PHYSIOLOGICAL AND PATHOPHYSIOLOGICAL ASPECTS OF PARTIAL BODY COOLING GARMENTS UNDER HEAT STRESS

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The use of cooling garments reduces efficiently thermal and cardiovascular strain in a hot working environment. Individual personal cooling however may not be seen as a substitute for technical climate control. It rather serves under very hot working conditions as a supportive measure or prevents unreasonable heat stress. In any case those working under extreme thermal conditions should be required to make use of their own ability to increase their tolerance to heat through heat acclimation (1) or their physical endurance capacity (2).

Our own four hour investigations using water-ice cooling vests with 17 physically trained and 14 untrained male subjects on a treadmill (3 km/hr , 1° increase corresponding to a 300 watt consumption of energy at a room temperature of 40°C and a 45% rel. humidity) demonstrated an on-the-average significantly less increase in rectal temperature and heart rate than in similar experiments without cooling vests (figure 1). For subjects with lower physical endurance capacity wearing a cooling vest the differences in physiological relief were 0.5 (±0.08) Kelvin in rectal temperature and 23 (±5) beats per minyte in heart rate. In trained subjects the differences were 0.44 (±0.15) Kelvin in rectal temperature and 15 (±4) beats per minute in heart rate.

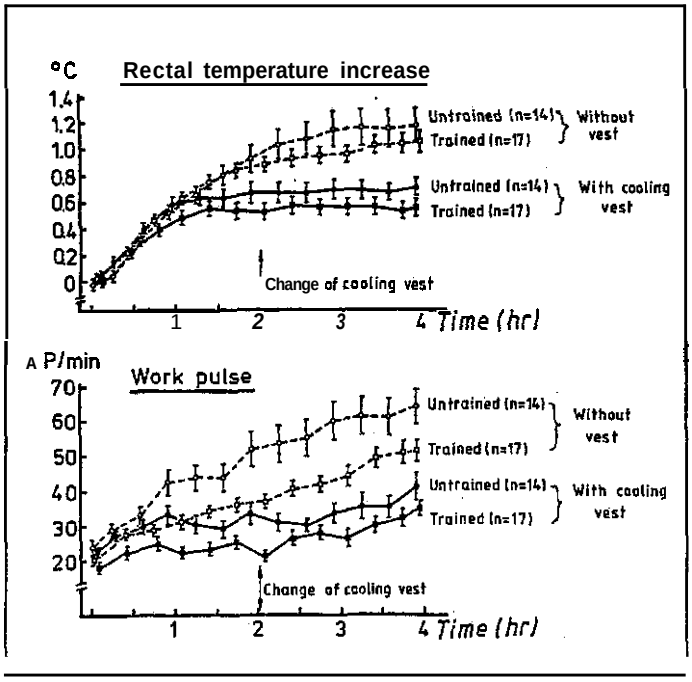

Fig. 1: Physiological strain during 4 hr heat work of 17 physical endurance trained and 14 untrained male subjects (unused, to heat) wearing water-ice cooling vests, and control test. Brackets = standard error.

A basic question arising from these experiments is the following: does cooling of the chest by means of cooling vests lead to certain health risks such as the common cold? This issue was further borne out by measurements of the mucous membrane temperature of the pharynx by infrared methodology which were performed on 4

male subjects under conditions of 23°C and 40°C room temperature (figure 2). No change in pharynx temperature was observed under 45 minutes passive heat exposure as well as when walking on a treadmill at 40°C. To a distinct decrease of mucous membrane as well as rectal temperature led passive exposure at 23°C room temperature. At 40°C room temperature rectal temperature of the subjects also showed a slight increase. In conclusion there seems to be no general health risk wearing a cooling vest under passive heat exposure as well as heat work.

