The Effects of Low-Intensity Blood Flow Restriction Training vs. No Blood Flow Restriction Training on Measures of Aerobic Capacity in Physically Active Individuals

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INTRODUCTION

Blood flow restriction (BFR) training has become an extremely popular training method over the years. Improvements in measures of aerobic capacity (such as VO_2max) are crucial for individuals who seek to be physically active for longer periods of time.[1,2] Recent studies have focused on the combination of BFR and aerobic exercise at lower training intensities as an adapted training method for either maintaining or improving measures of aerobic capacity in physically active individuals.[3-6]

FOCUSED CLINICAL QUESTION

In physically active individuals, is the utilization of low-intensity BFR training more effective than no BFR training at improving measures of aerobic capacity?

SEARCH STRATEGY

Terms Used to Guide Search Strategy:

- Physically active individuals
- Low-intensity
- Blood flow restriction training
- Aerobic capacity
- VO_2max or VO_{2p}peak
- Time to exhaustion

Sources of Evidence Searched:

- PubMed
- MEDLINE
- SPORTDiscus
- EBSCOHost
- Additional resources obtained via review of reference lists and hand search

Inclusion Criteria:

- Studies of level 3 or higher evidence
- Studies focused on comparing low-intensity BFR training and no BFR training performed by physically active individuals
- Study must compare either pre-post testing assessments of aerobic fitness or aerobic performance
- Studies with a training protocol that lasted a minimum of 2 weeks

Exclusion Criteria:

- Studies performed over 10 years ago
- Examined only acute effects of BFR training during a single exercise session
- No mention of physically active individuals, aerobic capacity, comparison of low-intensity BFR training and no BFR training, or pre-post testing assessments of aerobic fitness or performance.

Table 1.

Ref Citation	Demographics	Methods & Intervention	Primary Outcome Measures	Key Findings	Conclusion
Kim et al[3]	31 physically active college-aged men (mean age: 22.4 ± 3.0yr) VI Group: n = 10 LI-BFR Group: n = 11 CON Group: n = 10	RCT; Cycle training 3x/week for 6weeks and 3week detraining LI-BFR Group: 20min BFR training at 30% of HRR VI Group: 20min no BFR at 60% HRR for the first 3 weeks; at 70% HRR for the final 3weeks CON Group: No training	VO_2peak, thigh mCSA, body composition, concentric isotonic 1RPM muscle strength for knee extension and flexion	For pre-post training periods, VO_2peak increased in the VI group (5.25%, $p < 0.05$), in the LI-BFR group (1.96%, $p < 0.05$), and in the CON group (-1.17%, $p < 0.05$).	Low-intensity cycling with BFR did not show better responses in VO_2peak compared to the vigorous intensity cycling and no exercise control groups.
Abe et al[4]	19 physically active men (mean age: 23.0±1.7yr) BFR-training Group: n = 9 CON-training Group: n = 10	RCT; Cycle training 3x/week for 8weeks BFR-Training Group: 15min BFR training at 40% of VO2max for 15min. CON-Training Group: 45min no BFR at 40% of VO2ma	VO_2max, time until exhaustion, thigh and quadriceps mCSA and volume	For pre-post training periods, VO_2max increased for the BFR-training group (6.5%, $p < 0.05$) but was unchanged for the CON-training group. Time until exhaustion increased for the BFR-training group (15.4%, $p < 0.01$), but was unchanged in the CON-training group.	There was a significant increase in aerobic capacity for low-intensity (40% VO_2max) cycling BFR training of short duration (15min) compared to the control group.
de Oliveira et al[5]	37 recreationally active subjects (mean age: 23.8 ± 4yr) HIT Group: n = 10 (men: 7, women: 3) HIT+BFR Group: n = 10 (men: 3, women: 7) BFR Group: n = 10 (men: 8, women: 2) LOW Group: n = 7 (men: 4, women: 3)	RCT; Cycle training 3x/week for 4weeks BFR Group: BFR training at ~30% Pmax LOW Group: Training no BFR at a ~30% Pmax. HIT Group: Training at a variable high-power output without BFR HIT+BFR Group: One set 50% HIT and one set 50% BFR training	VO_2max, Pmax, OBLA, isometric knee extension strength	For pre-post training periods, VO_2max increased for the BFR group (5.6 ± 4.2%, $P = 0.006$, ES = 0.33), HIT group (9.2 ± 6.5%, $P = 0.002$, ES = 0.9), and HIT + BFR (6.5 ± 5.5%, $P = 0.03$, ES = 0.33). VO_2max remained unchanged in the LOW group .	Low-intensity interval BFR training showed significant improvements in VO_2max; The HIT and HIT + BFR groups also induced improvements for aerobic variables, with the HIT group having a higher effect size compared to that of the low-intensity interval BFR training and HIT + BFR groups.
Held et al[6]	31 elite rowers (INT: mean age: 21.9±3.2yr; CON: mean age: 21.7±3.7yr) INT Group: n = 16 (men: 12, women: 4) CON Group: n = 15 (men: 11, women: 4)	RCT; Endurance rowing training protocol 3x/week for 5weeks Intervention Group: 10min boat-training and indoor-rowing training with pBFR Control Group: 10min training with no pBFR	VO_2max	For pre-post training periods, VO_2max significantly increased for the INT group (+9.1± 6.2%, $P < 0.001$, ES = 1.335). There were no significant increases in VO_2max for the CON group (+2.5± 6.1%, ES= 0.3).	The pBFR training group showed considerable increases in VO2max for elite rowers compared to that of the control group.

EVIDENCE OF QUALITY ASSESSMENT

The 4 relevant studies[3-6] identified are categorized in Table 1. based on criteria identified in the levels of evidence as summarized by the Centre for Evidence-Based Medicine, 2011. All studies included in the analysis were randomized controlled trials with a graded level of evidence of 1c or higher. Three studies performed a cycle training protocol[3-5] and one study[6] performed an endurance rowing training protocol.

RESULTS

One study showed no significant improvements[3], and two studies showed significant improvements in measures of aerobic capacity when using low-intensity BFR training versus not using BFR training.[4,6] Another study[5] showed significant improvements in aerobic capacity when using low-intensity BFR training versus low-intensity training without BFR; however, high-intensity training without BFR showed greater improvements in aerobic capacity when compared to low-intensity training with BFR.

CLINICAL BOTTOM LINE

There is moderate evidence to support the use of low-intensity BFR training to improve aerobic capacity in physically active individuals. Although, low-intensity BFR training is not a suitable replacement for high-intensity training in healthy or non-injured individuals, it may be a suitable replacement during rehabilitation of injured individuals or other groups where high-intensity training is a contraindication.

RECOMMENDATION

Grade B, based on SORT

REFERENCES

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5. de Oliveira MFM, Caputo F, Corvino RB, Denadai BS. Short-term low-intensity blood flow restricted interval training improves both aerobic fitness and muscle strength. *Scand J Med Sci Sport*. 2015;26(9):1017-1025.
6. Held S, Behringer M, Donath L. Low intensity rowing with blood flow restriction over 5 weeks increases VO2max in elite rowers: A randomized controlled trial. *J Sci Med Sport*. 2019;23(3):304-308.