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# ANTAGONISTIC EFFECT OF COLD EXPOSURE ON HUMAN HEAT TOLERANCE

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Little is known about the effects of acclimatization, or even prolonged exposure, to cold on human responses to heat, although the question is important to many occupational groups (e.g. cold-store workers in hot climates, or furnace workers in cold climates). After cold winters some authors have observed reduced heat tolerance, as shown by a decrease in sweating sensitivity (sweat loss per degree increase in deep body temperature), but this change might simply reflect the withdrawal of the stimulus of habitual summer sweating. We here report the effects on heat tolerance of both artificial and natural exposure to cold. The investigation was part of the International Biomedical Expedition to the Antarctic (IBEA), a scientific project organised by the Scientific Committee on Antarctic Research (SCAR) Working Group on Human Biology and Medicine.

In late spring (November in Sydney) six white men (the 'bath group') were acclimatized to cold by ten daily cold baths, of mean duration 48 min, in 15°C water. Immediately before and after the bath treatment they underwent a standard heat-tolerance test consisting of 4 h of alternating light work and rest, nude, in air temperature 38°C, relative humidity 54%, and air speed 0.5 m $s^{-1}$. The heat-tolerance tests were shared with 6 control subjects (the 'control group') who had had only two baths. Four months later both groups underwent a further heat-tolerance test, 19 days after they had completed a 69 day motor-toboggan traverse on the Antarctic plateau.

The tests after the bath treatment showed that sweating sensitivity had decreased by 38% ($P = .02$) in the bath group but had not changed in the control group. The reduction in sweating sensitivity was accompanied by an increase in perceived stress ($P = .02$), but not by any significant change in thermal sensation or discomfort. After the Antarctic traverse, when acclimatization to cold had decayed, sweating sensitivity had not changed further in the bath group but had decreased by 23% in the control group, although the change was not significant. Both groups, however, revealed an additional reduction in heat tolerance after the traverse, as shown by increases in mean skin temperature (0.5°C) and body heat storage (31%), with a consequent 13% reduction in the core-to-skin temperature gradient ($P < .05$ for all changes).

The observed reductions in heat tolerance were not significantly associated with V02 max or skinfold thickness, and hence cannot be attributed to changes in fitness or fatness. Nor can they be attributed to withdrawal of the stimulus of habitual sweating. There was no reason for it to have changed in the bath group alone during the ten days of the bath treatment; and the sweat losses measured throughout the traverse (mean 328 g, range 176-995 g, per 9.7 h work day) are unlikely to have been less than those the expedition members would have experienced during the months of sedentary activities in temperate climates that preceded the traverse. We therefore conclude that cold exposure has an antagonistic effect on heat tolerance.