Performance Fatigability, Muscle Excitation, and Neuromuscular Efficiency After Cycling Anchored to Vigorous Ratings of Perceived Exertion

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Introduction

- The traditional paradigm used to examine the responses to cardiorespiratory endurance (CE) exercise is based on constant velocity or power output (P) exercise.
- However, when exercise is anchored to a rating of perceived exertion (RPE), these responses become dissociated. Therefore, our understanding of the potential stimuli provided by constant RPE exercise is less clear and the ability to accurately prescribe exercise to improve cardiorespiratory fitness (CRF) is limited.
- It has been suggested that, for trained individuals, exercise anchored to RPE should range from RPE 14 (RPE_{14}) to RPE 17 (RPE_{17}) to improve CRF. However, it is unclear what type of stimuli that provides to the exercising muscle.
- Performance fatigability (percent change [%Δ] from pre- to post-exercise maximal voluntary isometric contraction [MVIC] force), muscle excitation (electromyography amplitude [EMG AMP]), and the neuromuscular efficiency (MVIC/EMG AMP [EFF]) may provide insights into the stimulus provided by constant RPE exercise.

PURPOSE

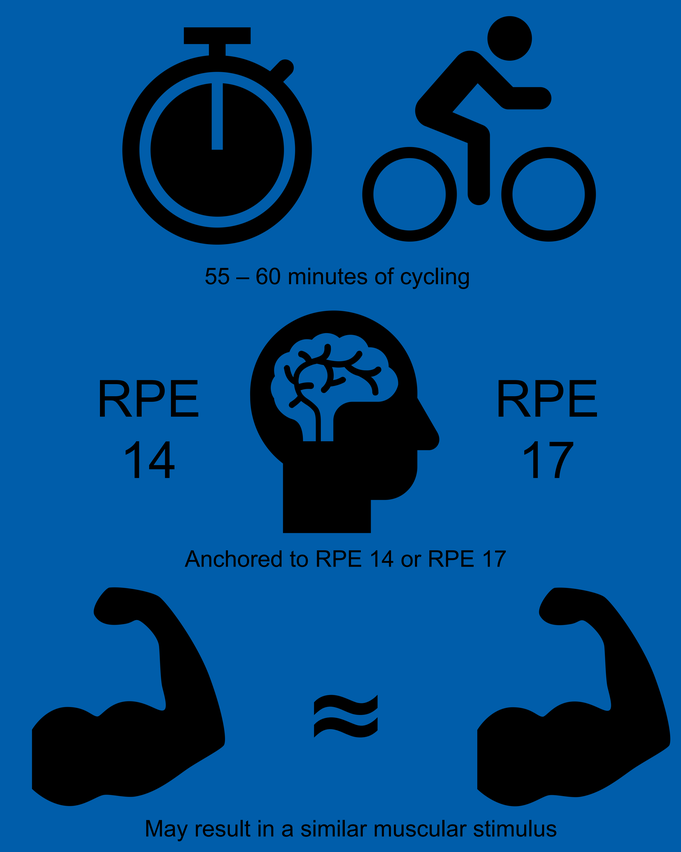
- This study aimed to quantify the performance fatigability, changes in muscle excitation, and EFF after prolonged cycle ergometry anchored to RPE_{14} and RPE_{17}.

Methods

- Six men and four women (age=22.8±3.3yrs) completed a graded exercise test to determine the RPE vs. P relationship that was used to determine the P associated with RPE_{14} and RPE_{17} and served as the starting P for the constant RPE trials.
- On separate days, subjects performed randomly ordered trials to exhaustion, up to 60 minutes, at RPE_{14} or RPE_{17}, where P was modulated to maintain the designated RPE.
- Before (Pre) and immediately after (Post) the completion of the RPE trials, subjects performed a 6-second MVIC on the cycle ergometer using a custom-built dynamometer.
- EMG AMP was recorded from the vastus lateralis of the right limb.
- A time (Pre vs. Post) x RPE (14 vs. 17) repeated measures ANOVA was used to compare EFF
- Paired-samples t-tests were used to compare the performance fatigability and the %Δ in the EMG AMP normalized to the pre-test MVIC for the RPE_{14} and RPE_{17} trials ($p<0.05$).

Conclusions

- No differences in performance fatigability, muscle excitation, and EFF during prolonged exercise anchored to RPE_{14} and RPE_{17} suggest a common underlying mechanism regulating perceived exertion that may be attributed to a sensory tolerance limit of peripheral fatigue.
- Exercise anchored to RPE_{14} may be preferred to RPE_{17} since the perceived exertion was less, but there were no differences in fatigability, muscle excitation, or EFF.



