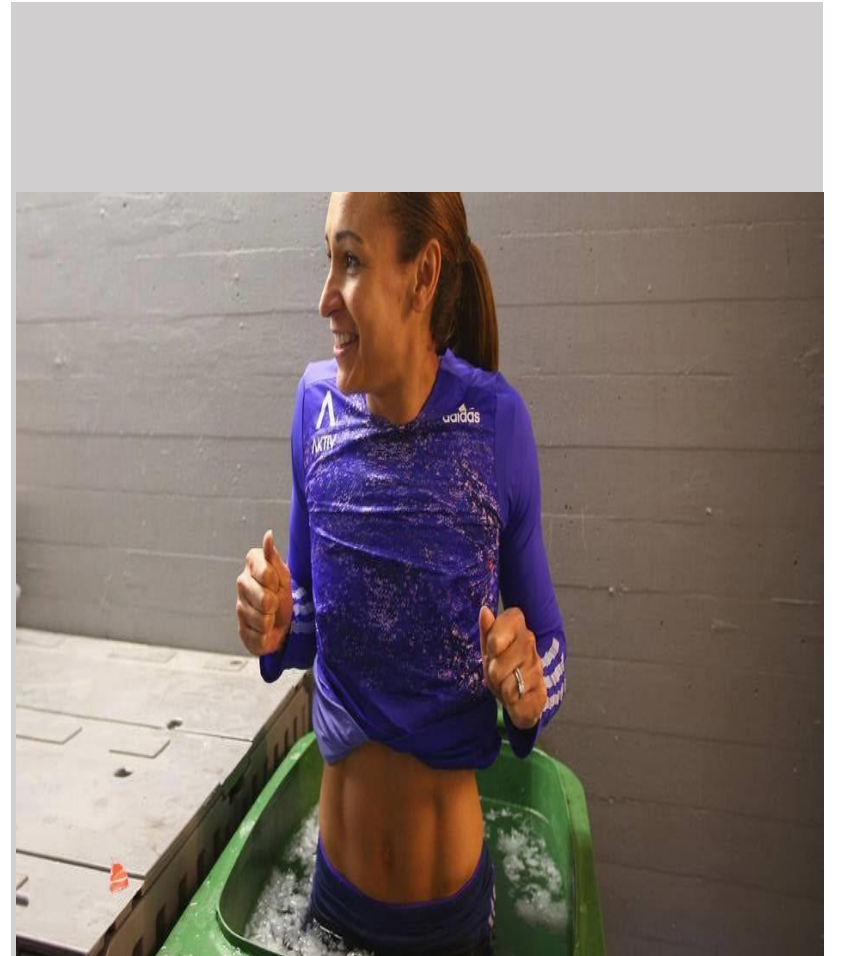


Ice Baths vs Cold Water



Recovery Strategies

- Reduce recovery time between training and competition
- Maintain optimal state of performance
- Minimise Exercise induced muscle damage (EIMD)
- Reduce delayed onset muscle soreness
- Minimise risk of over training
- Minimise risk of injury
- Promotion of physical and psychological readiness

Common beliefs of Cryotherapy

- Decrease the perception of pain associated with muscular soreness
- Alter localised blood flow and reduce oedemas
- Alter localised tissue and core temperature
- Reduce muscle spasms
- Reduce tissue inflammation
- Reduce muscle damage
- Improve range of motion
- Decrease the perception of fatigue

Methods of Cooling

- Cold Water Immersion (CWI)
 - Ice Bath using iced water
 - 8-15°C (46-59°F)
 - Plunge Pools

- Cold water 18-24 °C (65-75 °F)

- Warm water Immersion
 - Thermo-Neutral Immersion
 - 34-35°C (93-95°F)
 - Ambient temperature
 - At rest and healthy, no sweating or shivering
- Contrast Baths
 - Alternate cold and warmer water immersion

Stages of immersion

1. **INITIAL Immersion; i.e. the first 2 or 3 mins.**
2. **SHORT TERM Immersion; i.e. 3 to 15 mins.**
3. **LONG TERM Immersion; i.e. 30 mins and thereafter.**
4. **POST Immersion**

Initial response to cold immersion 'Cold Shock'

- Respiratory Responses
 - Gasp Reflex
 - Decreased breath hold time
 - Hyperventilation
- Circulatory Response
 - Tachycardia
 - Peripheral Vasoconstriction
- Circulatory Outcome
 - Change in hydrostatic pressure
 - Cardiac Arrhythmias
 - Hypothermia
 - Cold diuresis and hydrostatic problems

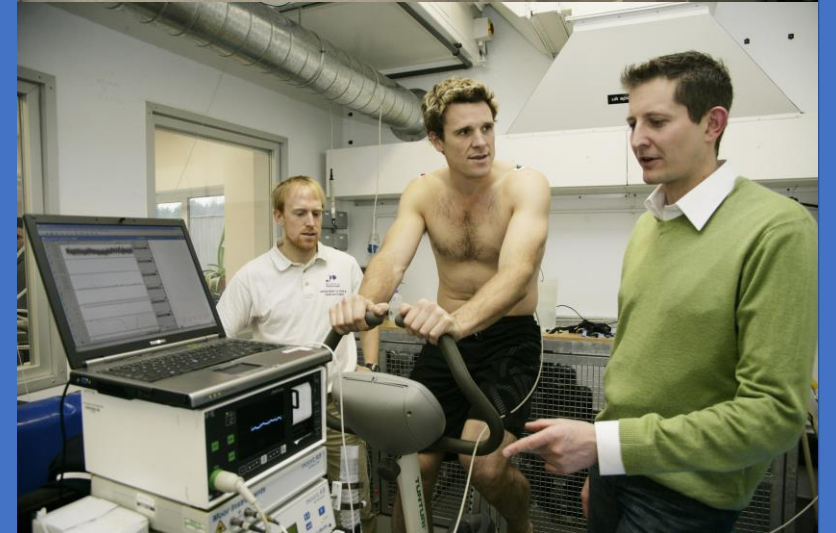
Measured Effects of cryotherapy

- **Subjective Measures**

- DOMS (Delayed Onset of Muscle Soreness)
- Ratings of Perceived Exertion (RPE)

