Annals Physiol. Anthrop. Vol 5. No. 3 1986

61 Prediction of the psychrometric range of a clothing system using the relation between subjective comfort votes and variables

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An experiment was set up to determine the psychrometric range of a military clothing system. The clothing system consisted of 11 items. enabling the user to wear a variety of clothing assemblies according to the weather conditions. The clothing system was developed to cover the temperature range between **-20** and +**30** degrees Celsius at activity levels ranging from rest to heavy work.

Four clothing combinations (cold to hot weather gear) were involved in the test, each tested on four subjects at two metabolic levels [standing (65 W/m^2, duration of experiment 3 hours) and bicycle ergometer work **(230** W/m^2 for 1 hour)] and in three climatic conditions. The climatic conditions were chosen in combination with the estimated clothing insulation and the metabolic rate, in order to result in mild cold Stress or mild heat stress.

Data were collected on $\mathbf{0_2}$ uptake, skin temperatures and humidities, oesophageal and rectal temperatures, suit surface temperatures and, in a 15 minute cycle, subjective comfort sensations regarding both temperature and humidity.

With these data, the clothing insulation values for each outfit and climatic conditions were determined, using the method of partitional calorimetry. Further, the relation between subjective comfort votes and physiological variables was investigated by multiple regression analysis, up to 78 percent of the variance in comfort votes being explained in terms of physiological parameters. In this way the physiological status could be determined, associated with any of the comfort votes. Subsequently, this status and the actual determined clothing insulation values were used to predict the ambient (climatic) and work rate conditions that would evoke such comfort votes, resulting in the prediction of the psychrometric range.

The results show that the width of the psychrometric range runs from P C for comfortable cold to comfortable warm, up to 22% for uncomfortable cold to uncomfortable warm. The range is more or less symmetrically distributed around the neutral point, indicating that redistribution of heat loss in combination with clothing behaviour in the cold is as effective as is sweating in the heat. The width of the psychrometric range tends to increase with work rate, and shows only a slight dependence on insulative value.

Using the method described above, the complete psychrometric range of the system is predicted from measurements at only a limited number of climatic conditions.