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Age-Related Differences in the Onset of Cardiovascular Drift during Progressive Heat Stress (PSU HEAT Project)

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As a result of the increasing duration, frequency, and severity of heat waves, older men and women are at greater risk for heat-related morbidity and mortality, with the majority of excess heat-related deaths attributed to increased cardiovascular strain associated with heat stress. **PURPOSE**: To (1) identify the critical environmental limits (ambient temperature (T_{db}) and humidity (rh)) at which increased cardiovascular strain (i.e., continuous rise in heart rate (HR)) begins, and (2) compare the environments in which increases in cardiovascular strain occur relative to those at which a continuous rise in core temperature (T_c) is observed in young (Y), middle (M), and older (O) adults. **METHODS**: 19 Y (7F; 23±3 yrs), 26 M (21F; 54±8 yrs), and 16 O (7F; 70±3 yrs) subjects were exposed to progressive heat stress in an environmental chamber at a low metabolic rate reflecting activities of daily living (159 ± 34 W) in a warm-humid (WH, ~ 34°C, 50-80% rh) and/or hot-dry (HD, 38°C-52°C, <30% rh) environment. The environmental thresholds above which HR and T_c equilibrium could no longer be maintained were identified. **RESULTS**: In WH (34°C) environments, sustained increases in HR preceded the T_c inflection point in Y (73±5% rh vs. 81±4% rh; p=0.001), M (67±11% rh vs. 72±12% rh; p<0.001), and O adults (34°C, 53±11% rh vs. 34°C, 57±12% rh; p=0.041). Similarly, in HD (15-20% rh) environments, the onset of cardiovascular drift preceded the T_c inflection point in Y (47±3°C vs. 49±3°C; p=0.004), M (44±4°C vs. 46±4°C; p<0.001), and O adults (42±5°C vs. 44±4°C; p=0.007). Additionally, in WH environments, cardiovascular drift began at lower combinations of T_{db} and rh in O vs. Y (34°C, 53±11% rh vs. 34°C, 73±5% rh; p<0.001) and O vs. M adults (34°C, 53±11% rh vs. 34°C, 67±11% rh; p=0.008). In HD environments, cardiovascular strain occurred at lower environments in M vs. Y (44±4°C, 18% rh vs. 47±3°C, 15% rh; p=0.044) and O vs. Y (42±5°C, 20% rh vs. 47±3°C, 15% rh; p=0.006) **CONCLUSION**: These data suggest that cardiovascular drift, indicating increases in cardiovascular strain, precede uncompensable heat stress at metabolic rates reflecting activities of daily living in Y, M, and O adults. Further, there is an age-associated shift in the onset of drift toward lower combinations of T_{db} and rh. **SIGNIFICANCE/NOVELTY**: These results are the first to identify the specific environmental conditions at which increases in cardiovascular strain occur across age groups. These findings provide important information for the development of safety guidelines and policy decisions to mitigate cardiovascular-related morbidity and mortality during impending heat events.

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