The acute haemodynamic responses of young and older men to resistance and aerobic modes of blood-flow restriction exercise

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Introduction: Resistance exercise with heavy loads (> 60% 1 RM) designed to increase muscle strength may be contraindicated in populations with reduced functional fitness because of the high mechanical stress (Abe *et al.*, 2006). Blood-flow restriction (BFR) exercise would, therefore, seem like a suitable alternative because it utilises light loads (~20% 1 RM) or low-intensity aerobic exercises (Wernbom *et al.*, 2008). The haemodynamic responses to BFR exercise therefore warrant investigation to assess the cardiovascular risk for clinical use, especially in elderly populations. Therefore, this study assessed the haemodynamic responses to resistance and aerobic BFR exercise in a young and older-age population.

Methods: Young (n = 11; 22.5 ± 1.9 years; mean ± standard deviation) and older (n = 13; 70.2 ± 4.6 years) healthy males performed a bilateral leg press (LP) and a treadmill (TM) exercise trial in a randomized crossover design. Each trial comprised a BFR (60% limb occlusion pressure) and a non-BFR control bout conducted in a random order, separated by a 30-min recovery. LP comprised 4 sets (30, 15, 15, 15 repetitions) at 20% 1 RM, while TM comprised 4 × 2-min walking sets at 4 km.hr^{-1}), with 1-min rest periods between sets. Cardiac output (CO), stroke volume (SV) and heart rate (HR) were measured prior to bouts and during sets 2 and 4. Mean arterial pressure (MAP) was measured prior to bouts and during sets 2, 3, and 4.

Results: The table below shows the average exercising measurements for each trial, while baseline measures were all equivalent between bouts (BFR, non-BFR). * different from baseline (p < 0.05); # different from Non-BFR (p < 0.05); ‡ different from Young (p < 0.05), † denotes a main effect for age for both LP and TM, and for CO only for TM (p < 0.05).

	LP		TM	
	Non-BFR	BFR	Non-BFR	BFR
Young				
HR (beats.min^{-1})	108 ± 4*	113 ± 6*#	92 ± 4*	99 ± 4*#
SV (mL)	114 ± 8	110 ± 8	120 ± 8*	107 ± 9*
CO (L.min^{-1})†	11.9 ± 0.6*	12.1 ± 0.5*	10.6 ± 0.4*	10.3 ± 0.5*
MAP (mmHg)	102 ± 4*	113 ± 5*#	90 ± 3	97 ± 3*#
Older-Age				
HR (beats.min^{-1})	86 ± 3*‡	92 ± 5*#‡	83 ± 4*	89 ± 4*#
SV (mL) †	89 ± 6	82 ± 6	100 ± 4*	97 ± 6*
CO (L.min^{-1})†	7.4 ± 0.4*‡	7.3 ± 0.4*‡	8.2 ± 0.4*	8.4 ± 0.4*
MAP (mmHg) †	110 ± 2*	121 ± 2*#	98 ± 2	104 ± 3*#

Conclusions: Despite the slightly elevated haemodynamic stress of exercise in the Older-Age group compared with the Young group, both light-load leg-press exercise and treadmill walking only marginally elevated exercising HR and MAP above levels observed for non-BFR exercise. In conclusion, therefore, resistance and aerobic BFR exercise do not seem to result in excessive haemodynamic stress in either young or older populations, thereby suggesting both these modes of BFR exercise to be suitable alternatives to improve muscle strength in ‘at risk’ populations.

Abe, T, Kearns, CF & Sato, Y. (2006) *Journal of Applied Physiology* **100**, 1460-6.

Wernbom, M, Augustsson, J & Raastad, T. (2008) *Scandinavian Journal of Medicine and Science in Sports* **18**, 401-16.