Thermal sensation and thermophysiological responses with metabolic step-changes

This study investigated the effect on thermal perception and thermophysiological variables of controlled metabolic excursions of various intensities and durations. Twenty-four subjects alternately were seated on a chair or exercised by walking on a treadmill at a temperature predicted to be neutral at sedentary activity. In a second experimental series, subjects alternated between rest and exercise as well as between exercise at different intensities at two temperature levels. Measurements comprised skin and oesophageal temperatures, heart rate and subjective responses. Thermal sensation started to rise or decline immediately (within one minute) after a change of activity, which means that even moderate activity changes of short duration affect thermal perceptions of humans. After approximately 15-20 min under constant activity subjective thermal responses approximated the steady-state response. The sensitivity of thermal sensation to changes in core temperature was higher for activity down-steps than for up-steps. A model was proposed that estimates transient thermal sensation after metabolic step-changes. Based on predictions by the model, weighting factors were suggested to estimate a representative average metabolic rate with varying activity levels, e.g. for the prediction of thermal sensation by steady-state comfort models. The activity during the most recent 5 min should be weighted 65%, during the prior 10-5 min 25% and during the prior 20-10 min 10%.