- **Objective Measures**

- Creatine-kinase (CK)
- Blood lactate-levels
- Interleukines
- C-reactive protein (CRP)
- Lower limb proprioception



Subjective Support for CWI

- CWI has been shown to consistently reduce the effects of DOMS and RPE
- Effective protocol for reducing the effects of DOMS 24hrs, 48hrs, and 96hrs post-exercise
- Reduce the symptoms of RPE 24hrs post-exercise
- Analgesic (pain relieving) effect of the cold water
- Perceived fatigue
- Placebo effect

Objective Support for CWI

- Less apparent with physiological processes (CK, Lactate)
- Improves 30 s continuous jump performance (12hrs)
- Repeated Sprint drills (6x20m)
- Vasoconstriction (blood vessel constriction)
- Reducing inflammatory pathways
- Hydrostatic pressure

Immersion Depth



Immersion depth

- Hydrostatic pressure at pelvis level
- Displacement of fluids from the lower extremities towards thorax
 - Reduce exercise-induced oedema
 - Increases the transfer of extracellular fluid into the bloodstream
 - Increases cardiac output
 - Increased blood flow and metabolism of waste products that accumulate during exercise.
 - The buoyancy reduces fatigue by lowering neuromuscular signaling and improving energy conservation

CWI vs Cold bath or Thermo-neutral Immersion

- CWI risk of hypothermia, shock and sudden death
- Thermoneutral water less detrimental effect on knee proprioception
- Too cold may counteract positive effects of hydrostatic pressure.
 - Induces vasoconstriction
 - Reduces heart rate and cardiac output.
 - Reduce peripheral blood flow and reserve its core temperature
 - Central metabolism is increased in order to maintain this core temperature
 - Enhances the production of waste products
 - Erodes energy store
- Cold bath very little research

CWI vs Contrast Baths

- Systematic Review
 - Reduced muscle soreness and reduced deficits in muscle strength compared with passive recovery/rest
 - Little difference with other forms of CWI or TNI
- CWI was more effective than CWT
 - Repeat sprint time, mean muscle soreness and fatigue in Australian football
- Contrast water therapy for 6 min assisted acute recovery from high-intensity running
- CWT reduced creatine kinase 42hrs post rugby game.

Cold Water Immersion vs Active Recovery

- 2016 study
 - Intense resistance exercise
 - Muscle biopsy skeletal muscle
 - Inflammatory cells, pro-inflammatory cytokines, neutrophils and heat shock proteins (HSPs)
- CWI no more effective than active recovery for reducing inflammation or cellular stress
- Substantially reduced long-term gains in muscle mass and strength
- *Journal of Physiology, 2016*

Duration and timing

- Ranges from 1 - 15 mins
- 11 -15 minutes in systematic review (2016)
- Minimum 10 minutes

- Contrast baths maybe better if training later in the day
- Ice baths/cold water if in team or collision sports
- Thermo-neutral or active recovery if reliant on long term muscle mass and strength detrimental to sport.

Guidelines for use of plunge pools

- Always wear swim shorts/trunks/costume
- Always shower (with soap) before using the pools
- Re-hydrate before, during and after each session
- Always be accompanied in the pool area

Contrast bathing protocols (i.e. alternating hot and cold water immersions):

| During general preparation phase | | During specific preparation phase | | During competition phase | |
|----------------------------------|--|-----------------------------------|--|---------------------------|--|
| When | How | When | How | When | How |
| At least wait 2h post session | Alternate 3-4min hot, 30-60sec cold, 4-6 times | At least wait 2h post session | Alternate 3-4min hot, 30-60sec cold, 4-6 times | Within 30min post session | Alternate 3-4min hot, 30-60sec cold, 4-6 times |

Ice bath protocols (i.e. cold water immersion):

| During general preparation phase | | During specific preparation phase | | During competition phase | |
|--|-----|--|-----|---------------------------|--------------------|
| When | How | When | How | When | How |
| Not recommended unless guided by support staff and/or your coach | | Not recommended unless guided by support staff and/or your coach | | Within 30min post session | 5-15min continuous |

- You must not use the pools if you have a recent cut or soft tissue injury
- Do not use the pools if you have a cold or virus
- When using the pools please maintain high standards of personal hygiene

Conclusions

- Vertical half-body immersion into cold ($\leq 15^{\circ}\text{C}/59^{\circ}\text{F}$)
- 11-15 minutes post-exercise
- Positive effect upon recovery 12-24 hours post cooling.
- CWT or thermoneutral temperatures $34\text{-}35^{\circ}\text{C}$ ($93\text{-}95^{\circ}\text{F}$)
 - May negative effects of strength and muscle mass affected by CWI
 - Better for those with trauma
- Sport specific and timing specific

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