Abstract
Distance runners often complete a long distance run in their regular training program. This training run may cause muscle damage. Creatine Kinase (CK), an enzyme in the blood, is a marker of muscle damage. Delayed onset muscle soreness (DOMS) often accompanies elevations in CK. Together, these variable may negatively affect a runner’s performance. PURPOSE: To determine whether a long distance run evokes DOMS and increased CK levels. METHODS: Subjects (n=16) were recruited from various running clubs around the Seacoast area and visited the lab 5 times. Visits 1, 3, 4 and 5 involved flexibility, muscle power, and muscle soreness tests, as well as a blood draw to measure CK levels. Visit 2 involved a 16 mile road run through Durham and Dover. RESULTS: A repeated measures ANOVA analysis of the Creatine Kinase values revealed that CK was significantly higher (p=0.0053) 24 and 48 hours post run. Although it was not significant, CK levels were still increased at 72 hours. DOMS was not significant at any time post run. CONCLUSIONS: The results from this study show that CK levels are in fact increased 24 and 48 hours after a 16 mile run, suggesting muscle damage. However, the muscle damage that takes place is not enough to elicit a DOMS reaction.

Background
• Creatine Kinase (CK) is an enzyme in the blood that is typically used as a marker of muscle damage.
• After any bout of strenuous exercise, muscle damage and inflammation occurs, precipitating a delayed onset muscle soreness (DOMS) response. The inflammation impairs the muscle’s ability to contract efficiently and makes work more difficult.
• Previous studies have shown a relationship between DOMS and impaired performance, but have not necessarily determined a link between CK levels and DOMS.

Purpose
This study looked at the rise in Creatine Kinase levels in the blood 24, 48, and 72 hours after a 16 mile run, as well as the possible link between Creatine Kinase levels and DOMS. The practical implications of this study are to aid athletes in their training regimen.

Hypothesis
We hypothesized that muscle damage would ensue after 16 mile run, causing an increase in Creatine Kinase levels and delayed onset muscle soreness.

Methods
- 10 healthy males (see Table 1) visited the Robert Kertzer Exercise Physiology Lab a total of 5 times.
- Visit 1:
  - First visit included anthropometric measurements as well as flexibility (Sit and Reach), muscle power (Vertical Jump), Muscle Soreness, and a VO2max test, assessed using a Sensormedics Metabolic Cart.
  - A urine sample was obtained to determine hydration status, and Creatine Kinase (CK) was measured via blood sample.

Conclusions
This study showed that there is significant muscle damage 24 and 48 hours following a long bout of exercise, even if delayed onset muscle soreness was not seen. These results coincide with previous studies that suggest that the mechanism for blood CK elevation and DOMS are different (8). In conclusion, it was determined that there is an occurrence of muscle damage after a 16 mile run regardless of the lack of physical symptoms such as DOMS.

Table 1: Subject Demographics

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>Body Fat (%)</th>
<th>VO2max (mL/kg*min^-1)</th>
<th>Average kcw^-1</th>
<th>Training (y)</th>
<th>Long Run Time (min)</th>
<th>Long Run Pace (min/mi)</th>
<th>Long Run HR (bpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.1 ± 12.35</td>
<td>170.91 ± 14.36</td>
<td>74.89 ± 12.75</td>
<td>12.96 ± 5.22</td>
<td>60.15 ± 12.09</td>
<td>45.46 ± 16.82</td>
<td>14.4 ± 10.4</td>
<td>128.7 ± 12.97</td>
<td>8.14 ± .85</td>
<td>150.2 ± 11.19</td>
</tr>
</tbody>
</table>

Results
Although the subject’s reported slight increase in muscle soreness the days following the long run, there was no significant increase in muscle soreness in the calf, hamstring, or quadriceps. A repeated measures ANOVA analysis of the Creatine Kinase values revealed that CK was significantly higher (p=0.0053) 24 and 48 hours post run. Although it was not significant, CK levels were still increased at 72 hours. (Figure 1).

References