



ACUTE PHYSIOLOGICAL RESPONSES TO DIFFERENT BLOOD FLOW RESTRICTION PROTOCOLS

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Background

- The addition of blood flow restriction (BFR) to training has become increasingly popular in a variety of rehabilitation populations because it intensifies low-intensity exercise for those whose exercise capacities are limited due to current limitations such as injury.
- During resistance training, the addition of BFR to a low-intensity program results in significant improvements in strength and hypertrophy that are similar to higher-intensity programs (1).
- By reducing blood flow, working muscles are provided with similar levels of metabolic stress as higher-intensity exercise. The reduction of blood flow decreases the amount of oxygen being delivered to the muscle. This causes an increased accumulation of metabolic by-products (1-2).
- When utilizing BFR various factors should be considered that can impact the exercise prescription.
 - BFR is intended to be performed at a percentage of limb occlusion pressure (LOP). Which is defined as the amount of pressure that is required to completely occlude blood flow to the limb. BFR has been performed between 20-80% of LOP (2)
 - The intensity of exercise commonly ranges from 20-40% of maximal strength or one repetition maximum (2)
 - The set-repetition scheme should also be considered. The majority of BFR protocols implemented in rehab programs have followed a traditional set-repetition scheme consisting of 1 set of 30 repetitions, followed by 3 sets of 15 repetitions with 1 minute of rest in between each set. Additionally, sets have been completed to fatigue (2). However, it is currently unclear how other various set-repetition schemes may impact the physiological responses to low-intensity exercise with BFR.

Purpose

The purpose of this study was to compare the acute physiological responses of various blood flow restriction protocols to the traditional commonly utilized BFR protocol.

Methods

Condition	Total # of Sets	Set-Rep Scheme	Rest Interval Time
Traditional BFR (TRAD-BFR)	4	Set 1: 30 reps Sets 2-4: reps	Sets 1-4: 1 minute
Modified Sets BFR (MS-BFR)	9	Set 1: 15 reps Sets 2-9: Alternating pattern of 7 and 8 reps	Sets 1-9: 1 minute
Modified Time BFR (MT-BFR)	4	Set 1: 30 reps Sets 2-4: 15 reps	Sets 1-4: 2 minutes 40 seconds
Modified Time/Sets BFR (MTS-BFR)	9	Set 1: 15 reps Sets 2-9: Alternating pattern of 7 and 8 reps	Set 1: 40 seconds Sets 2-9: 20 seconds

References

- Patterson SD, Hughes L, Warmington S, Burr J, Scott BR, Owens J, Abe T, Nielsen JL, Libardi CA, Laurentino G, Neto GR, Brandner C, Martin-Hernandez J, Loenneke J. Blood Flow Restriction Exercise: Considerations of Methodology, Application, and Safety. *Front Physiol.* 2019 May 15;10:533.
- Lauver JD, Cayot TE, Rotarius TR, Scheuermann BW. Acute Neuromuscular and Microvascular Responses to Concentric and Eccentric Exercises With Blood Flow Restriction. *J Strength Cond Res.* 2020 Oct;34(10):2725-2733.

Methods

Participants

- Nine healthy adults (26 ± 8 yrs., 5 male, 4 female) participated in this study. All participants completed five separate visits

Visit 1

- Participants first completed an informed consent and medical history questionnaire
- Next participants completed a one-repetition maximum (1-RM) for a bicep curl.

Visits 2-5

- Participants completed all conditions in a randomized order
 - The 4 experimental conditions were, Traditional BFR (TRAD-BFR), Modified Time BFR (MT-BFR), Modified Sets BFR (MS-BFR), and Modified Time and Sets BFR (MTS-BFR).
- Blood Flow Restriction Cuffs (SAGA Fitness International) were placed on the upper arms of the participants
- Each subject performed all experimental conditions at 30% of their 1-RM which was determined in Visit 1. They also performed each experimental condition at 50% of their limb occlusion pressure (LOP) which was determined prior to each session.
- A near-infrared spectroscopy (NIRS) device (PortaMon, Artinis Medical Systems) was placed just below the cuffs on the subject's nondominant arm.
- A heart rate monitor (Polar) was placed on the chest.
- Blood Lactate was measured prior to exercise and following the completion of 75 reps via finger prick (Lactate Plus, Nova Biomedical).
- A rating of perceived exertion scale (RPE) was used to assess perceived exertion (1-10 scale) at the completion of 30 reps, 45 reps, 60 reps, and 75 reps.

