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# THERMOREGULATION DURING COLD WATER IMMERSION 48h AFTER HARD EXERCISE AND CARBOHYDRATE DEPRIVATION

Ira Jacobs, Dr. Med. Sc. and Tiit T. Romet, M.Sc.

Defence & Civil Institute of Environmental Medicine

**Address** for reprints:

1133 Sheppard Avenue West
Toronto, Canada
M3M 3B9

Shivering thermogenesis by skeletal muscle is the primary source of heat production when humans are exposed to cold. Although it is well established that circulating substrates fuel the increased muscle metabolism associated with shivering, the role of endogenous intramuscular substrates is not clear. In the present study it was hypothesized that the ability to maintain normal body temperature during cold water immersion would be impaired if the glycogen concentration was low in a large muscle group.

Two groups of male subjects were immersed to the chest in 17.5° C water twice. The Experimental group (n=6) was immersed during a control trial and again after 2-3 days of a carbohydrate-(CHO) poor diet preceded by hard, prolonged cycle exercise. A Control group (n=4) was immersed at identical intervals while maintaining a normal diet and avoiding exercise. Rectal temperatures, $\dot{V}O_2$, and $\dot{V}CO_2$ were monitored during the immersion, and venous blood samples were obtained before and after the immersion. The subjects remained in the water until either rectal temperature decreased by 1° C from the pre-immersion value or 60 min elapsed.

Assays of biopsies from the vastus lateralis showed that glycogen concentration prior to the second immersion was only 63% of the control values in *Ex*. Rectal temperature decreased more rapidly following the CHO-poor diet in Ex ($p<0.05$). Although $\dot{V}O_2$ increased similarly in both groups during the immersions to about four times the resting metabolic rate, a lower respiratory exchange ratio indicated that a greater proportion of heat production was fueled by fat combustion during the second immersion in Ex ($p<0.05$). The first water immersion caused increases ($p<0.05$) in plasma free fatty acid, glucagon, thyroxine, and triiodothyronine and a decrease ($p<0.05$) in insulin concentrations; the changes were similar in both groups. A significant trial-time interaction for insulin and glucagon changes suggested that the dietary manipulations in *Ex* affected the responses to the immersion in a different manner than Con during the second trial.

Considering that only a part of the total body muscle mass was exercised, the results suggest that hard, prolonged exercise and/or nutritional carbohydrate deprivation may impair the ability to maintain body temperature, and delay hypothermia, during subsequent cold water immersion.