Mid Atlantic Regional Chapter
of the
American College of Sports Medicine

45th Annual Scientific Meeting, November 4th- 5th, 2022
Conference Proceedings
International Journal of Exercise Science, Issue 9, Volume 11

Core Temperature Responses to Compensable vs. Uncompensable Heat Stress in Young Adults (PSU Heat Project)

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Purpose: With global warming, much attention has been paid to the upper limits of human adaptability. However, the time to reach a generally-accepted core temperature criterion (40.2°C) associated with heat-related illness above (uncompensable heat stress) and just below (compensable heat stress) the upper limits for heat balance remains unclear. **Methods:** Forty-eight (22 men/26 women; 23±4 y) subjects were exposed to progressive heat stress in an environmental chamber during minimal activity (MinAct, 159±34W) and light ambulation (LightAmb, 260±55W) in warm-humid (WH; ~35°C, >60% RH) and hot-dry (HD; 43-48°C, <25% RH) environments until heat stress became uncompensable. For each condition, we compared heat storage (S) and the change in gastrointestinal temperature (ΔT_{gi}) over time during compensable and uncompensable heat stress. Using the slopes of the T_{gi} response, we estimated the time to reach T_{gi}=40.2°C. Finally, we examined whether individual characteristics or seasonality were associated with the rate of increase in T_{gi}. **Results:** During compensable heat stress, S was higher in HD than in WH environments ($p<0.05$) resulting in a greater but more variable ΔT_{gi} ($p\geq0.06$) for both metabolic rates. There were no differences among conditions during uncompensable heat stress (all $p>0.05$). There was no influence of sex, aerobic fitness, or seasonality, but a larger body size was associated with a greater ΔT_{gi} during LightAmb in WH ($p=0.003$). **Conclusion:** Sustained light activity *without intervention* in uncompensable thermal environments may result in a T_c of 40.2°C (from a 37°C baseline) in 3-7 hours even in young adults vs. several days under compensable heat stress.

Supported by NIA Grant T32 AG049676 and NIH Grant R01 AG067471