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Critical Environmental Limit Protocol: Validity and Reliability (PSU HEAT)

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An incremental heat stress protocol used to establish critical environmental limits for human heat exchange, i.e., those combinations of ambient temperature and humidity above which heat stress becomes uncompensable and, therefore, unsafe. However, no studies have rigorously investigated the reliability and validity of this experimental paradigm. **PURPOSE:** Here, we assessed the (1) between-visit repeatability and (2) validity of an experimental paradigm that either holds ambient vapor pressure (P_a) constant and incrementally increases dry-bulb temperature (T_{db}) or vice versa. **METHODS:** Twelve subjects (5M/7W; 25±4 yr) completed a progressive heat stress protocol during which they walked on a treadmill (2.2 mph, 3% gradient) in a controllable environmental chamber. After an equilibration period, the progressive heat stress protocol involved increasing T_{db} every 5 min while P_a was held constant (T_{crit} experiments), or increasing P_a (P_{crit} experiments) every 5 min while T_{db} was held constant (P_{crit} experiments), until an upward inflection in gastrointestinal temperature (T_{gi}) was observed. For repeatability experiments, 11 subjects returned to the lab to repeat the same protocol as their first visit. For validity experiments, 10 subjects returned to the lab for a progressive heat stress trial in which T_{db} or P_a was held constant at the T_{crit} or P_{crit} value from their first visit. **RESULTS:** The between-visit repeatability for critical environmental limits was excellent (ICC = 0.98). Similarly, there was excellent agreement between original and validity trials for T_{db} (ICC = 0.95) and P_a (ICC = 0.96). Furthermore, the wet-bulb temperature at the T_{gi} inflection point was not different during reliability ($p = 0.78$) or validity ($p = 0.32$) trials compared to original trials. **CONCLUSION:** These findings suggest that this experimental paradigm is highly repeatable and valid for the determination of critical environmental limits delineating compensable from uncompensable heat stress.

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