THE EFFECTS OF BICYCLE WARM UP ON MAXIMAL EXERCISE PERFORMANCE

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Abstract

INTRODUCTION: Warm up is widely practiced by many in athletic events. Warm up is thought to increase performance by raising muscle and core temperatures. Some studies have found that raising muscle and core temperatures significantly improves performance in short-term duration (<10 secs). Although some studies show improvement in performance, little is still known about the effects of warm up on long-term performance (>5 min).

PURPOSE: The purpose of this study was to determine if warming up using a bicycle ergometer would increase performance during a maximal oxygen consumption exercise test (VO_{2max}) conducted on a treadmill.

METHODS: Five University of Texas at Arlington students (3 male, 2 female, age 28 ±7 yrs, height 174 ± 8 cm, weight 80 ± 9 kg) participated in this study. They were asked to perform two maximal exercise tests (VO_{2max}) on separate days. One VO_{2max} test was performed with a 10 minute warm up on a bicycle ergometer at 60% of their age predicted maximal heart rate, and the other VO_{2max} test was performed without warming up on the bicycle ergometer. During these tests, maximal heart rate (HR_{max}), maximal oxygen consumption (VO_{2max}), maximal rate of perceived exertion (RPE), and time to exhaustion were measured and recorded. The order of testing, warm up and no warm up, were counterbalanced.

RESULTS: Data was analyzed using a paired sample t-test. The results revealed a small increase in VO_{2max}, HR_{max}, RPE, and time to exhaustion when the subjects warmed up for 10 minutes before a VO_{2max} test. Although there was a small increase in all categories measured, there were no statistical differences between VO_{2max} test with a warm up and without a warm up. The maximal values: HR_{max} (w/o warm up 182 ± 17 bpm, w/ warm up 188 ± 13 bpm, p=0.098), VO_{2max} (w/o warm up 38.02 ± 8 ml/kg/min, w/warm up 40.8 ± 5 ml/kg/min, p=0.180), VO_{2max} (w/o warm up 3.034 ± 0.78 L/min, w/warm up 3.263 ± 0.66 L/min, p= 0.186), RPE (w/o warm up 17 ± 0.7, w/warm up 18 ± 1, p= 0.089), and time to exhaustion (w/o warm up 10.6 ± 1.5 minutes, w/ warm up 11.3 ± 1.17, p=0.0569).

CONCLUSION: Despite slight increases in HR_{max}, VO_{2max}, RPE, and time to exhaustion, the results of this study indicate that warming up before maximal exercise will not significantly improve performance.

Introduction

Warm up is widely used in athletic events. Warm up is primarily used to increase performance through increasing muscle and core temperature. The increase in muscle and core temperature is thought to increase blood flow throughout the body, and therefore increase oxygen delivery to the exercising muscles (Bishop et al, 2002). Warm up also acts to reduce muscle and joint stiffness, increase transmission rate of nerve impulses, and change the force velocity relationship (Bishop, 2003)

The effectiveness of warm up has been supported in events lasting <10 seconds. Warm up increases performance during short-term events mainly through an increase in muscle temperature (Bishop, 2003). Warm up is also thought to increase performance in intermediate (>10 sec but <5 min) and long-term (>5 min) events through reducing the initial oxygen deficit. A reduction in the initial oxygen deficit is thought to leave more anaerobic capacity for later in the event.

Purpose

The purpose of this study was to determine if warming up using a bicycle ergometer would increase performance during a maximal oxygen consumption exercise test (VO_{2max}) conducted on a treadmill.

Methods

Subjects

- 5 University of Texas at Arlington students
- 3 males, 2 females
- Physically active

Instrumentation

- Sensormedics metabolic cart w/treadmill
- Polar heart rate monitor
- Monark cycle ergometer
- Stopwatch

Protocol

Each subject performed two Bruce protocol maximal exercise tests. One test was performed with a 10 warm up on a cycle ergometer at 60% of their age predicted HR_{max}, and the other was performed without a warm up. The order of testing, warm up and no warm up, was counterbalanced. HR_{max}, VO_{2max}, RPE, and time to exhaustion were measured during each test.

Statistical analysis

Significance of the data was determined using a paired sample t-test. All data was analyzed using Microsoft Excel 2011.

Results

Subject Demographics

Table 1: Subject demographics

	Age (years)	Height (cm)	Weight (kg)	Body Fat %
Mean ± SD	28 ± 8	174 ± 8	79.6 ± 9	18.4 ± 5

Results (cont'd)

Table 2: The comparison of HR_{max}, VO_{2max}, RPE, & time to exhaustion with warm up and without warm up

	HR_{max} (bpm)	VO_{2max}(L/min)	VO_{2max}(ml/kg/min)	RPE	Time to exhaustion (min)
No warm up	182 ± 17	3.034 ± 0.78	38.02 ± 8	17 ± 0.7	10.6 ± 1.5
Warm up	188 ± 13	3.263 ± 0.66	40.8 ± 5	18 ± 1.0	11.3 ± 1.2
p value	**0.098**	**0.186**	**0.180**	**0.089**	**0.056**

- No statistically significant differences between the max test with warm up and without warm up were found in the measured variables.

Conclusions

Despite the increase in HR_{max}, VO_{2max}, RPE, and time to exhaustion, the results indicate that warming up before maximal exercise will not increase performance in those categories.

Studies on this topic have indicated that the warm up must be of sufficient intensity (>40% VO_{2max}) and include a rest period of no longer than 5 minutes in order for performance to be increased. Similar guidelines were followed in this study, and performance was slightly increased. Although there was an increase in performance, the difference was not significant. The possible reasons why warm up did not significantly increase performance, include insufficient rest period and wrong intensity level.

Future studies

- Increasing the number of subjects
- Comparing the effectiveness of different warm up intensity levels
- Including various warm up methods
  - Example: jogging, calisthenics, swimming, etc.