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Cold Water Immersion and Mental Well-Being in Athletes: A Narrative Review

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Abstract

Introduction

Cold water immersion is commonly employed by athletes as a recovery method to support restoration after physical exertion. Although its physiological benefits have been extensively documented, increasing interest has focused on its influence on psychological variables, including mood state, perceived recovery, stress levels, and mental fatigue.

Literature Review

Evidence suggests that cold water immersion positively affects several psychological domains, particularly subjective outcomes such as improved mood, reduced stress, and enhanced perceived recovery. Athletes often report better well-being and readiness for subsequent exercise, even without clear physiological changes. However, findings on cognitive function remain inconsistent.

Materials and Methods

This review included experimental studies, randomized controlled trials, crossover designs, and review articles involving athletes and physically active individuals. Psychological variables were assessed using validated subjective measures. Due to heterogeneity in study protocols and measurement tools, a qualitative synthesis was applied.

Discussion

The findings reveal a discrepancy between subjective and objective outcomes, indicating that perceived recovery may not reflect physiological status. Psychological effects appear to result from interactions between physiological responses, perceptual processes, and contextual factors such as expectations and prior experience. Cold water immersion may act as both a stressor and a recovery tool.

Summary and Conclusions

Cold water immersion significantly influences psychological aspects of recovery, particularly mood, perceived recovery, and stress reduction. These effects are largely subjective and context-dependent. Further research is needed to clarify underlying mechanisms and their relationship with physiological adaptations.

Keywords: cold water immersion, recovery, psychological responses, mood, perceived recovery, stress, mental fatigue, athletes.

1. Introduction

Cold water immersion is a commonly used recovery strategy among athletes, particularly following intense training sessions or competitive efforts. [20,4] It typically involves partial or whole-body immersion in water of low temperature for a specified period of time. [20] This method has been widely investigated in the context of post-exercise recovery, with numerous studies focusing on its physiological effects, such as reductions in muscle soreness, inflammation, and fatigue. [20,3,1]

In recent years, increasing attention has been given to the psychological responses associated with cold water immersion. Many studies indicate that the recovery process is not solely physiological but also involves a significant perceptual and psychological component. Athletes often report subjective improvements in recovery following cold water immersion, even in cases where objective physiological markers do not show clear changes. This suggests that psychological factors may play an important role in the perceived effectiveness of recovery interventions. [20,13]

The literature indicates that cold water immersion may influence various psychological domains, including mood, perceived recovery, stress levels, and mental fatigue. [13] Acute exposure to cold water is associated with changes in affective responses, including reductions in negative emotional states and improvements in overall well-being. [5] Furthermore, repeated exposure to cold stimuli may lead to psychological adaptation and a potential increase in stress resilience. [15]

An important aspect is also the role of expectations and perception in shaping recovery outcomes. [13] Athletes who believe in the effectiveness of cold water immersion may experience greater subjective benefits, highlighting the contribution of psychological mechanisms to the observed effects. [5] Additionally, variability in responses to cold water immersion may be influenced by factors such as water temperature, immersion duration, timing relative to exercise, and individual characteristics of participants. [15]

2. Materials and Methods

The selection included experimental studies, randomized controlled trials, crossover designs, and review articles examining the effects of cold water immersion in athletes and physically active individuals.

The analysed studies involved both trained athletes and recreationally active individuals subjected to various forms of physical exercise, including resistance training, endurance training, and high-intensity efforts. Cold water immersion protocols varied across studies and most involved water temperatures ranging from approximately 8 to 15°C and immersion durations of 5 to 20 minutes. In most cases, Cold water immersion was applied immediately after exercise, although some studies also investigated delayed or repeated interventions.

The primary focus of the analysis was on psychological variables such as mood, perceived recovery, stress, mental fatigue, and cognitive function. These variables were assessed using subjective scales and validated questionnaires at different time points, including pre-exercise, post-exercise, and during the recovery period.

Due to the heterogeneity of study designs, protocols, and measurement tools, data synthesis was conducted qualitatively. The results were grouped into thematic categories corresponding to the main psychological domains.

3. Literature Review

The analysis of the literature indicates that cold water immersion influences multiple aspects of psychological recovery, particularly in subjective domains. [13] The most consistently reported effects relate to mood, perceived recovery, stress, and fatigue, whereas findings regarding cognitive function are more heterogeneous. [13,19]

Cold water immersion affects both immediate and short-term psychological responses [13,6]. Athletes often report improved well-being, reduced fatigue, and greater readiness for

subsequent exercise following immersion. [13,20] These effects frequently occur independently of physiological changes, highlighting the important role of perceptual factors. [13]

Cold exposure also functions as an acute stressor, eliciting an initial stress response followed by a reduction in perceived stress during the recovery phase. [7,5] Repeated exposure may lead to habituation and increased stress tolerance. [15] Additionally, contextual factors such as expectations and prior experience influence psychological outcomes, emphasizing the importance of cognitive and perceptual mechanisms. [13,12]

At the same time, considerable variability in results is observed due to differences in protocols, participant characteristics, and measurement methods. Nevertheless, the overall trend suggests that subjective psychological indicators are more consistent than objective measures of cognitive function [13,19].

3.1 Mood and Affective Responses

Mood-related effects are among the most frequently observed outcomes of cold water immersion. [13,7] Studies indicate reductions in negative emotional states, such as fatigue and tension, as well as improvements in overall well-being. [5,13] Participants often report feelings of refreshment and increased alertness following immersion. [5,7] Although initial exposure to cold may induce discomfort and negative sensations, these effects are transient and are replaced by improvements in mood during the recovery phase. [5,7] Repeated exposure may further enhance positive affective responses, suggesting a degree of psychological adaptation to the cold stimulus. [15].

