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Energy Expenditure, Physiological, and Perceptual Responses to a Brief, Simple Bodyweight Resistance Training Protocol in Previously Sedentary Adults

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Energy expenditure, physiological, and perceptual responses to a brief, simple bodyweight resistance training protocol in previously sedentary adults: A pilot study

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INTRODUCTION

Current guidelines for physical activity include recommendations to participate in 'muscle strengthening activities' 2x/week. Yet there are concerns that many of the activities often provided as examples to meet this recommendation may be insufficient to promote outcomes such as improved fitness and strength e.g. gardening, yoga, etc.¹ Contrastingly, resistance training (RT), is well evidenced as a modality of exercise that can improve health and fitness related outcomes, even with relatively minimal doses². Despite this, compared with the moderate-vigorous aerobic activity portion of physical activity guidelines, and indeed even the muscle strengthening activity guidelines more broadly, participation in RT specifically is low. Estimates suggest that participation is at ~5-6% for males and ~1% for females^{3,4}. Time and accessibility are often cited as barriers, yet RT can be performed in an accessible time efficient manner using bodyweight exercises. However, it is not known whether such training performed using a minimal dose approach might present a sufficient physiological stimulus.

OBJECTIVE(S)

The aim of this pilot study was to examine energy expenditure, physiological, and perceptual responses of a brief, simple bodyweight resistance training protocol in previously sedentary adults.

METHOD(S)

Participants: Ten previously sedentary participants (male = 4, female = 6; age = 47±7 years; body mass = 76.61±16.52 kg; BMI = 26.4±5.3 kg.m²) were recruited.

Bodyweight RT Protocol: Participants performed under supervision a bodyweight RT protocol consisting of 4 exercise designed to target the main muscle groups of the body. The exercises included variations of a push up, isometric wall sit, bodyweight row, and a plank. Dependent upon the participants starting ability the exercises were adapted by adjusting participants body position (in essence altering the moment arm and torque demands placed upon them) such that they felt they would be able to perform at least 10 repetitions at a ~3 second concentric, and ~3 second eccentric repetition duration, or 60 seconds for isometric exercises. Participants were instructed prior to attempt to train to the point of momentary failure as previously defined⁵, but to retain ecological validity with persons completing this recommendation themselves they were not forced to achieve this and instead trained to volitional failure. All exercises were performed for a single set followed by 4-minute rest periods.

Measures: Oxygen consumption was measured continuously throughout exercise and rest periods and blood lactate measured at rest, immediately post exercise, and at 2 and 4 minutes recovery. From this total energy expenditure was estimated. Heart rate was also measured continuously. Muscle swelling was determined from changes in pre-post ultrasound muscle thickness from the triceps brachii, biceps brachii, and quadriceps femoris. Lastly both perceived effort and discomfort (0-10) were examined using scales specifically designed for this purpose in RT⁶.

RESULT(S)