Data Analysis

- The NIRS signal was sampled at a frequency of 2 Hz and was averaged over the 20 seconds prior to 30 reps, 45 reps, 60 reps, and 75 reps
- The NIRS data are expressed relative to the initial baseline (resting prior to exercise), and therefore, are reported as the difference from baseline

RESULTS

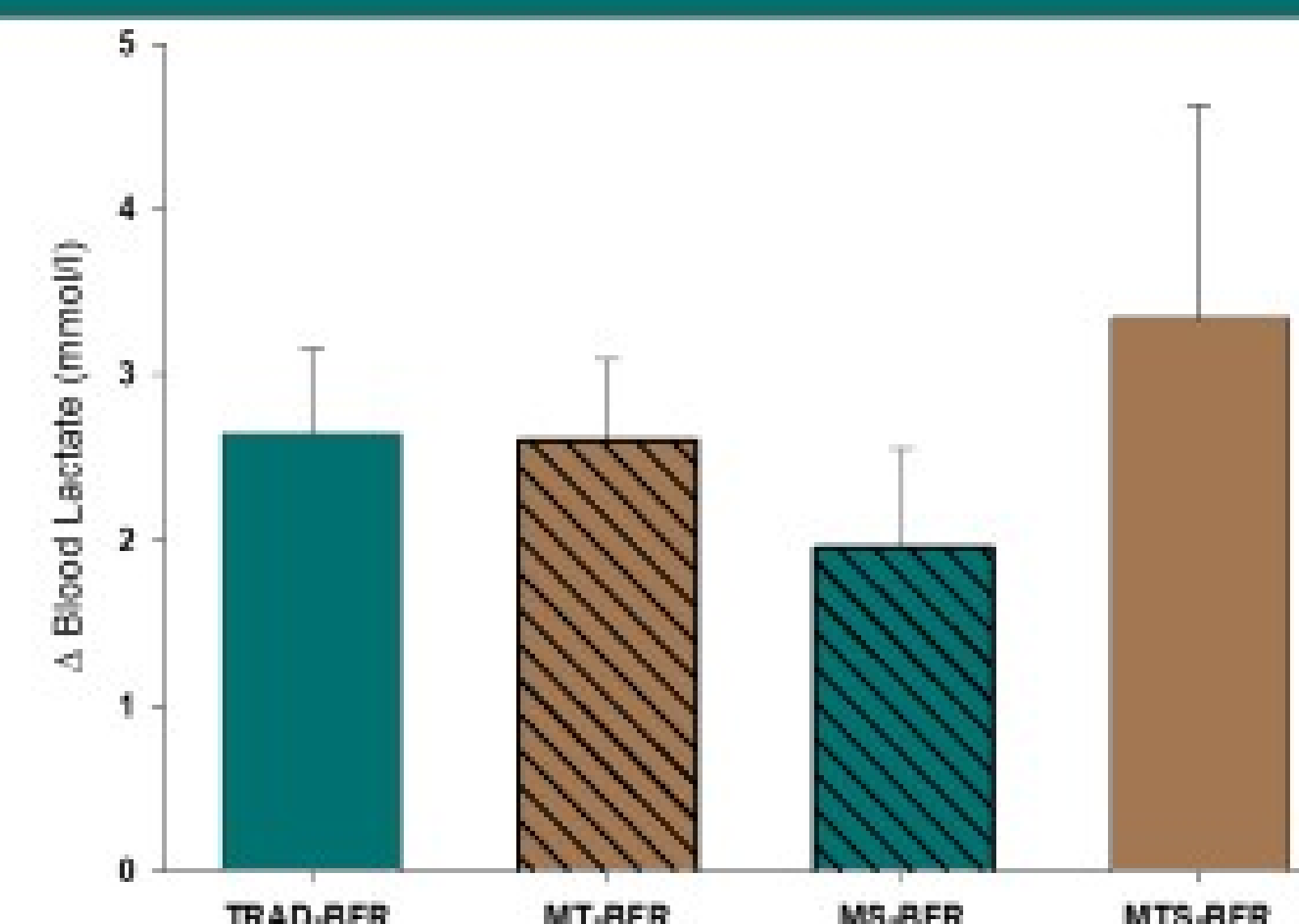


Figure 1. No difference in blood lactate between BFR conditions

Practical Application

By utilizing a Modified Set BFR exercise protocol, it is possible to receive similar metabolic stress while also better tolerating the exercise protocol, as evidenced by RPE. This may allow for similar training adaptations with improved adherence, particularly in individuals with low exercise tolerances.

