Proceedings of 3rd International Conference on Environmental Ergonomics
8—12 August 1988 Helsinki, Finland
eds. R. Ilmarinen and A. Påsche, p. **28**

REQUIREMENTS OF PHYSIOLOGICAL TEMPERATURE REGULATION TO THE DESIGN OF PARTIAL BODY COOLING SYSTEMS

Jürgen Werner
Institut für Physiologie, Ruhr-Universität Bochum

Address for reprints:
D 4630 Bochum 1, Universitätsstraße 150, MA 4/59,
Federal Republic of Germany

The aim of the studies was to determine the conditions of compatibility of partial body cooling with the body's physiological responses.
Experiments were carried out on 8 male students of normal health, condition and weight in a climatic chamber. Local skin temperatures, mean skin temperature and two core temperatures (oesophagus and rectum) were recorded using fine thermocouples. O_2-consumption and CO_2-production were continuously measured by an open mask system. Local evaporation was recorded using capsule evaporimeters. Data acquisition, linearisation, compensation for influences of temperature, pressure and humidity on gas analysis and all further necessary calculations were carried out by a microprocessor system.
One or both legs could be put into climatic boxes in which the temperature could be controlled independently of the climatic chamber and of one another. In the second half of the experimental series the right leg was fastened to a special bicycle ergometer constructed in our laboratory. This ergometer made it possible to pedal with one leg only at a constant, adjustable work load independent of pedalling velocity.

Four types of experiments were carried out:
Series 1: Global thermal load on the body / partial cooling of one leg
Series 2: Thermal load on one leg / energy equivalent compensation by cooling the other leg
Series 3: Work on the ergometer with global thermal load
Series 4: Energy equivalent cooling of one leg with contralateral ergometer work

The results may be summarized as follows:

Experiments without work load:

1. Local thermal load/compensation yields increase/decrease of local skin temperature and sweat rate.
2. Contralateral compensation by controlling the overall heat balance evokes antagonistic behaviour of local temperatures but no change of local sweat rates.

Experiments with work load:

3. Local load by work yields a local increase of sweat rate without a significant increase of local skin temperature.
4. Contralateral compensation by controlling the overall thermal balance evokes an antagonistic drive for local sweat rates.

The following conclusion with respect to the design and application of partial body cooling units is drawn: Cooling should be applied to those parts of the body which are submitted to the thermal load.
When cooling other parts, high local temperatures or antagonistic drive of local effector responses have to be envisaged.

Supported by Deutsche Forschungsgemeinschaft SFB 114 + We 919/2-1