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Original Research

Aural Canal, Esophageal, and Rectal Temperatures During Exertional Heat Stress and the Subsequent Recovery Period

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Abstract

Context: The measurement of body temperature is crucial for the initial diagnosis of exertional heat injury and for monitoring purposes during a subsequent treatment strategy. However, little information is available about how different measurements of body temperature respond during and after exertional heat stress.

Objective: To present the temporal responses of aural canal (T_{ac}), esophageal (T_{es}), and rectal (T_{re}) temperatures during 2 different scenarios (S1, S2) involving exertional heat stress and a subsequent recovery period.

Design: Randomized controlled trial.

Setting: University research laboratory.

Patients or Other Participants: Twenty-four healthy volunteers, with 12 (5 men, 7 women) participating in S1 and 12 (7 men, 5 women) participating in S2.

Intervention(s): The participants exercised in the heat (42°C, 30% relative humidity) until they reached a 39.5°C cut-off criterion, which was determined by T_{re} in S1 and by T_{es} in S2. As such, participants attained different levels of hyperthermia (as determined by T_{re}) at the end of exercise. Participants in S1 were subsequently immersed in cold water (2°C) until T_{re} reached 37.5°C, and participants in S2 recovered in a temperate environment (30°C, 30% relative humidity) for 60 minutes.

Main Outcome Measure(s): We measured T_{ac}, T_{es}, and T_{re} throughout both scenarios.

Results: The T_{es} (S1 = 40.19 ± 0.41°C, S2 = 39.50 ± 0.02°C) was higher at the end of exercise compared with both T_{ac} (S1 = 39.74 ± 0.42°C, S2 = 38.89 ± 0.32°C)

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< Previous Next >

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and T_{re} (S1 = 39.41 ± 0.04°C, S2 = 38.74 ± 0.28°C) (for both comparisons in each scenario, $P < .001$). Conversely, T_{es} (S1 = 36.26 ± 0.74°C, S2 = 37.36 ± 0.34°C) and T_{ac} (S1 = 36.48 ± 1.07°C, S2 = 36.97 ± 0.38°C) were lower compared with T_{re} (S1 = 37.54 ± 0.04°C, S2 = 37.78 ± 0.31°C) at the end of both scenarios (for both comparisons in each scenario, $P < .001$).

Conclusions: We found that T_{ac}, T_{es}, and T_{re} presented different temporal responses during and after both scenarios of exertional heat stress and a subsequent recovery period. Although these results may not have direct practical implications in the field monitoring and treatment of individuals with exertional heat injury, they do quantify the extent to which these body temperature measurements differ in such scenarios.

Keywords: cold-water immersion, core temperature, exercise, hyperthermia

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Cited by

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top