RESULTS

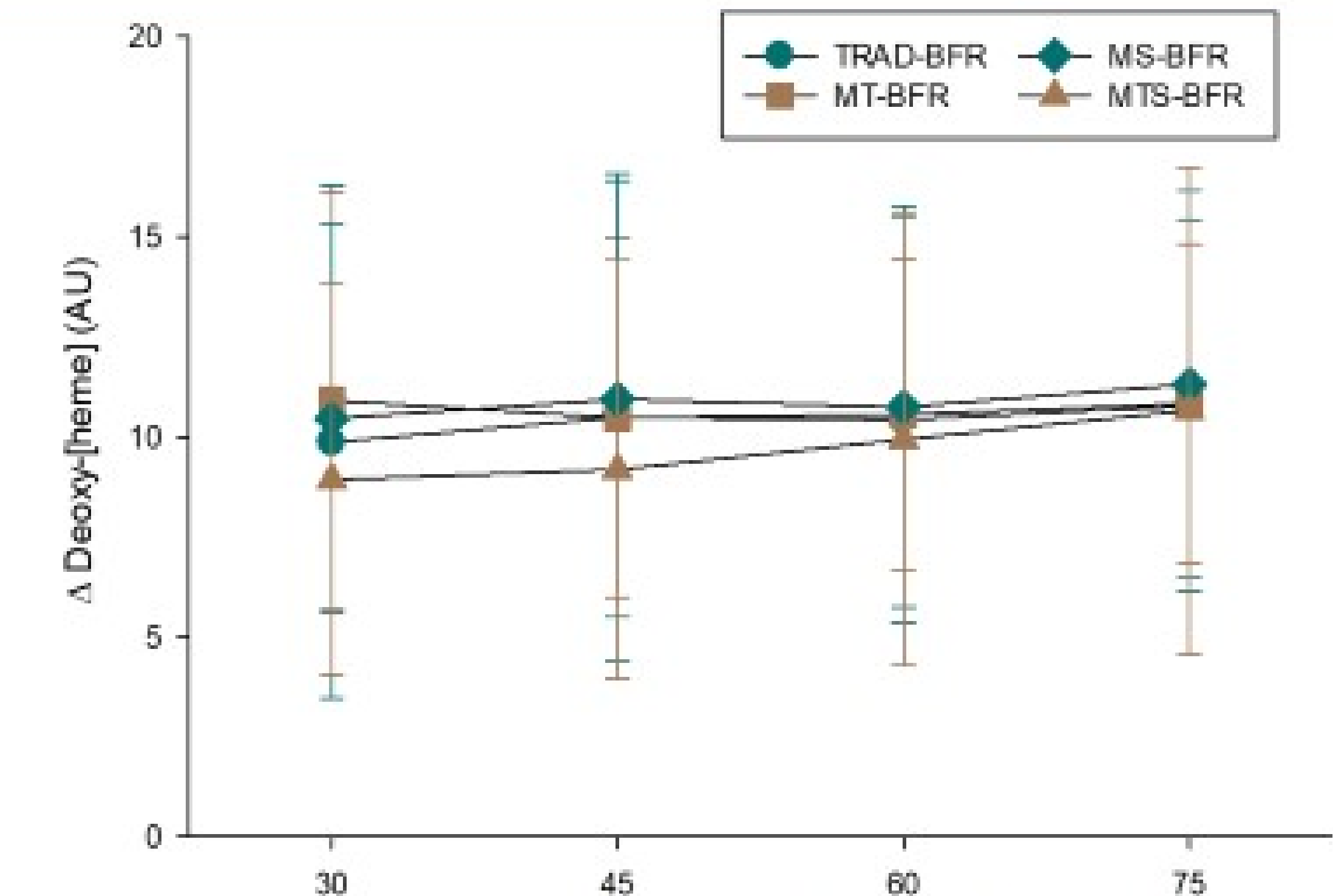


Figure 2. No difference in deoxygenated hemoglobin between BFR conditions.

