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Influence of Individual Characteristics on Critical Environmental Limits in Middle-aged and Older Adults (PSU HEAT Project)

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Critical environmental limits represent the temperature/humidity combinations at which heat balance can no longer be maintained for a given metabolic rate. Individual characteristics (e.g., sex, body weight and size, and aerobic fitness) are known to alter environmental heat exchange as well as thermoregulatory effector responses and therefore may modify critical environmental limits. **PURPOSE:** To determine which individual characteristics, if any, may be associated with higher or lower critical environmental limits [combinations of ambient dry-bulb temperature (T_{db}) and relative humidity (rh)] in middle-aged and older adults. **METHODS:** Forty-eight male (n=16) and female (n=32) participants (63±11 yrs; range: 40-92 yrs) were exposed to progressive heat stress at a low metabolic rate designed to reflect activities of daily living. Experiments were conducted in both hot-dry (HD; up to 53°C; ≤25% rh) and warm-humid (WH; ~35°C; ≥50% rh) environments. After determining critical limits for each age group and condition, forward stepwise multiple linear regression analyses were conducted with net metabolic rate (M_{net}) and age entered into the model first, followed by sex, body mass, $\dot{V}o_{2max}$, body surface area, and LDL cholesterol. **RESULTS:** After accounting for M_{net} and age, both sex and body mass further significantly improved the regression model in the HD environment ($R^2_{adj} = 0.41$, $p < 0.001$) whereas only sex ($R^2_{adj} = 0.51$, $P < 0.001$) added significantly to the WH model. Sex explained 11% of the variance in critical environmental limits in HD conditions and 14% of the variance in WH conditions. In both WH and HD environments, females exhibited lower critical combinations of T_{db} and rh than their male counterparts. Additionally, body mass was negatively related to critical environmental limits in the HD environments and accounted for 8% of the variance after metabolic rate and age were accounted for. **CONCLUSION:** These data indicate a modest influence of individual characteristics, specifically sex and body mass, on critical environmental limits in both WH and HD environments in adults between the ages of 40 and 92. **SIGNIFICANCE/NOVELTY:** These results contrast previously published data in young adults showing no significant contribution of individual characteristics to the upper limits of heat balance at low metabolic rates reflecting activities of daily living. This reflects the heterogeneity of thermal-balance thresholds associated with aging relative to those seen in young adults.