Physiological and haemodynamic differences between peak exercise blood pressure and blood pressure-power output slope in healthy women

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Background: A hypertensive response to exercise (HRE) is considered indicative of increased arterial stiffness (1). However, HRE is common in individuals with high cardiorespiratory fitness (CRF) (2), which we hypothesize is due to increased stroke volume (SV) and cardiac output (Qc).

Purpose: This study compared differences in CRF and peak-exercise SV (SVpeak) and Qc (Qcpeak) according to absolute and workload-indexed definitions of exercise hypertension in women.

Methods: Women free of overt CVD (n=142; 52±8 years, BMI: 26.3±4.5 kg/m²) underwent exercise cardiac magnetic resonance to quantify SVpeak and Qcpeak, and cardiopulmonary exercise testing to quantify peak VO2, power output (PO) and systolic blood pressure (SBP) responses. SBP-PO slope was determined using linear regression of SBP and PO values obtained every 2-minutes throughout exercise. HRE was defined as peak SBP ≥190 mmHg (3), and elevated SBP-PO slope was defined as a slope >90th percentile for sex and age based on previously published values (4).

Results: 51% and 23% of the cohort met criteria for HRE and elevated SBP-PO slope, respectively, with 16% meeting both criteria. HRE was associated with higher VO2peak (2.03±0.53 vs 1.83±0.44 L/min, P=0.015), peak PO (191±66 vs 167±51 Watts, P=0.014), SVpeak (109±27 vs 98±19 mLs, P=0.008), and Qcpeak (15.1±3.3 vs 13.9±2.8 L/min, P=0.023). In contrast, elevated SBP-PO slope was associated with lower VO2peak (1.57±0.36 vs 2.04±0.48 L/min), peak PO (135±34 vs 192±60 Watts), SVpeak (88±13 vs 108±24 mLs) and Qcpeak (12.5±1.8 vs 15.1±3.1 L/min; P<0.001 for all). Overall, the group with HRE and elevated SBP-PO slope had the lowest physical capacity, VO2peak and haemodynamic response to exercise (Figure 1A-D), whilst the opposite trend was seen for those with a HRE and a normal SBP-PO slope. All results remained significant (P<0.05) after adjustment for age, BMI, resting SBP and menopausal status (pre vs peri/post-menopausal).

Conclusion: Contextualising exercise SBP responses against measures of PO better accounts for confounding from increased Qcpeak, and may improve identification of women with increased arterial stiffness.

Figure 1A-D