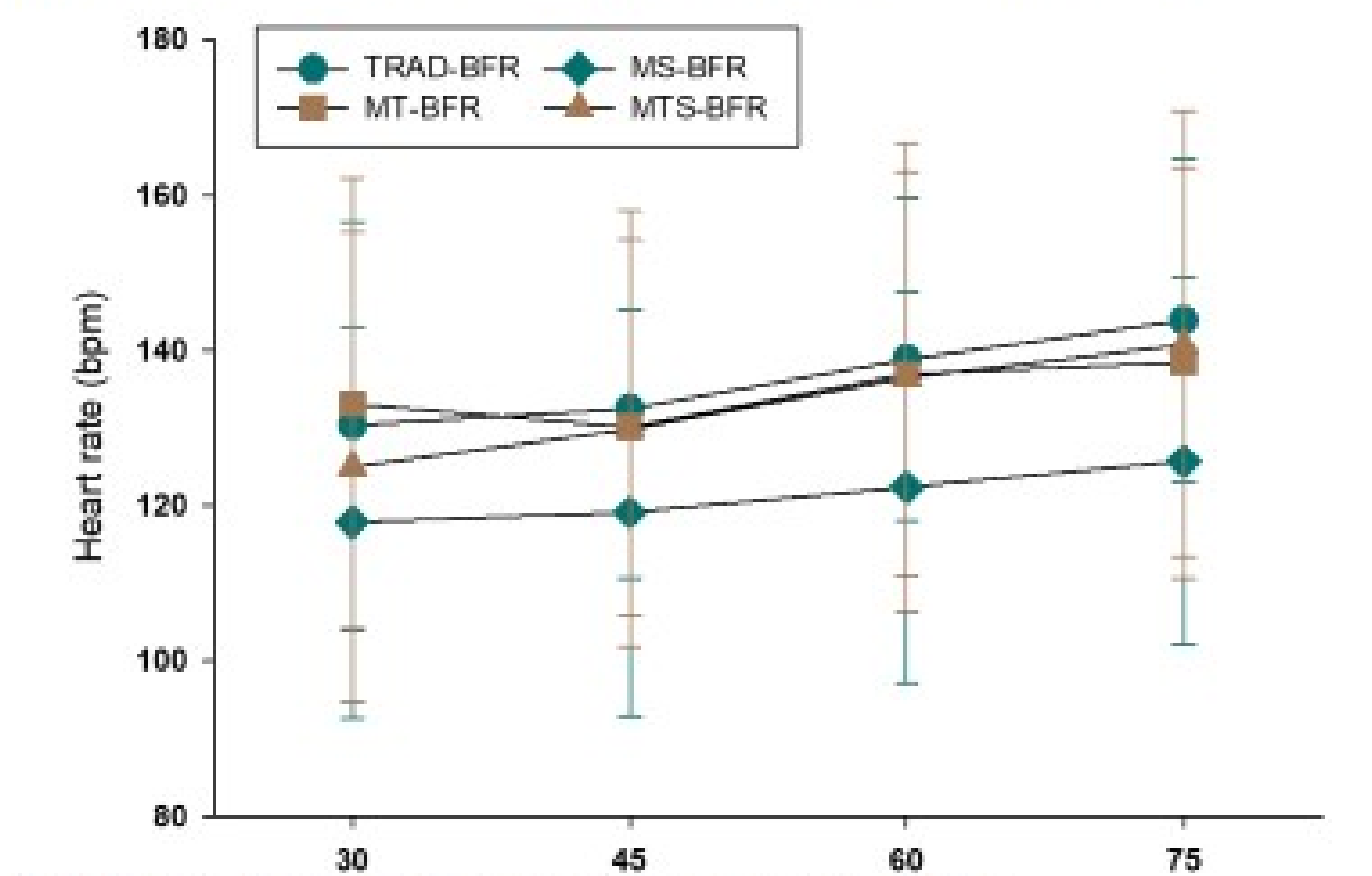


Figure 3. No difference in heart rate between BFR conditions

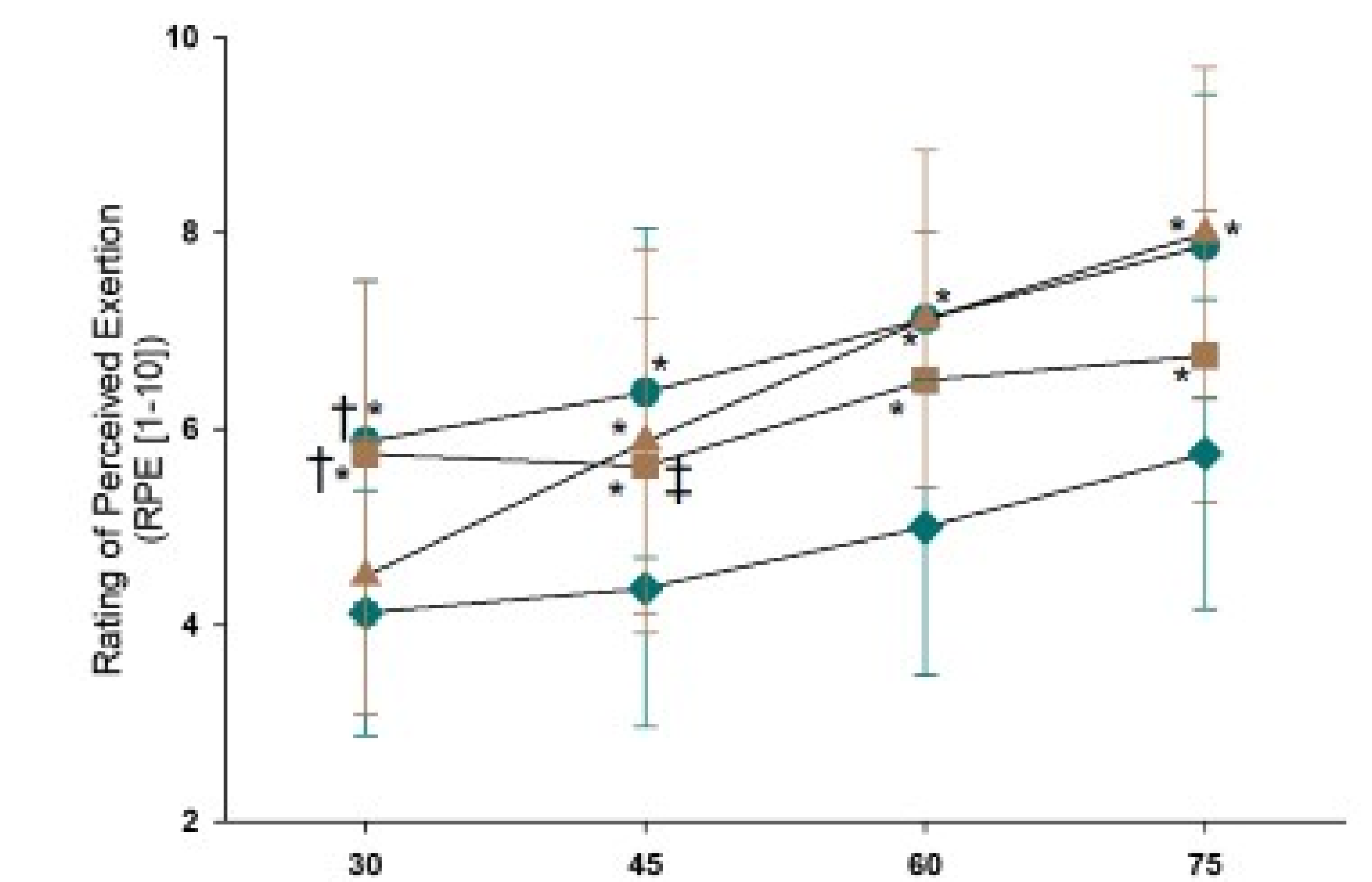


Figure 4. Rating of perceived exertion (RPE). * - significantly different from MS-BFR, † - significantly different from MTS-BFR, ‡ - significantly different from TRAD-BFR.

Conclusion

There were no differences in the metabolic stress, as assessed by Deoxy-[heme] and blood lactate, between conditions; however, RPE was significantly lower during Modified Sets BFR compared to the other BFR conditions.