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CORRESPONDENCE

The advantage of using differential data in thermal biology

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The homeostatic mechanisms involved in the maintenance of thermal balance during exercise in the heat influence fluid balance regulation and, therefore, contribute to heat illnesses and decrements in work performance (Flouris and Cheung 2010a). In this light, the study by Wakabayashi and colleagues published recently in this journal raised considerable interest, after reporting that the heat dissipation response of Malaysian and Japanese males during exercise in humid heat stress is different (Wakabayashi et al. 2010). The experimental protocol consisted of a 60-min submaximal exercise bout in 32°C and 70% relative humidity, followed by 30 min recovery. Amongst other parameters, the authors measured rectal temperature (T_{re}) and hand skin temperature (T_h). At baseline, these two variables were significantly different between the two groups. Specifically, T_{re} was higher in Malaysian individuals, while T_h was higher in the Japanese. The data for these variables are presented as measured (i.e., raw) averaged every minute, despite the fact that the authors are also referring to 'changes' and to 'ΔT_{re}' (e.g., Figure 1 in Wakabayashi et al. 2010). Interestingly, despite the baseline differences, the peak T_{re} and T_h values measured at the end of the exercise bout were similar between the two groups. Consequently, the authors cannot convincingly argue that the heat dissipation response is different between the two groups because their data analysis does not provide statistically-derived proof for this claim.

The main value of thermometry in research as well as in clinical decision-making stems from monitoring changes in core temperature across time (i.e., temperature history), not from comparing an individual's temperature with what is regarded as 'normal' temperature (Flouris and Cheung 2010b). This is because 'normal temperature' has a relatively large range across different individuals (Mackowiak et al. 1992) and measurement sites (Farnell et al. 2005). This consideration is pertinent to the interesting study conducted by Wakabayashi and colleagues (2010). Specifically, the mean T_{re} and T_h values presented in Figure 1 of Wakabayashi et al. (2010) should have been replaced with differential data calculated as T_{re} and T_h at *time t* minus T_{re} and T_h at *time 0* (mean baseline value). Based on these differential data, the discrepancy in the heat dissipation response of Malaysian and Japanese individuals would become apparent and interpretable in terms of biological control processes. Specifically, these data would have shown that T_h (and, hence, skin heat dissipation) in Japanese individuals did not show drastic changes after the start of exercise, and was unable to prevent an excessive body heat storage, evident by the substantial change in T_{re}. In contrast, differential data in Malaysian individuals would have revealed that T_h increased sharply after the start of the exercise bout and demonstrated an overall two-fold increase compared to that of Japanese individuals. This enhanced skin heat dissipation in Malaysian men was successful in preventing excessive body heat storage, evident by the small change in T_{re}. Of course, these observations would have to be confirmed by appropriate data analysis.

Differential data analysis, as the name implies, focuses not on the actual measured level of the parameter but rather on the magnitude of change observed in the parameter over a given period of time from the initial values. As such, differential data analysis can be much more sensitive than level-based analysis in thermal biology because the analyst tracks change of the target parameter relative to an individual's resting values. Had Wakabayashi et al. (2010)

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used differential data instead of level data, their argument that the heat dissipation response is different between the two groups would be proven by statistics and would convince on the merit of this very interesting article.

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