

Regulating the Temperature and Level of Cold Water Immersion as an Effective First-aid of Hyperthermia

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Introduction

Heat stroke, an emergency condition characterized by severe hyperthermia and organ dysfunction, causes significant morbidity and mortality if left untreated. Common in hot environments, the number of individuals exposed to high heatwave frequency is predicted to increase to 2.02 billion in 2050. Study in tropical countries estimated the mortality rate for heat-related illness was 19.5%. As one of the best first-aid, cold water immersion (CWI) was proven to have superior cooling rates, unsurpassed survival rates, and accessible implementation than ice water. However, to this date, the most effective temperature and the best level of cold water immersion have yet to be determined.

Objective

To investigate the effectiveness of cold water immersion in managing exertional heat stroke, including the most effective temperature and level of immersion.

Method

This study followed the Preferred Reporting Item for Systematic Review and Meta-analysis (PRISMA). We systematically searched PubMed, Scopus, Cochrane, Wiley, and ProQuest for relevant literature up to 16 September 2022. The included documents were further assessed for risk of bias using the Cochrane Risk of Bias 2.0. We then pooled the effect estimates using random-effects meta-analysis.

Result

Nineteen randomized studies cumulating a total of 332 participants are included. Cold water immersion showed a beneficial effect on hyperthermia (MD=0.02 [95%CI: 0.01-0.03], $p<0.001$; $I^2=12\%$). The temperature of 14-16°C turned out to be the most optimal temperature for cold water immersion, significantly increasing the body temperature by 0.02°C·min⁻¹ (95%CI: 0.01-0.03, $p<0.001$). Level of immersion above the iliac crest showed significant results (MD=0.02 [95%CI: 0.01-0.03], $p<0.001$; $I^2=24\%$) as well as below iliac crest (MD=0.02 [95%CI: 0.00-0.04], $p<0.020$; $I^2=0\%$).

Conclusion

Hyperthermia patients who were treated with cold water immersion significantly had superior cooling rates and it is potentially the best choice for the first aid. Implementation of optimal temperatures and immersion level through proposed guidelines is needed.

Key Words:

Cold water immersion, immersion level, meta-analysis, temperature