

ADAPTATION IN CENTRAL THERMOSENSITIVITY OF METABOLIC HEAT PRODUCTION  
 FOLLOWING FIVE COLD WATER EXPOSURES

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During immersion in cold water, metabolic heat production is elevated as a result of both peripheral and central (core) thermoreceptor stimulation. Previous studies have reported that short-term (5 days), repeated cold water exposures may reduce the magnitude of the transient elevation in ventilation ( $\dot{V}_E$ , "gasp response") and thus oxygen consumption ( $\dot{V}O_2$ ), which result from cutaneous thermoreceptor stimulation during the initial phase of immersion. Although data from short-term cold air exposures have suggested a diminished thermogenic response along with a greater reduction in core temperature, these studies have not attempted to isolate the modification of central thermosensitivity of metabolic heat production to a given thermal stress.

In the present study head-out immersion in cold water (15°C) on 5 consecutive days was used to clamp skin temperature ( $T_{sk}$ ) as the thermogenic response (HP, indirectly assessed from  $\dot{V}O_2$ ) to an esophageal temperature ( $T_{es}$ ) reduction was evaluated in 4 healthy, male subjects (24.7-33.8 yrs). Within each subject, the magnitude of the decrease in  $T_{es}$  and rate of esophageal temperature cooling ( $\dot{T}_{es}$ ) were controlled by utilizing the pressure cuff occlusion (10 minutes) and subsequent release of blood within the cooled limbs. Subjects were immersed for one hour or until  $T_{es}$  reached 35°C.

Comparative data (mean  $\pm$  SD) for day 1 and day 5 values are shown in the following table: ( $\Delta T_{es}$  = decrease in  $T_{es}$  following release of occluded blood,  $\dot{T}_{es}$  = rate of  $T_{es}$  cooling corresponding to  $\Delta T_{es}$ , AHP = increase in heat production following release of occluded blood, and  $\beta$  = slope of HP vs.  $T_{es}$  following release of occluded blood)

	$T_{sk}$ (°C)	$\Delta T_{es}$ (°C)	$\dot{T}_{es}$ (°C·min <sup>-1</sup> )	AHP (W·kg <sup>-1</sup> )	$\beta$ (W·kg <sup>-1</sup> ·°C <sup>-1</sup> )
Day 1	17.67 $\pm$ .93	-.54 $\pm$ .24	-.20 $\pm$ .09	3.40 $\pm$ 1.40	-5.49 $\pm$ .87
Day 5	17.68 $\pm$ .98	-.66 $\pm$ .33	-.17 $\pm$ .07	2.40 $\pm$ 1.26	-2.48 $\pm$ 1.95

Both  $\Delta$ HP and  $\beta$  were significantly reduced during the 5th immersion when compared with the initial immersion response. Although the thermogenic response was diminished for all subjects by day 5, only one subject showed a continuous decrease across the daily immersions.

These results indicate that central thermal drive to metabolic heat production is reduced following short-term (5 day) cold water exposure. Individual variability in the pattern of adaptation was observed which is in agreement with previous acclimation studies.

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