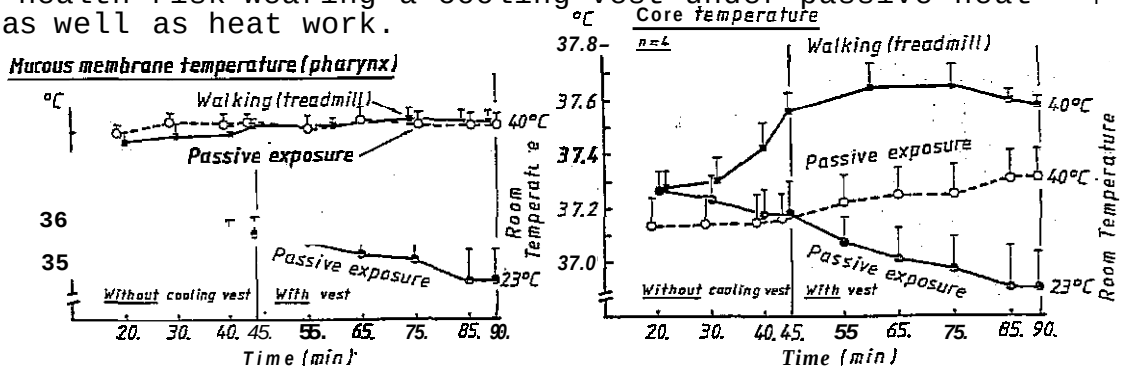

Fig. 2: Average mucous membrane (pharynx) and core temperature during normal and hot room temperature of 4 subjects wearing a water-ice cooling vest. Brackets = standard error.

The use of cooling vests offers the chance to expose also subjects with disturbances of their thermoregulatory system more safely to extreme heat. Taking a Finnish sauna bath spinally injured patients have greater internal heat storage than able-bodied subjects because of their insensate parts of the body (3). In our own experiments 8 para-and quadroplegic patients took a 15 minute sauna bath in a supine position at 85°C dry temperature and 5-10% rei-humidity with and without wearing a water-ice cooling vest (figure 3). Increase of core temperature and heart rate at the end of the heat exposure were clearly smaller when wearing a cooling vest than without its use.

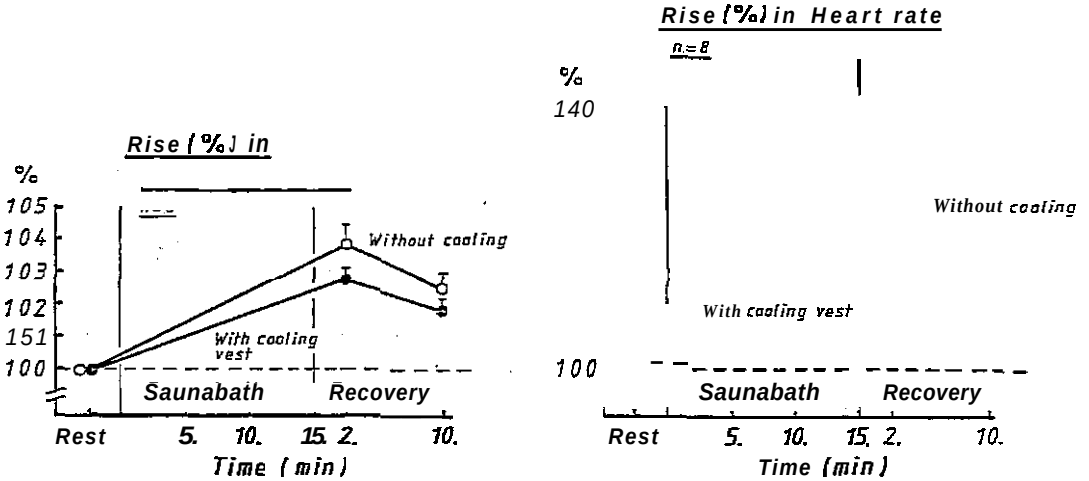

Fig. 3: Average rise (percent) in core temperature and heart rate of 8 spinally injured subjects taking a 15 min Finnish sauna bath, with and without wearing a cooling vest. Brackets = standard error.

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