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Office workers frequently experience up-step and down-step air temperature when moving out of and into a relatively cold office building in tropical and temperate countries in the summer. Air temperature step changes promptly suppress or activate thermoregulation functions (Xiong et al., 2016). However, no study investigates the effect of air temperature step changes on brain function and mental task performance. Besides, no previous study presents the comparison between different level of heat acclimatization subjects in air temperature step changes. The purpose of this study was to provide basic knowledge regarding the effects of air temperature step changes to support human health and work performance in tropical and temperate subjects. Experiments were conducted in actual environment in experiment 1 and laboratory in experiment 2 and 3.

In the first experiment, the aim was to investigate the effects of air temperature step-changes on thermal perception and perceived arousal of workers in actual offices in Indonesia. Subjective responses to thermal perceptions and perceived arousal were evaluated in two offices experiencing different air temperature step changes (up-step and down-step). Office A and office B experienced air temperature step changes of about 9 °C and 5 °C, respectively. Air temperature step changes of about 23-32-23 °C in Office A elicited a hysteresis effect on thermal sensation, thermal comfort, and perceived arousal. It also increased heat stress and decreased perceived arousal after down-step temperature. Thus, initial thermal conditions affected thermal perception and arousal after the air temperature step changes. The range of air temperature recorded in this actual environment of 22 °C up to 32 °C, was further examined in the laboratory.

The second experiment was aimed to evaluate the effects of air temperature step changes (22-32-22 °C and 28-32-28 °C) and different level of heat acclimatization on thermoregulation responses (Indonesian and Japanese) and calculation performance were compared. Measurements of calculation task, sweating rate, blood pressure, and subjective vote were repeatedly measured in each phase, while body temperatures and heart rate were continuously measured. This

experiment shows that air temperature step changes of 22-32-22 °C induced stronger thermoregulation and suppressed heat stress during heat exposure in both subject groups than air temperature step changes of 28-32-28 °C. The advantage of pre-exposure to cold temperature was more pronounced in Japanese subjects up to the end of heat exposure. In addition, heat acclimatization features in Indonesian subjects was beneficial to adapt to sudden heating, enhanced dry heat dissipation during the heat exposure, and limited thermal stress during down-step without decreasing calculation task performance.

The third experiment aimed to investigate cardio circulatory and brain functions during calculation task performance in air temperature step changes conditions in Indonesian and Japanese subjects. Calculation task performance, alpha attenuation task and blood pressure were measured repeatedly in each phase. Body temperature, electroencephalogram, electrocardiogram, cerebral oxygenation which emphasize the results of Tissue Hemoglobin Index (THI), and forehead skin blood flow were measured continuously. During performing a series of calculation task in 22-32-22 °C, up-step temperature suppressed the increased of sympathetic nervous activity and relatively increased cerebral oxygenation of Japanese subjects. It suppressed their heat stress and hence had a significantly higher performance than Indonesian subjects during heat exposure. While during down-step temperature, it suppressed the decrease of cerebral oxygenation in both subjects and significantly improved their performance, set optimum arousal, and hence maintained their performance as down-step temperature with a tendency of a higher performance obtained in Japanese subject than Indonesian subjects. This study suggests that the intensity of air temperature step changes and thermal acclimatization level influenced cardio circulatory, cerebral function, and affected the calculation task performance.

Taken together from the first, second and third experiment, the main summary of this study can be drawn as follows; Tropical and temperate subjects response differently under air temperature step changes. Thermal acclimatization status in the previous phase affects the thermoregulatory, cardio circulatory, brain functions, and mental task performance in the next phase. These responses were more sensitive to the larger gap of air temperature step.