



Effectiveness of Cold-Water Immersion on Pain and Inflammation Due to Delayed Onset Muscle Soreness in College Students

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Introduction

- Delayed onset muscle soreness (DOMS) processes begin post exercise and can last for four to five days post exercise. (1)
- Majority of symptoms can peak between 24 and 48 hours post exercise. (2)
- The majority of literature that utilized cold-water immersion (CWI) as an intervention for DOMS applied the CWI protocol immediately post exercise.
- This may not be the most beneficial time for application as it may impede other processes important to post-exercise recovery. (3)
- Metabolic recovery occur in the anabolic window in the four hours following recovery
- The most effective timing of CWI is important to identify as to apply the most effective recovery without limiting metabolic recovery. (4)

Question - How does the application of a ten minute 10°C cold-water immersion (CWI) intervention either immediately post exercise or 4 hours post exercise effect pain and inflammation as a product of delayed onset muscle soreness (DOMS) in the 48 hours following exercise by comparison to static recovery on healthy but untrained college students between the ages of 18 and 32?

Hypothesis - It was hypothesized that a ten minute CWI immediately post exercise would be the most effective in reducing muscular pain and swelling as a product of DOMS due to the immediate effect of CWI on the interruption of the inflammatory process.

Exercise Protocol & Intervention

Exercise Protocol - Eccentric exercise to induce DOMS. Single 30 minute bout of downhill running at 15/20 on Borg RPE Scale. Hill grade = -12.3%. Hill distance = 96.6 m
Cold-Water Immersion (CWI) - 10°C ,10 minutes. Submerged to ASIS.
Control - After exercise, perform passive recovery
Intervention #1 - After exercise, perform immediate CWI.
Intervention #2 - After exercise, performed CWI after 4 hours.

Measures

Application Times - Measures were examined pre-exercise, 15 minutes post exercise, 24 hours post exercise and 48 hours post exercise.
Pain - Measured using visual analog scale. Given 100mm line and asked to mark on line pain level between “No Pain” and “Worst Pain Imaginable”. Test-retest reliability $r=0.94$ ($P<0.001$). Construct validity with 5 point pain scale, correlation = 0.71-0.78 (5)
Inflammation - Measured using thigh circumference. Taken 1/3 distance between most superior aspect of patella and ASIS. No measure of reliability or validity. This measure was exploratory

Inclusion Criteria

- Between ages of 18-34 years
- Moderately active according to ACSM guidelines
- Within “normal” to “overweight” BMI classification
- No lower body musculoskeletal injuries in past calendar year
- No fitness training specific to downhill running

Participant Demographics

Participants included 7 Seattle University students, 4 males (57.1% and 3 females (42.9%). The ages of participants ranged from 18 to 22 years ($m= 20.14$ years). Information regarding height and weight were collected and BMI’s were calculated. BMI ranged between 20.4 and 25.1 ($m= 23.7$). In final analysis, one subject was excluded due to outlying data.

Preliminary Analysis & Results

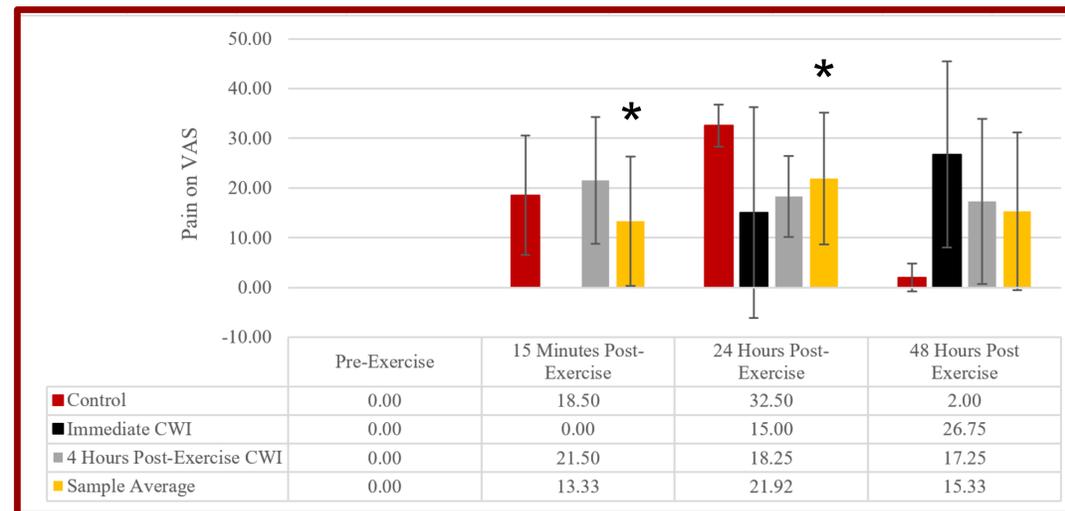


Figure 1. Mean differences in pain in CWI intervention conditions in 48 hours following exercise protocol
 * Indicates significant pairwise comparison between pre-exercise and noted time points