3.2 Perceived Recovery and Readiness for Exercise

Cold water immersion is consistently associated with improvements in perceived recovery and readiness for subsequent exercise. [13,20] Athletes report greater preparedness for subsequent training sessions, reduced muscle soreness, and improved recovery perception [20,3]. These effects often occur independently of physiological changes, highlighting their psychological nature [13]. Improved perceived recovery is also associated with increased motivation and confidence, which may influence the quality of subsequent training sessions [12,2].

3.3 Stress and Mental Fatigue

Cold water immersion influences the perception of stress and mental fatigue [5,7]. Although it initially induces a stress response, a reduction in perceived stress and improvement in mental recovery are observed in the later phase [5,7]. This suggests that cold water immersion may act as a controlled stressor that promotes adaptation [15]. Repeated exposure may increase stress tolerance and reduce sensitivity to both physical and mental fatigue over time [15,7].

3.4 Cognitive Function and Alertness

The effects of cold water immersion on cognitive function are less consistent [19,11]. Some studies report improvements in alertness and attention immediately following immersion, whereas others show no significant changes [7,5,11]. These discrepancies may be related to the timing of measurement, the type of cognitive task, and study design [19,18]. Short-term increases in alertness may be linked to physiological activation induced by cold exposure [7,17], although these effects do not appear to persist consistently over longer recovery periods [19,11].

3.5 Psychological Mechanisms

The psychological effects of cold water immersion result from the interaction between physiological responses, perceptual processes, and contextual factors [1,2]. These include activation of the autonomic nervous system, reduction of physical discomfort such as muscle soreness, expectation-related effects, and adaptation to repeated exposure [17,14,12]. The reduction of perceived pain and fatigue plays a significant role in improving perceived recovery, while beliefs regarding the effectiveness of the intervention may further enhance subjective outcomes [12,2,14].

3.6 Variability of Results

Significant variability in findings arises from differences in protocols, participant characteristics, and measurement methods [9,18]. Variations in water temperature, immersion duration, and timing of application influence the intensity of the stimulus and the resulting responses [4,14]. Individual responses to cold also vary, affecting the magnitude of psychological outcomes [12,9]. Subjective measures tend to be more consistent than objective ones; however, they remain sensitive to contextual and methodological factors [18,16].

4. Discussion

The findings of this review indicate that the effects of cold water immersion on psychological aspects are significant; however, they require cautious interpretation [6,3]. A key issue is the discrepancy between subjective and objective outcomes, suggesting that perceived recovery does not always reflect the actual physiological state [6,16]. The role of expectations and prior experience further complicates the interpretation of results, as beliefs about the effectiveness of cold water immersion may influence the observed outcomes [2,12]. Athletes familiar with this method may report stronger effects, highlighting the importance of cognitive factors in the perception of recovery [12,6].

Additionally, some studies suggest that the use of cold water immersion may attenuate long-term training adaptations, indicating a potential conflict between short-term recovery benefits and long-term training outcomes [8]. Importantly regular use of cold water immersion does not always lead to significant changes in physiological adaptations or performance, despite potential subjective benefits [10].

The dual role of cold water immersion as both a stressor and a recovery method highlights the complexity of its effects [7,17]. Initial discomfort and physiological activation are often followed by improvements in mood and reductions in perceived stress, reflecting the dynamic relationship between stress and recovery [7,14]. Furthermore, some findings suggest that external environmental factors associated with cold exposure may modulate psychological responses, contributing to the variability of observed outcomes [4,9].

Moreover, evidence indicates that physiological responses induced by cold exposure may interact with neural regulatory processes, potentially influencing psychological outcomes beyond immediate perceptual effects [17,1]. Variability in findings, resulting from methodological and individual differences, limits the ability to draw definitive conclusions [18,9]. Reliance on subjective measures may introduce certain biases; however, these measures remain important in the context of readiness for exercise and performance [16,20].

Overall, the literature suggests that psychological factors play a key role in the effectiveness of cold water immersion [6,1]. Nevertheless, further research is needed to better understand the relationship between subjective and objective outcomes, as well as the mechanisms underlying these effects [3,18].

5. Summary and Conclusions

Cold water immersion demonstrates a significant impact on the psychological aspects of

recovery, particularly in terms of improvements in mood, perceived recovery, and reductions in stress and fatigue. These effects are primarily subjective in nature and may occur independently of physiological changes.

The effects of cold water immersion result from the interaction between physiological responses, perceptual processes, and contextual factors. Improved recovery is associated with reductions in muscle soreness and fatigue, as well as cognitive factors such as expectations and prior experience.

Despite consistent observations, variability in results and individual differences limit the generalizability of conclusions. Differences in immersion protocols, participant characteristics, and measurement methods contribute to the heterogeneity of outcomes. Overall, cold water immersion represents a recovery strategy with significant psychological effects; however, the mechanisms underlying these effects remain complex and multifactorial.

Disclosure

Author's contribution:

Conceptualization: [SFS], [MMi]

Methodology: [PK], [NM],

Check: [SSz], [PAK], [KRT]

Investigation: [PK], [NM], [KRT]

Data curation: [SFS], [PAK], [MMa], [JM]

Writing -rough preparation: [SSz], [NM], [MMi]

Writing -review and editing: [PW], [MMa], [JM]

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