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EFFECTS OF FITNESS, FATNESS, AND AGE ON HUMAN RESPONSES TO HEAT AND COLD

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Attempts to define safe limits for occupational exposures to heat and cold are bedevilled by the wide differences that exist between individuals in their tolerance of heat and cold. Likewise, in many circumstances (e.g. selection and monitoring of personnel for emergency services, military training, and competitive sports) it is necessary to take account of individual characteristics that may increase or reduce the risk of adverse reactions. Previous studies have reported the effect of single characteristics, such as physical fitness or body fat content, on individuals' responses to either heat or cold. We here report the effects, separate and combined, of fitness, fatness, and age on the same subjects' responses to both heat and cold. The investigation was part of the International Biomedical Expedition to the Antarctic (IBEA), a scientific project organised by the Scientific Committee on Antarctic Research (SCAR) Working Group on Human Biology and Medicine.

The subjects were 12 white men who in baseline laboratory tests underwent a 2 h cold exposure, nude, in air temperature 10°C, and a 4 h work-in-heat test in air temperature 38°C and relative humidity 54%. In the cold, the change in rectal temperature ranged from a rise of 0.30°C to a fall of 1.25°C, and shivering heat production ranged from 384 to 693 kJ m^{-2}. In the heat, body heat storage ranged from 30 to 185 kJ m^{-2}, heart rate ranged from 90 to 172 beats min^{-1}, and subjective reports ranged from 'extremely easy' to 'hard'. This diversity in men's responses was accompanied by an equally great diversity in their age (26-52 y), body mass (58-103 kg), and skinfold thickness (6-18 mm). Maximum oxygen uptake ranged from 34 to 49 ml kg^{-1} min^{-1}. The wide ranges of both the dependent and the independent variables provide an excellent basis for regression analyses.

Significant ($P<.05$) preliminary findings are that in the cold the fatter men lost less heat to their surroundings than the leaner men but did not thereby achieve a lesser heat debt; instead, they shivered less and produced less heat. Their skin temperatures were lower but they felt less cold, less uncomfortable, and less stressed. Conversely, in the heat the fatter men accumulated more heat, sweated more, and had higher heart rates. Responses of the fitter men to both heat and cold did not differ from those of the less fit, possibly because of the smaller range of variation in fitness. Older subjects sweated slightly more than the younger ones. The results of multiple regression analyses, currently in progress, will be reported.