The Effects of High-Intensity Exercise on IL-6 Release in College Males

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Abstract
It has been recently hypothesized that secretion of interleukin-6 (IL-6) by active muscles during and post exercise regulates carbohydrates and free fatty acid mobilization by contracting muscle. While increased circulating IL-6 levels have been reported during, and especially after, a variety of exercise protocols, the extent to which high intensity exercise contributes is not yet well characterized. This project investigated the regulation of IL-6 secretion by high intensity, anaerobic cycling exercise. The purpose of this project was to characterize the difference between repeated high intensity bouts and one continuous bout on an absolute workload. 10 healthy, college-aged subjects completed the investigation. This study found that the high intensity and low intensity bouts were equal in workload, and that the continuous bout was an adequate control to examine the effects of this high intensity exercise bout.

Introduction
Interleukin (IL-6) belongs to a group known as cytokines, which are proteins secreted from a variety of cells in the body in response to a stimulus. IL-6 is often classified as a pro-inflammatory, but also has been reported to both promote an anti-inflammatory response. IL-6 has been shown to increase the amount of blood glucose and free fatty acid availability; it promotes lipolysis in adipose tissue and glycogenolysis in the liver. Because IL-6 is produced in and released from skeletal muscle during exercise, some have suggested that it should be called a “myokine.” Skeletal muscle may now be seen in a novel role: an endocrine organ which produces and releases myokines in response to contractions due to exercise.
Exercise intensity has been found to be an important factor in IL-6 concentrations. Higher intensity levels elicit higher concentrations of IL-6 secretion, but the reason behind this is still unconfirmed. Peak levels of IL-6 are reached at the end of the exercise, or shortly thereafter. The IL-6 response to repeated bouts of high intensity exercise has not been studied, although this has been evaluated in endurance exercise.

The purpose of this study is to characterize the response of IL-6 as a consequence of the intensity of exercise, rather than the duration. Therefore, it was important to create a protocol that can be used to measure this response.

Method
Ten college-aged individuals with characteristics in Table 1 completed one familiarization session in which subjects learned the procedures used, determined settings for the cycle ergometer (Velotron; RacerMate Inc.) and completed a maximal aerobic test on the cycle ergometer to determine their maximal oxygen consumption (VO2 max), a quantitative measure of their cardio-respiratory fitness. VO2 max data was gathered with the use of a metabolic cart (TrueMax 2400 Metabolic Measurement System, Parvomedics). Subjects pedaled the cycle ergometer at steady increasing workloads, until maximum oxygen consumption was achieved. At the two subsequent testing sessions, subjects performed two different cycling tests. Both protocols used a 5 minute warm-up and cool-down at 50W and 20W, respectively. The cycle exercise protocol was as follows:

1) Four 30 s Wingate tests were performed with 4 min of recovery cycling at 20 W for total test duration of 14 min. Wingate test workload was 0.075 kpm/kg weight. Protocol used was in accordance with Greer et al.

2) The total work performed during the first test was equally distributed over a 14 min exercise test duration.

An indwelling catheter was used to sample venous blood before, during, and after the exercise bouts at pre-test, 6.5, 11, and 15.5 minutes, as well as postexercise at 1, 15, 30, and 60 min for both protocols to determine the effects of intensity on blood IL-6 concentrations (Figure 2). Hemoglobin and hematocrit levels were determined to account for changes of blood plasma volume during exercise. Corrections due to blood plasma volume alterations were made to assess whether increased IL-6 concentrations are observed, or merely more concentrated due to loss of plasma. Hemoglobin and hematocrit were analyzed by cyanmethemoglobin and microcapillary techniques, respectively. While IL-6 will be measured by chemiluminescent immunosassay (Immunoassay; Diagnostic Products Corporation). Subjects’ metabolic state was determined through blood glucose, lactate, and respiratory quotient, which will be used as a quantitative measure of substrate utilization during exercise.

Table 1. Subject Characteristics

Table: Subject Characteristics

<table>
<thead>
<tr>
<th>Age</th>
<th>Height (in.)</th>
<th>Weight (lbs.)</th>
<th>VO2 Max (ml/kg/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.9 ± .78</td>
<td>69.4 ± 4.05</td>
<td>161.1 ± 26.58</td>
<td>47.9 ± 9.05</td>
</tr>
</tbody>
</table>

All data are mean ± standard deviation. Subject pool was n = 5 each of males and females.

Discussion
The purpose of this study was to create a protocol which studies the effects of intensity of exercise on IL-6 release without the influence of duration of exercise or volume of exercise. The t-test shows that with P > 0.05, there was no significant difference between the total work done in each test, showing that the volume was equal for both tests. Since the tests lasted for the same length of time, duration was constant as well.

As stated before, IL-6 response to repeated bouts of high intensity exercise has not been studied, although this has been evaluated in endurance exercise. These experiments were not done at a higher intensity. Therefore, this protocol was not used on a standardized protocol. Some studies have looked at resistance training, while others have looked at running. With such variance in the testing protocol, the values from the studies cannot be compared between different subject pools. The protocols used in this study can now be evaluated as a standard cycle ergometer protocol, eliminating variance so that any subject pool can be compared without outside factors affecting data.

Conclusion
The continuous bout of exercise was a good control for the high intensity, repeated wingate tests. As expected, due to the calorific content of the tests, the overall number of calories burned was similar to the total work performed during the two tests. The regained work was not significantly different with a P > .05. The continuous bout of exercise was a good control for the high intensity, repeated wingate test.

References

Acknowledgements
Special thanks to research advisor Gary McCall, as well as to the other members of the research team. CHELSIE CORSER-JENSEN and CAROLYN MOORE. Funding for this project was provided by a NASA grant awarded through the University of Puget Sound Summer Science and Mathematics Research Grant and the University of Puget Sound Enrichment Committee.