After repeated exposures to heat and/or prolonged exercise bouts, heat-tolerance is achieved by facilitation of sweating. Such short-term heat acclimatization is accomplished within several days to two weeks. On the contrary, tropical inhabitants possess heat-tolerance with suppressed sweating (long-term heat acclimatization). We compared heat tolerance and sweating response to heat between tropical Thai and temperate Japanese. Thermal sweating tests showed the smaller amount of sweating with the longer latent period for sweat onset in Thai. Dripping of sweat (ineffective sweating) was observed in many Japanese, but seldom in Thai. The skin temperature decreased with sweating in Japanese, however it elevated in the majority of Thai (enhanced dry heat loss). Suppressed sweating in tropic inhabitants was attributed to the suppression of both the central and peripheral sudomotor activities. Recently, using quantitative sudomotor axon reflex test by iontophoresis of ACh, we showed that sweating responses of tropical Malaysian increased and approached to the response of Japanese during their 2-72 months stay in temperate Japan and that those in Japanese decreased and approached to those of tropical natives during their 2-13 years stay in tropics after growing up. Heat-tolerance with suppressed sweating after long-term heat acclimatization is considered to be an economical strategy to survive in the heat. On the other hand, short-term heat acclimatization with enhanced sweating is a strategy to achieve the higher work capacity in the heat. Since the latter includes the risk of dehydration, the former is superior to the latter in body fluid and osmo-regulation. Though these two types of heat acclimatization lay on the opposite from the view point of sweating behavior, it is interesting whether the long-term heat acclimatization comes after the continuum of the short-term heat acclimatization.

S07-3 Aging Process of Heat Loss Effector Function

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Cutaneous vasodilation and sweating are the two main heat loss responses to internal and external heat stress in humans. This presentation attempts to address how the heat loss effector function declines with aging. Our cross-sectional and longitudinal findings suggest that age-related decrement in heat loss effector function may involve cutaneous vasodilation, sweat output per gland, and active sweat gland density in that order. The successive decrement may proceed from the lower limbs to the back of the upper body, the front of the upper body, then the upper limbs and finally to the head. We found that several factors related to peripheral circulation may contribute to the mechanisms responsible for the age-related decline in the cutaneous blood flow response to heating, such as physical changes in the structure of the cutaneous vasculature, lower sensitivity of the active vasodilation system, or a lesser withdrawal of vasoconstrictor tone. Furthermore, our recent results related to central circulation suggest that the age-related decrement of cutaneous blood flow that begins in the lower limbs may be associated with the decrement of femoral artery blood flow. Lower sweating rate in older men may be due to age-related alterations of peripheral mechanisms rather than central drive activity. From our recent results of sweat expulsion test, quantitative sudomotor axon reflex test by iontophoresis of acetylcholine, and skin thermal sensitivity test in the same older and younger men, we also discovered that the age-related change in the sweat gland itself (atrophy and/or lower sensitivity to cholinergic stimulus) and in the sensitivity of skin thermoreceptors may precede a decrement in the activities of the central sudomotor and sympathetic nerves.

S07-4 Apparent and Real Cooling Efficiency of Moisture Evaporation from the Skin while wearing Protective Clothing

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The major mechanism humans use to avoid overheating while working in hot environments is the production and evaporation of sweat. Wearing protective clothing exacerbates the heat strain caused by the environment as the clothing hampers dry and evaporative heat loss.

Protective clothing typically has a diminished vapour permeability compared to normal clothing, and this reduces the cooling capacity. When in addition liquid protection is present in the clothing, vapour permeability and cooling capacity will diminish further, increasing the risk of heat stress even further. In a series of experiments in different laboratories heat loss from protective clothing with