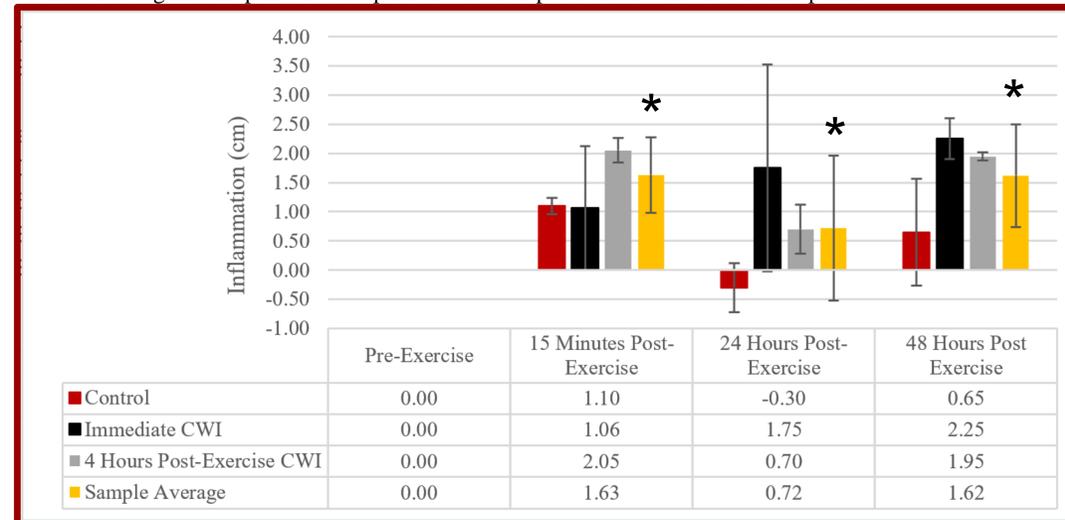


Figure 2. Mean differences in inflammation in CWI intervention conditions in 48 hours following exercise protocol
 * Indicates significant pairwise comparison between pre-exercise and noted time points

Table 1.3 Repeated-Measures ANOVA Findings for Mean Differences Between and Within Subjects for Intervention Condition on Pain and Inflammation over Time Measures

Measure	MS	df	F	p	Sphericity Assumed
Within-Subjects Effects for Pain					
Time	507.12	3	7.19	.009	< 0.05
Between-Subject Effects for Intervention Condition and Time					
Time * Intervention	241.66	6	3.43	.048	< 0.05
Within-Subjects Effects for Inflammation					
Time	3.72	3	11.58	.002	< 0.05
Between-Subject Effects for Intervention Condition and Time					
Time * Intervention	.50	6	1.56	.262	< 0.05

*Note. MS = Mean Square; df = degrees of freedom; p values for within subjects time assume sphericity.

Discussion and Clinical Applications

- No significant impact of CWI either immediately after, or four hours after an eccentric loading exercise protocol to be effective at minimizing pain or inflammation as a result of DOMS in college students.
- There appeared to be a mean differences between groups in both measures, but the power of the test was too low to conclude a significant effect (N=6).
- Future research should examine the usefulness of CWI in conjunction with other recovery methods and therapeutic modalities, like stretching, myofascial release, and deep muscle stimulation.
- The practical applications of this study and its results suggest the CWI is not the most effective means for reducing pain and inflammation as symptoms of DOMS in moderately trained college students.
- While immediate CWI is predicted to reduce post-exercise blood flow and thus limit metabolic recovery, this study supports that no harm is present in pain or inflammation reduction when delaying CWI past the anabolic window, thus not reducing blood circulation and glycogen reuptake by the affected muscle groups.
- Clinically, this might suggest that delaying vascular constriction after exercise by cryotherapy in order to allow anabolic processes to correct for post-exercise depletions may not have any significant impact in the pain and inflammation as a result of DOMS.

References

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