THE EFFECTS OF EXERCISE-INDUCED MUSCLE DAMAGE
ON THE HUMAN RESPONSE TO DYNAMIC EXERCISE

Submitted by Rosemary C. Davies to the University of Exeter as a thesis for the degree of Doctor of Philosophy in Sport and Health Sciences (May, 2010).

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Abstract

Exercise-induced muscle damage (EIMD) is a commonly experienced phenomenon, yet its effect on the human response to dynamic exercise is poorly understood. Therefore the intention of this thesis was to provide empirical evidence to advance the scientific knowledge and understanding of the phenomenon of EIMD; principally by investigating the physiological, perceived exertion and metabolic responses to the performance of dynamic exercise with EIMD. The eccentric, muscle-damaging exercise protocol employed for all four studies involved participants completing 100 squats performed as 10 sets of 10 repetitions with the load on the bar corresponding to 70% of the individual’s body mass. Measures of markers of muscle damage were taken before and after the eccentric exercise protocol in each of the four studies. The markers used were plasma creatine kinase activity, isokinetic peak torque and perceived muscle soreness. Cycling rather than running was used as the dynamic exercise mode in studies 1, 2 and 4 in order to avoid the confounding influence of alterations in gait subsequent to EIMD. The dynamic exercise in study 3 was performed inside a whole body scanner and was therefore limited to knee extension and flexion.

These four studies have provided novel insights into the influence of eccentric, muscle-damaging exercise on the human response to the performance of dynamic exercise. We have demonstrated for the first time that following EIMD, the enhanced ventilatory response to dynamic exercise is provoked by stimuli unrelated to the blood lactate response, and that this enhanced ventilation may provide an important cue to inform the perception of effort. Furthermore, we have shown that the reduced time to exhaustion observed following EIMD is associated with an elevated perception of exertion and increases in [Pi] during dynamic exercise. Finally, we have demonstrated that the \( \dot{\text{VO}}_2 \) kinetic response is unaltered during the transition to high intensity dynamic exercise. Changes in [HHb] kinetics indicate that compensatory mechanisms act to preserve blood-myocyte \( \text{O}_2 \) flux in the face of microvascular dysfunction, resulting in the unaltered \( \dot{\text{VO}}_2 \) observed across the rest-to-exercise transition.
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