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The acute effect of strenuous cycle exercise on muscular strength and power

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INTRODUCTION

Concurrent training is utilised by athletes and recreational exercisers alike for the development of both aerobic power and muscular strength. The physiological bases of training and recovery for specific sports and activities has been comprehensively studied (Calder, 1990), although the interaction between concurrent aerobic and strength training is less clear and requires further investigation due to conflicting scientific evidence (Abernathy, 1993). The purpose of this study was to investigate the acute effects of a cycle VO$_{2\text{max}}$ test on muscle strength and power generation. In addition, the effects of previous training backgrounds of individuals and the responses in different muscle groups were also investigated.

METHODS

Subjects. Ten male subjects, with mean (±SD) age of 22.4 ± 3.4 years, body mass of 74.1 ± 6.6 kg and height 1.77 ± 0.05 m, participated in the study. Five subjects who had more than 12 months of endurance training were assigned into a previously endurance trained group (PE), whilst the other five subjects who were physically active, however, without formal endurance training were assigned into a non-endurance trained group (NE). No significant differences were found in the age, mass and height between the two groups. All subjects completed a medical clearance questionnaire and signed an informed consent document. The experimental procedure was approved by the University Ethics Committee.

Experiment. Subjects performed a VO$_{2\text{max}}$ test on a Mornark cycle ergometer. A set of muscular performance tests were performed 30 minutes pre, and 30 minutes and 24 hours post the VO$_{2\text{max}}$ test. All subjects were given a familiarisation session for all tests 48 hours prior to the tests. No dietary control was applied, however, subjects were instructed to keep their normal diet and perform no strenuous exercise 24 hours before and after the VO$_{2\text{max}}$ test.

The VO$_{2\text{max}}$ test began at a workload of 120 watts, and the workload was increased by 30 watts every 3 minutes till volitional exhaustion. The muscular performance tests included a standing vertical jump test using a Vertek device, a 1-RM bench press test and a 1-RM parallel squat test performed on a Plyo Power Smith machine.

Data analysis. A two-sample t-test was used to examine the differences between the two subject groups while paired Student t-tests were used to compare muscular performance pre and post the VO$_{2\text{max}}$ test. Relationships between the conditions were tested using Pearson product moment correlation. Statistical significance was set at p<0.05.

RESULTS AND DISCUSSION
The duration of the VO$_{2\max}$ test was in a range of 15 to 36 minutes. Significant difference in aerobic power were found between the PE (63.8 ± 3.5 ml·kg$^{-1}$·min$^{-1}$) and NE (48.4 ± 5.8 ml·kg$^{-1}$·min$^{-1}$) groups. However, no significant differences in muscular performance were found between the two groups, and as such, the data was pooled. All subjects exhibited significant strength decrements 30 minutes and 24 hours post the VO$_{2\max}$ test in both the bench press and squat, whilst the vertical jump performance was not significantly affected.

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post 30 min</th>
<th>Post 24 hrs</th>
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</thead>
<tbody>
<tr>
<td>Vertical Jump (cm)</td>
<td>64.9 ± 9.6</td>
<td>63.3 ± 10.1</td>
<td>64.0 ± 10.0</td>
</tr>
<tr>
<td>Bench Press (kg)</td>
<td>67.8 ± 10.6</td>
<td>64.4 ± 11.8*</td>
<td>54.0 ± 9.9*</td>
</tr>
<tr>
<td>Parallel Squat (kg)</td>
<td>143.0 ± 24.7</td>
<td>130.0 ± 22.1*</td>
<td>136.0 ± 21.2*</td>
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* p<0.05 compared with Pre test.

These results indicate that the capacity of muscular strength is affected similarly, regardless of the individuals previous endurance training history. Muscular power performance, which predominantly utilises the phosphate energy system, was able to recover in a short time period, however, muscular strength required more than 24 hours to recovery after a VO$_{2\max}$ test. These specific responses should be considered in exercise prescription for concurrent training. Interestingly, upper body strength was also affected, although the musculature was not heavily involved in the cycling exercise. A possible explanation for this could be fatigue in the central nervous system.

References cited