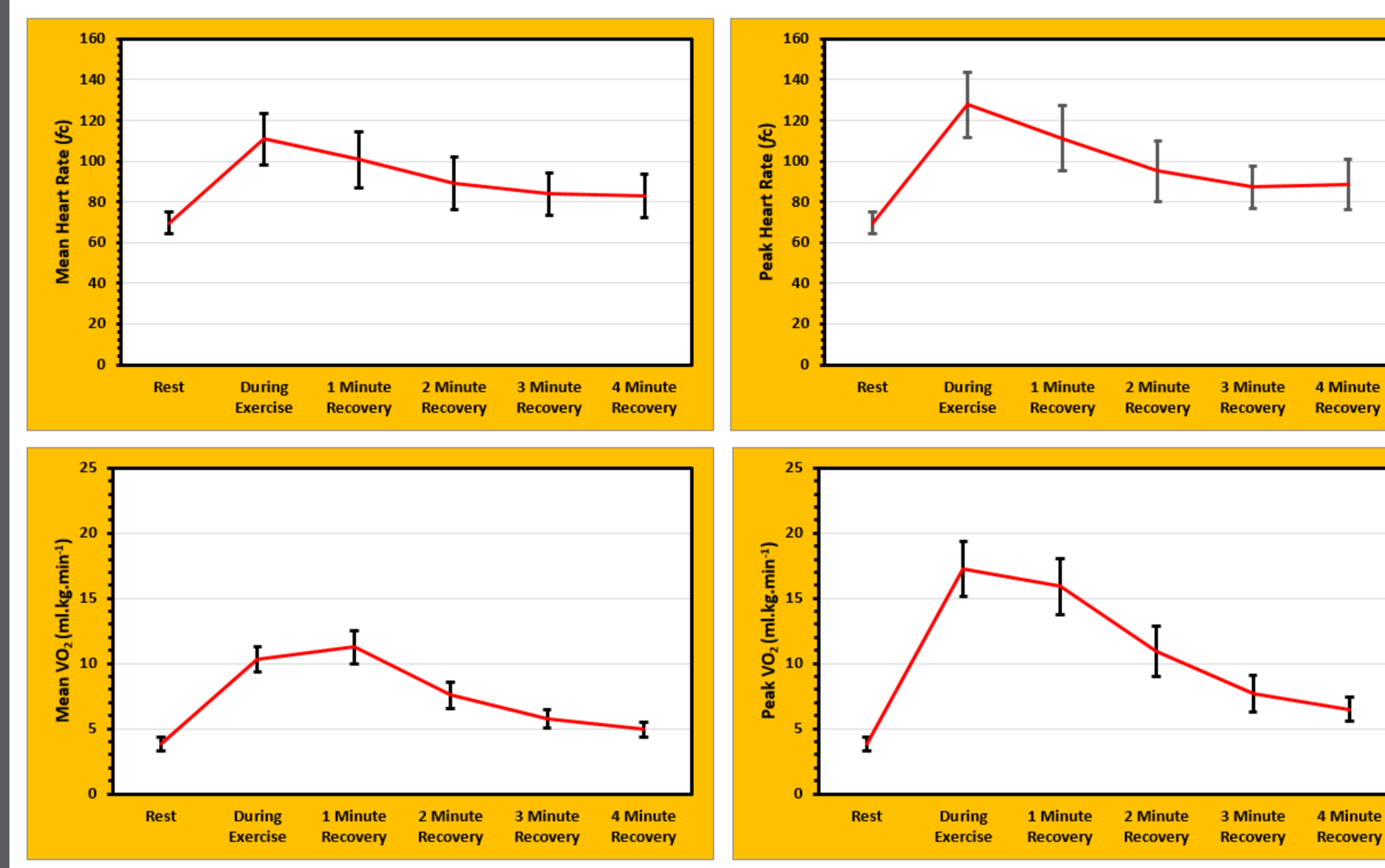


Figure 1. Mean heart rate (top left), peak heart rate (top right), mean VO₂ (bottom left), and peak VO₂ (bottom right) – Means [95%CI]

Total training time, including rest, was 25±2 minutes (exercise time was 9±2 minutes). Participants performed 20±7 repetitions with an average repetition duration of 6.8 seconds for the push up, 16±7 repetitions with an average repetition duration of 7.1 seconds, and performed a time to volitional fatigue of 173.3±93.9 seconds for the wall sit, and a time to volitional fatigue of 139.9±85.5 seconds for the wall sit. Total estimated energy expenditure was 118.9±22.0 kcals (converted to METS = 45.5±13.0). Perceived effort was 8.2±1.2 and discomfort was 7.3±1.0 (both measured on an 11 point scale 0-10).

