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Lower Limb Endothelial Function is Augmented in Habitually Endurance Trained versus Untrained Postmenopausal Women

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Title: Lower Limb Endothelial Function is Augmented in Habitually Endurance Trained versus Untrained Postmenopausal Women

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Key words: endothelial function, exercise, sex differences

Background

Exercise-mediated increases in blood flow, a known nitric oxide (NO) stimulus, is a key signal in vascular adaptations to exercise training, including augmented endothelial function. However, endurance trained postmenopausal women (PMW) demonstrate similar brachial artery endothelial function as untrained PMW, suggesting the vascular benefit of exercise is mitigated. To investigate whether endothelial function is also impaired in the lower limb skeletal muscle vascular bed, we compared calf blood flow (CBF), an index of endothelial function, in healthy habitually endurance trained and untrained PMW. To examine vascular responsiveness to exercise-mediated increases in blood flow, we also assessed CBF after an acute bout of dynamic exercise. We hypothesised that, pre-exercise endothelial function would not differ between groups, but that post-exercise endothelial function would be augmented in both groups, with greater increases observed in trained versus untrained PMW.

Methods

Two groups of healthy, age-matched (56 ± 1 years; overall mean \pm SEM), habitually endurance trained ($n=10$; VO_{2peak} 40 ± 1 ml/kg/min; PMWtr) and untrained ($n=12$; VO_{2peak} 29 ± 1 ml/kg/min; PMWun) PMW were studied. Resting (CBFr) and peak (CBFpk) CBF were assessed using strain-gauge plethysmography. Resting (VRr) and peak (VRpk) vascular resistance were calculated (mean arterial pressure/CBF). Heart rate and blood pressure were recorded using an automated cuff device.

Venous blood samples were collected for the determination of plasma nitrite, a stable metabolite of NO bioavailability. All measures were assessed at baseline and 60 minutes after an acute bout of moderate intensity exercise (45-min of brisk walking at 60% $\text{VO}_{2\text{peak}}$).

Results

Baseline: Between-groups, pre-exercise CBF_r and VR_r did not differ ($p>0.05$). In contrast, CBF_{pk} was higher ($p<0.05$) and VR_{pk} lower ($p<0.05$) in PMW_{tr}. Plasma nitrite concentration did not differ between groups ($p>0.05$). *Post-exercise:* Within-groups, resting and peak CBF were increased ($p<0.05$) and VR decreased ($p<0.05$). Plasma nitrite concentrations did not differ from baseline ($p<0.05$). Between-groups, post-exercise CBF_r and VR_r did not differ ($p>0.05$). However, CBF_{pk} was higher ($p<0.05$) and VR_{pk} ($p<0.05$) lower in PMW_{tr}. Plasma nitrite concentration did not differ between groups ($p>0.05$).

Conclusions

In habitually endurance trained PMW, peak CBF is higher and VR lower compared to their untrained counterpart. Acute dynamic exercise increases CBF in trained and untrained PMW, yet peak responses are augmented in trained PMW in association with lower VR. Our findings suggest that, in contrast to previous findings in the brachial artery, the age-associated decline in endothelial function is attenuated in the lower limb skeletal muscle vascular bed in endurance trained PMW. Greater vascular responsiveness to exercise-mediated increases in blood flow also suggests that the favourable vascular adaptations to exercise training are not mitigated in the lower limb in PMW.

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Table 1. Group characteristics.

	PMWtr (n=10)	PMWun (n=12)
Age (years)	57±1	56±1
Height (cm)	166±2	164±1
Weight (kg)	59±2	62±2
BMI (kg/m ²)	21±1	23±1 [†]
VO _{2peak} (ml/kg/min)	40±1	29±1 [†]
Heart rate (beats/min)	55±2	59±2
SBP (mmHg)	113±2	117±3
DBP (mmHg)	73±2	76±1

All values are mean±SEM

BMI, body mass index; VO_{2peak}, peak oxygen uptake; SBP, systolic blood pressure; DBP, diastolic blood pressure

[†] Significant between group differences, p<0.05

Table 2. Vascular measures pre- and post-exercise.

	PMWtr (n=10)		PMWun (n=12)	
	Pre-Ex	Post-Ex	Pre-Ex	Post-Ex
Resting				
CBF (ml/100ml/min)	1.7±0.3	2.5±0.3*	1.4±0.2	2.3±0.3*
VR (U)	57.7±6.1	39.2±6.0*	74.3±7.3 [†]	43.6±3.8*
Peak				
CBF (ml/100ml/min)	31.6±2.0	37.0±1.8*	26.4±2.0 [†]	29.4±1.9 ^{†*}
VR (U)	2.8±0.2	2.4±0.2*	3.6±0.2 [†]	2.9±0.2 ^{†*}
Plasma nitrite (nM)	64.9±7.2	78.7±12.6	83.4±14.6	95.5±10.4

All values are mean±SEM.

CBF, calf blood flow; VR, vascular resistance

[†] Between groups, within condition p<0.05

* Within groups, pre- versus post-exercise p<0.05