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EVALUATION OF THE EFFECT OF TWO FIXING METHODS ON SKIN TEMPERATURE MEASURED WITH TWO DIFFERENT TEMPERATURE SENSORS

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In most studies on heat and cold stress, skin temperature (T_{sk}) is measured continuously using contact techniques. Numerous factors affect the accuracy of measurement. A sensor or an adhesive tape act as insulators and affect dry heat transfer and evaporation. The force of the applicator affects blood flow on the skin, and thus also T_{sk}. A sensor may detect an intermediate temperature between the skin surface and the ambient temperature, or the temperature of liquid sweat on the skin surface. However, there is a need for a systematic study of the influence of different skin surface probes and different fixing methods on T_{sk} values.

This study aimed to evaluate the differences in T_{sk} measured using YSI 427 and Craftemp thermistors. The differences between the sensors were < 0.2 °C when calibrated in a water bath. The sensors were attached to the chest, abdomen, upper back and thigh as near each other as possible using "breathing" surgical tape (Scanpor) and a silicon rubber disc (thickness 0.3 mm and diameter 30 mm) supplied with double adhesive tape ring. The disc was also equipped with holes for evaporation. T_{sk} measurements were taken during the study on human survival in a dry cold climate (t_a -12 °C, rh 20 %, v_a 5ms^{-1}, I_{cl} 0.7 clo) and during manned evaluation of fighter pilot antiexposure suits (ca. 1.8 clo) in a warm environment (t_a 30 °C, $t_a = t_g$, rh 40 %, v_a 0.3 ms^{-1}) with the subjects sitting and performing exercises on a cycle ergometer (MR 290 W).

There were no significant differences between YSI 427 and Craftemp sensors. In most cases in the warm environment the sensors fixed with the surgical tape gave lower values. However, the differences were usually < 0.2 °C. The maximum difference was 0.5 °C whereas T_{sk} were between 33 °C and 36 °C. During physical work the T_{sk} measured with 'both taped sensors increased more slowly than that of sensors fixed with the silicon rubber disc, indicating that the disc affects heat flow from skin to air more than the tape. In the cold environment the fixing method affected the T_{sk} values more than in the warm environment. The T_{sk} measured with taped sensors were lower and the sensor responded more rapidly to temperature changes. The maximum difference was 4.5 °C while skin temperature varied between 15 °C and 25 °C.

This study indicates that under heat stress the calibration of skin surface probes should be done carefully, but that the fixing method is not so crucial. In the cold more attention should be paid to the fixing methods which affect greatly the accuracy of the measurements. It seems to be difficult to compare the T_{sk} values measured in different laboratories if the sensors and especially the fixing methods are not the same. Further work is required to standardize the measuring methods to be used in thermal studies.