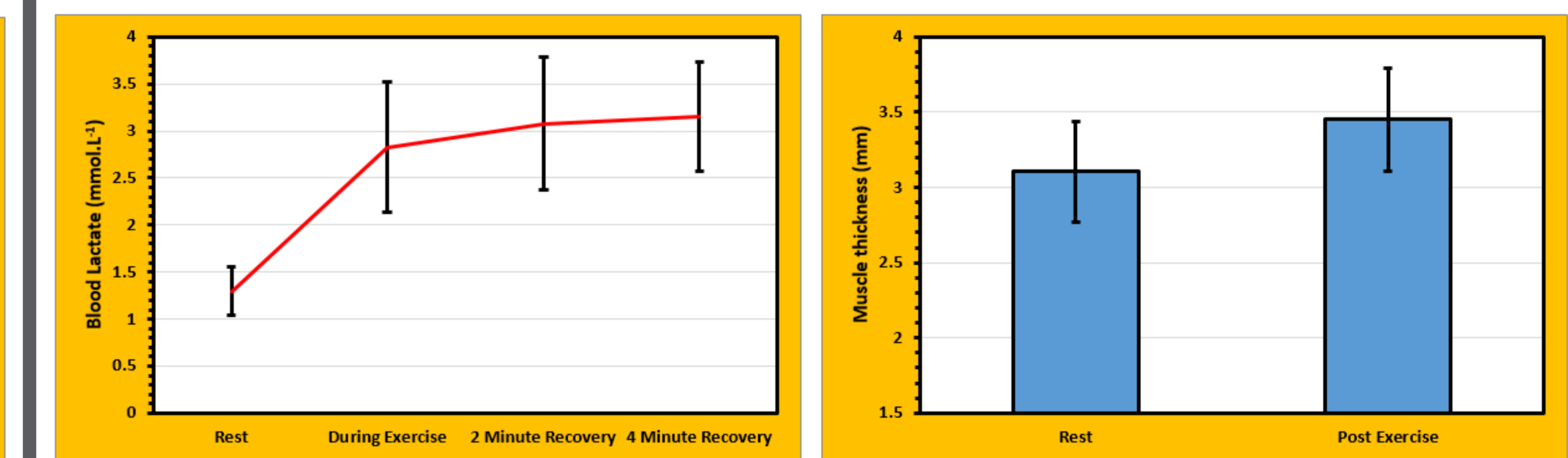
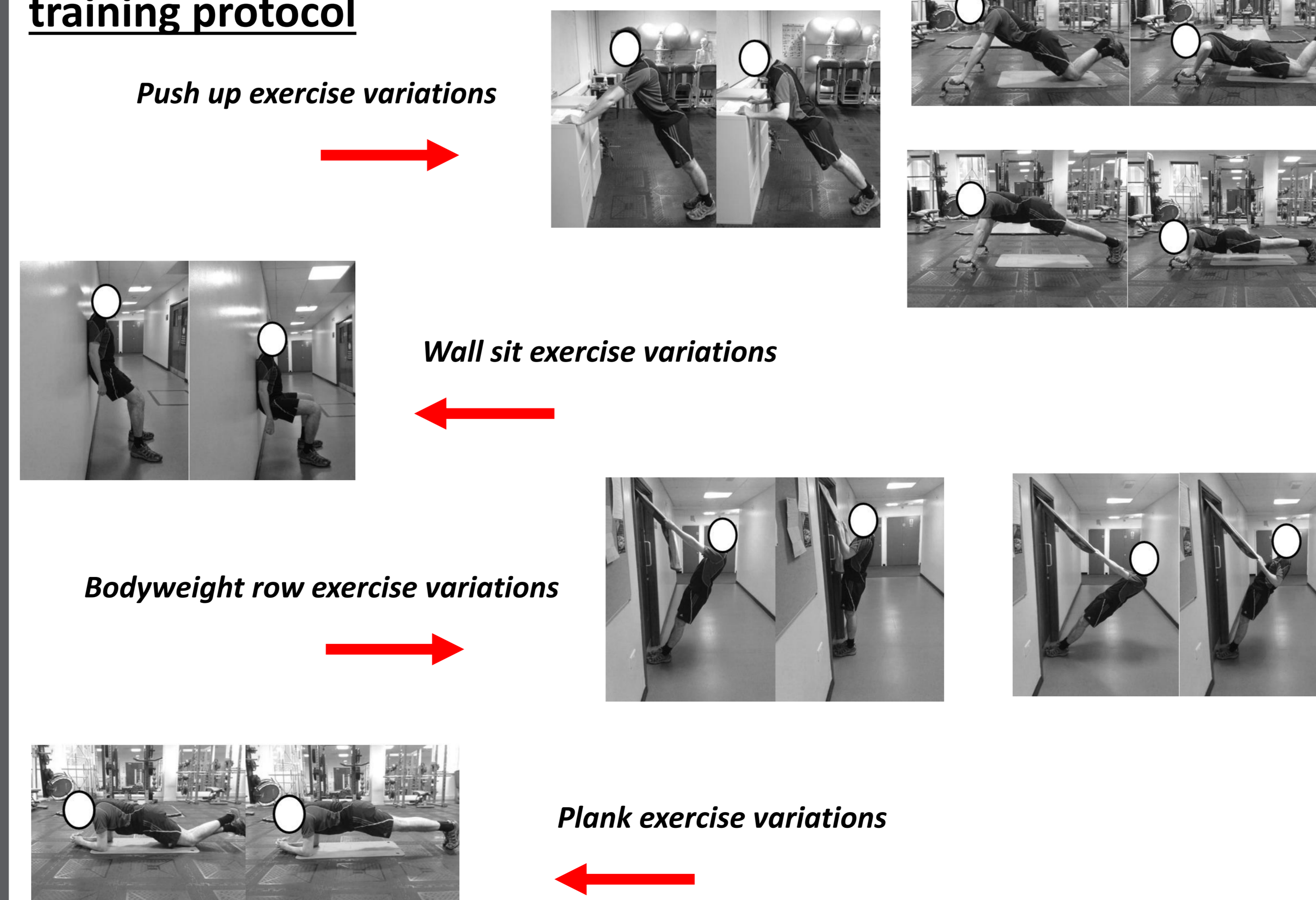


Figure 2. Blood lactate (left), and muscle thickness (left) – Means [95%CI]

Brief, simple bodyweight resistance training protocol



DISCUSSION & CONCLUSION(S)

The results of this small pilot study lend some evidence towards the notion that even minimal dose RT performed using bodyweight exercise can present a significant physiological stimulus. Participants in this study trained to volitional fatigue and achieved perceived effort ratings that would suggest they were working at vigorous levels. Indeed, converting the energy expenditures here to METS suggested that participants were reaching very vigorous levels of activity. This is similar to previous work which has suggested that RT might contribute to the moderate-vigorous aerobic portion of the physical activity guidelines⁷. Thus, simple approaches such as the protocol used here might fit within the emerging higher effort paradigm of physical activity for public health¹ and facilitate participation in RT due to the reduced time and accessibility barrier. Future work should now look to examine longitudinal interventions of such bodyweight RT, though emerging evidence suggests it may be effective⁸ and similarly so compared to traditional RT approaches⁹.

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