Practical Applications

- Coaches and practitioners prescribing CE exercise anchored to RPE may expect a similar muscular stimulus whether RPE is anchored to RPE_{14} or RPE_{17}, if sustained for 55-60 min.
- Exercise at RPE_{14} may be preferred to RPE_{17} because athletes can maintain a lower perceived exertion with a similar muscular stimulus.

Results

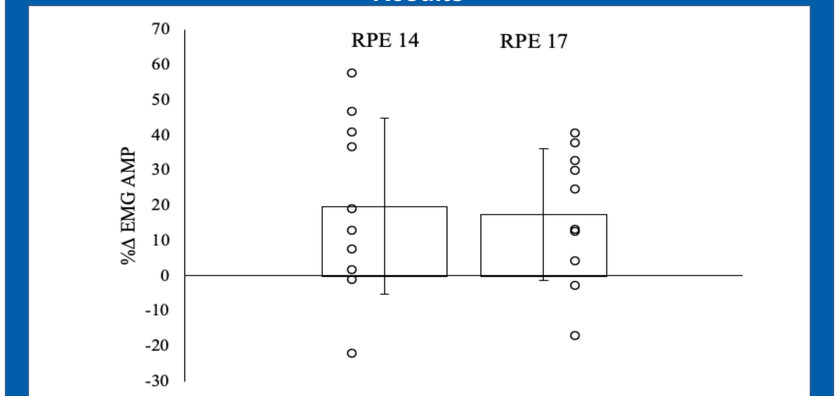


Figure 1. Changes in muscle excitation (%Δ normalized EMG AMP) after prolonged cycling anchored to RPE 14 or RPE 17 measured from pre- to post-test maximal voluntary isometric contraction (MVIC) ($p = 0.825$).

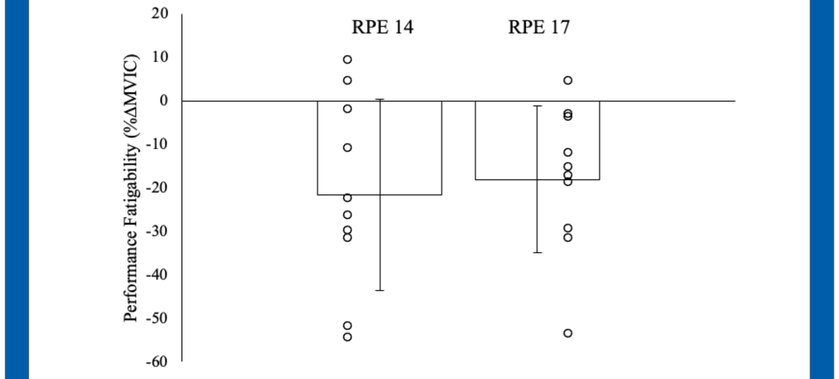


Figure 2. Changes in performance fatigability (%Δ pre- to post-exercise MVIC force) after prolonged cycling anchored to RPE 14 or RPE 17 ($p = 0.586$).

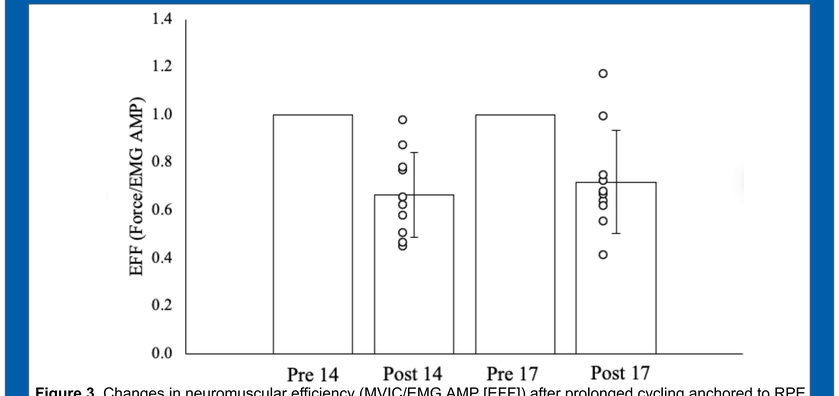


Figure 3. Changes in neuromuscular efficiency (MVIC/EMG AMP [EFF]) after prolonged cycling anchored to RPE 14 or RPE 17. There was no time x RPE interaction ($p=0.445$), but post-test (0.69±0.05) was lower than pre-test (1.0 ±0.0) ($p<0.001$)