Autonomic Thermoregulatory Responses and Subjective Thermal Perceptions Leading up to and upon the Initiation of Thermal Behavior in Hot and Humid Environment

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(高温多湿環境下における体温調節行動開始までの自律性体温調節反応と主観的温度知覚)

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Abstract of Dissertation

Thermal behavior has long been recognized as our first line of defense against uncompensable heat stress. Behavioral thermoeffectors have been postulated to alleviate the autonomic strain by preventing the rise in core body temperature and thereby minimizing the requirement to activate cutaneous vasodilation and sweating. While it is critical for homeostasis, our understanding of behavioral thermoregulation is limited compared to the substantial work on autonomic thermoregulation. Therefore, this dissertation aims to examine the control of human behavioral thermoregulation in a hot and humid environment at rest and during low-intensity exercise by uncovering the systematic recruitment of autonomic thermoeffectors in relation to changes in subjective thermal perceptions prior to thermoregulatory behavior initiation. Also, this dissertation aims to determine whether there are sex-differences in the autonomic thermoregulatory responses and subjective thermal perceptions preceding the decision to behaviorally thermoregulate.

In the first study, the autonomic thermoregulatory responses and subjective thermal perceptions leading up to and upon the initiation of thermal behavior in a hot and humid environment among young, healthy males in resting condition were examined. Results showed that when given the opportunity to behaviorally thermoregulate, changes in skin blood flow and sweating are not required for thermal behavior to be initiated. Nevertheless, acute changes in mean skin and core body temperature, which appear to elicit increased thermal discomfort, motivate thermal behavior.

The second study demonstrated that during low-intensity exercise in a hot and humid environment, changes in skin blood flow is not required for thermal behavior initiation. However, changes in sweat rate upon thermal behavior initiation were observed. Moreover, an increase in mean skin and core temperature, which appears to cause an increase in thermal discomfort, precedes the decision to thermoregulate behaviorally. In addition, an increase in mean body temperature leading up to thermal behavior initiation was observed, suggesting that changes in mean body temperature rather than mean skin and core temperature alone mediate thermal behavior during low-intensity exercise in the humid heat.

In the third and final study, the results revealed that there are no sex-differences in the temporal recruitment of autonomic thermoeffectors preceding thermal behavior

initiation at rest and during low-intensity exercise.

This dissertation has examined how humans regulate the core body temperature via autonomic and behavioral thermoeffectors in a hot and humid environment. It was evident that the skin and core body temperature play essential roles in mediating both autonomic and behavioral responses. However, it is somehow different in thermal behavior in which a given level of thermal discomfort is required for thermal behavior initiation. Moreover, conscious perceptions of the changes and skin wetness probably magnify the signals mediating thermal behavior activation. Lastly, this study showed that the orderly recruitment of autonomic thermoeffectors relative to their physiological costs holds true in a hot and humid environment.