Effects of Sleep on Maximal Exercise

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Abstract

INTRODUCTION: Sleep is a function of the body that is essential for proper recovery physically and mentally. Necessary for tissue repair and growth, mental relaxation and bodily functions in general. The amount of sleep a person receives greatly affects their performance in daily activities. Not getting enough sleep can lead to poor decision making problems such as high blood pressure, heart disease, diabetes, stroke, and obesity issues. Research shows that sleep has an effect on muscular endurance. Maximal oxygen consumption (VO_{2max}) is the maximum capacity of the body to transport and utilize oxygen during incremental exercise. It is expressed either as an absolute rate in liters of oxygen per minute (L/min) or as a relative rate in milliliters of oxygen per kilogram of body weight per minute (ml/kg/min).

PURPOSE: The purpose of this study was to evaluate the effects of sleep on maximal exercise.

METHODS: Five men (21.5 ± 3.8 yrs) and six women (23.3 ± 2.5 yrs) tested in the Cardiovascular Research Laboratory, The University of Texas at Arlington, Arlington, TX. The volunteers were volunteers from the University who were between the ages of 19-23 yrs. Each subject performed two graded exercise tests on the treadmill with increasing speed and elevation until exhaustion. Prior to the tests, subjects were familiar with the maximal test and including a larger sample.

RESULTS: The maximal values: VO_{2max} (FR: 3.3 ± 0.36 L/min; 4Hrs: 3.1 ± 0.38 L/min), HR (FR: 189.5 ± 1.73 bpm; 4Hrs: 187.8 ± 3.8 bpm), Max Time (FR: 11.5 ± 1.0 min; 4Hrs: 11.4 ± 1.1 min), and Max RPE (FR: 17.75 ± 0.96; 4Hrs: 17.75 ± 0.96). There were no significant differences in the variables measured by the metabolic cart, absolute VO_{2max} (p=0.96), Max HR (p=0.38), and Max Time (p=1).

CONCLUSIONS: The results of this study indicate sleep deprivation does not influence maximal exercise and is in agreement with previous studies where similar results have been found.

Methods (cont’d)

Procedures
1. Having a well-rested sleep of around 8 hours or a regular full sleep on one visit. The other visit was having sleep of 4 hours with communication maintained to monitor that subjects complied to sleeping 4 hours. The order of which was done first was chosen at random.
2. After a full rested sleep or 4 hours of sleep a Bruce protocol VO_{2max} test was performed.
3. The experimental testing sequence as follows:
   a) Preparation: subject and equipment. Fitting HR monitor and headgear, mouthpiece and tubbing preparation.
   b) Resting: a five-minute rest period during which heart rate (HR) was taken during the 5th minute.
   c) Exercise: Bruce protocol began. During exercise, HR is taken during the last 15 sec and 30 sec, respectively, of minute 3, along with RPE. The workloads will progressively increase every 3 minutes. Exercise will continue to volitional exhaustion.
4. A follow up of a next exercise test with same experiment testing but either fully rested or 4 hours of sleep, depending on what was done on the first test.

Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>Mean</th>
<th>±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>VO_{2max} (L/min)</td>
<td>4 Hours</td>
<td>3.1</td>
<td>±0.39</td>
</tr>
<tr>
<td></td>
<td>Full Rest</td>
<td>3.3</td>
<td>±0.38</td>
</tr>
<tr>
<td>Max HR (bpm)</td>
<td>4 Hours</td>
<td>187.8</td>
<td>±3.8</td>
</tr>
<tr>
<td></td>
<td>Full Rest</td>
<td>189.5</td>
<td>±7.1</td>
</tr>
<tr>
<td>Max Time (min)</td>
<td>4 Hours</td>
<td>11.4</td>
<td>±1.1</td>
</tr>
<tr>
<td></td>
<td>Full Rest</td>
<td>11.5</td>
<td>±1.1</td>
</tr>
<tr>
<td>Max RPE</td>
<td>4 Hours</td>
<td>17.75</td>
<td>±0.96</td>
</tr>
<tr>
<td></td>
<td>Full Rest</td>
<td>17.75</td>
<td>±0.96</td>
</tr>
</tbody>
</table>

Conclusions

• There were no significant differences in the variables depending on the amount of sleep the subjects received.
• A beginning trend started on an increase in VO_{2max}, and Max HR on the maximal test when fully rested from four hours of sleep.
• Max time and max RPE remained relatively equal.
• Recommendations for the future is having subjects more familiar with the maximal test and including a larger sample.