

ABSTRACTS

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1 Individual variations in the limits of cold tolerance in humans

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The limit of human tolerance of cold is when the extent of general or local body cooling is such that the integrity of the bodily functions and/or the ability to remain mobile are/is lost and cannot be restored without assistance. This limit, however, is determined not only by the degree of the cold stress (the ambient conditions including the extent of the extra-corporeal thermal insulation), but also by the magnitude of the induced physiological strain that the body can tolerate without systems failures. The tolerable strain depends upon many individually variable physiological, pathological, and often also pharmacological, factors which determine the risk of life-threatening hypothermia. Many of these variables in the degree of cold-induced strain that humans can withstand are generally recognized, but are under-emphasized in the literature on cold tolerance. This is largely because most cold endurance studies have been done on healthy young persons when studying in medical schools, or before or during relatively brief sojourns in polar regions. A more revealing and clinically useful study would be upon the full spectrum of an arctic or subarctic residential population, including the very young and the elderly, the middle-aged with various and varying degrees of metabolic, respiratory and cardiovascular disorders and adults of all ages on prescribed or unprescribed drugs. That, however, would be difficult, if not impossible, to execute. There is, nevertheless, an increasing need for an awareness of the individual variability of the risk of hypothermia as arctic residency and industrial activities increase.

Published graphical representations of the relations between ambient temperature, thermal insulation, metabolic rate and core temperature: and of the sensors, central regulator, correction effectors and feedback processes involved in mammalian thermoregulation, facilitate the provisional identification of at least some of the physiological, pathological and pharmacological factors which are likely to predispose an individual to hypothermia during cold-exposure. These include muscular, neuro-muscular, nervous, metabolic, cardiovascular and respiratory disorders, impaired mobility, the therapeutic use of tranquilizers and other centrally active substances, the voluntary consumption of alcohol, and the taking of unprescribed drugs, as well as the well-established susceptibility of the newborn and the elderly. Such identification by means of physiological reasoning, rather than by direct evidence, will be incomplete, and to some extent quite erroneous. It does, nevertheless, provide some guidance to populations at risk, and to their medical attendants, where presently there is little.

The final determinant of cold endurance, however, is not always the extent to which heat can be generated and retained within the body: fuel exhaustion is frequently the prelude to profound hypothermia, especially when this has been preceded by a prolonged period of intense shivering. This possibility needs to be recognised, since any attempt to re-warm without prior or simultaneous fuel replenishment is unlikely to succeed.

The intention of this presentation is to increase awareness of the individual variability of human cold endurance and the multifactorial reasons for it, and to indicate what some of these factors are, or may be,