Effects of Blood-flow Restriction on Hemodynamic and Cardiorespiratory Responses to Aerobic Exercise Testing

J. HANNAH STOVALL, MS, STACY D. HUNTER, PhD, and JOHN L. WALKER, EdD

Exercise Physiology Research Lab; Department of Health and Human Performance; Texas State University; San Marcos, TX

Category: Masters

Advisor / Mentor: Hunter, Stacy (s_h393@txstate.edu)

ABSTRACT

Blood-flow restriction (BFR) training has grown increasingly popular in the world of resistance training with noted benefits for muscle health in healthy individuals as well as a potential alternate training mode for populations who cannot tolerate high-intensity exercise. Although BFR resistance training is well-studied, its effects on hemodynamic and cardiorespiratory responses to aerobic exercise are not clearly established. **PURPOSE**: to evaluate hemodynamic and cardiorespiratory responses to aerobic exercise with and without BFR during submaximal treadmill exercise testing. **METHODS**: Ten healthy, physically active college students participated in two testing sessions, separated by ~7 days, completing a modified Balke treadmill exercise test both with and without BFR to the lower legs. Condition type was randomly assigned. Resting measures included five minutes of rest with minute ventilation (V_E), respiratory rate (RR), respiratory exchange ratio (RER), and heart rate (HR) recorded each minute as well as blood pressure (BP) manually measured at minutes one and five. For the BFR session, participants then stood on the treadmill while cuffs were inflated to a pressure equivalent to 1.3X resting systolic blood pressure (SBP). The treadmill test started at 2.0 mph and 0% grade for a one-minute warm-up, increased to 3.0 mph at 0% grade for Stage 1 (one minute), and the speed remained constant at 3.0 mph while the incline increased by 2.5% grade each stage (every two minutes) thereafter. V_E, RR, RER, HR and rating of perceived exertion (RPE) were recorded each minute of the test, while BP was measured manually every other minute. The test was terminated upon participant request or at 85% of age-predicted HR_{MAX}. A one-minute cool-down was completed followed by additional HR and BP measurements as well as post-exercise perception questionnaires. Predicted VO_2max, rate pressure product (RPP), pulse pressure (PP), and mean arterial pressure (MAP) were calculated. **RESULTS**: Repeated measures ANOVA indicated significant differences between BFR and normal conditions for HR, SBP, PP, predicted VO_2max, total test time, rating of discomfort/pain, and rating of numbness/tingling. Wilcoxon signed-rank tests indicated significant differences between BFR and normal conditions for RPP, RPE, V_E, and rating of soreness. Tests for the interaction between testing conditions across stages indicated that as the intensity of each stage increased, the differences between normal and BFR conditions also increased. During Stage 3, significant differences were found between normal and BFR conditions for HR, SBP, RPP, PP, RPE, and V_E, while during Stage 1, significant differences were only observed for HR, SBP, and RPP. **CONCLUSION**: BFR results in significantly increased myocardial oxygen consumption, cardiac work, ventilation, perceived exertion, and ratings of discomfort/pain, numbness/tingling and soreness as well as significantly decreased total test time and predicted VO_2max during aerobic exercise testing compared to normal conditions. Although this type of training may be beneficial for older adults or certain clinical populations, it may be intolerable based upon the augmented cardiovascular responses and perceptions of discomfort.