BOOK OF ABSTRACTS Open Access

Uphill Cycling: Seated versus Standing Economy and Heart Rate

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Introduction

Elite cyclists differentiate between seated and standing pedaling techniques while climbing. There has been debate as to which technique is the most economical for cyclists riding a sustained climb, and what the benefits and drawbacks of the two techniques are. The purpose of this study was to compare economy (VO_2) and heart rate (HR) for seated and standing cycling positions when riding uphill at constant speed and grade.

Methods

Three male collegiate team cyclists (21.3 ± 1.7 yrs; 68.0 ± 4.6 kg) participated in a pilot study of a single continuous bout of uphill riding which used both seated and standing positions. Cycling was at subthreshold intensity with fixed speed (8 mph; 3.58 m/s) and grade (8%) on a large treadmill (length 3 m). After a 10-minute warmup, a 20-minute trial began which randomly alternated 5-minute stages of either seated or standing cycling. Specific gears generating cadences of approximately 66 and 60 rpm (seated and standing respectively) were required during each 5-minute stage. VO2 and HR data were collected continuously throughout the test but the last two minutes of each stage were compared using single-subject analyses. VO2 data were averaged every 15 seconds using a Parvo Medics metabolic cart; HR was recorded at 1 s intervals using a Garmin Edge 800 and chest strap and Rating of Perceived Exertion (RPE) was determined at the end of each 5 minute stage.

Results

Each rider required greater oxygen uptake and had higher heart rates when standing compared to seated ($p < .05$). Mean VO2 values were 3.06 ± 0.37 L/min and 3.17± 0.43 L/min whereas mean HR values were 166 ± 5 bpm and 175 ± 4 bpm for seated and standing trials, respectively (Figure 1 & 2). RPE was less consistent; two riders increased RPE while standing, while one increased RPE when seated.

Discussion

Clear differences in VO_2 and heart rate were observed between the two cycling techniques. Two of the subjects began the trial in a standing position while one subject began seated. When VO_2 was compared across all three subjects, a higher metabolic cost for a standing vs. seated position was found. This could be due to factors such as slight differences in breathing patterns between the two positions, muscle recruitment shifts, as well as angular changes to the rider's body while moving back and forth in the standing position. The differences in heart rate, which were about 5% higher for standing vs. seated cycling, followed the increase in physiological demands while standing. Cardiovascular drift was observed during the 20 minutes of climbing with increases of both HR and VO_2 from first to second stage of the standing or seated periods. This complicated direct comparison of a 5 minute stage mean VO_2 or HR with the stage immediately afterward as these would be about 3 to 5% higher simply due to cardiac drift. Second bout comparisons (minutes 10-15 and 15-20) provided the clearest results with distinct decrease of VO_2 and HR from standing to seated in the last 10 minutes despite the upward cardiovascular drift.

Conclusions

In a real world scenario, muscle fatigue, pedaling technique and air drag forces may also impact a cyclist's decision to ride seated or standing. However, our research showed that elite cyclists required greater oxygen uptake and have higher heart rates when climbing in a standing position compared to seated.

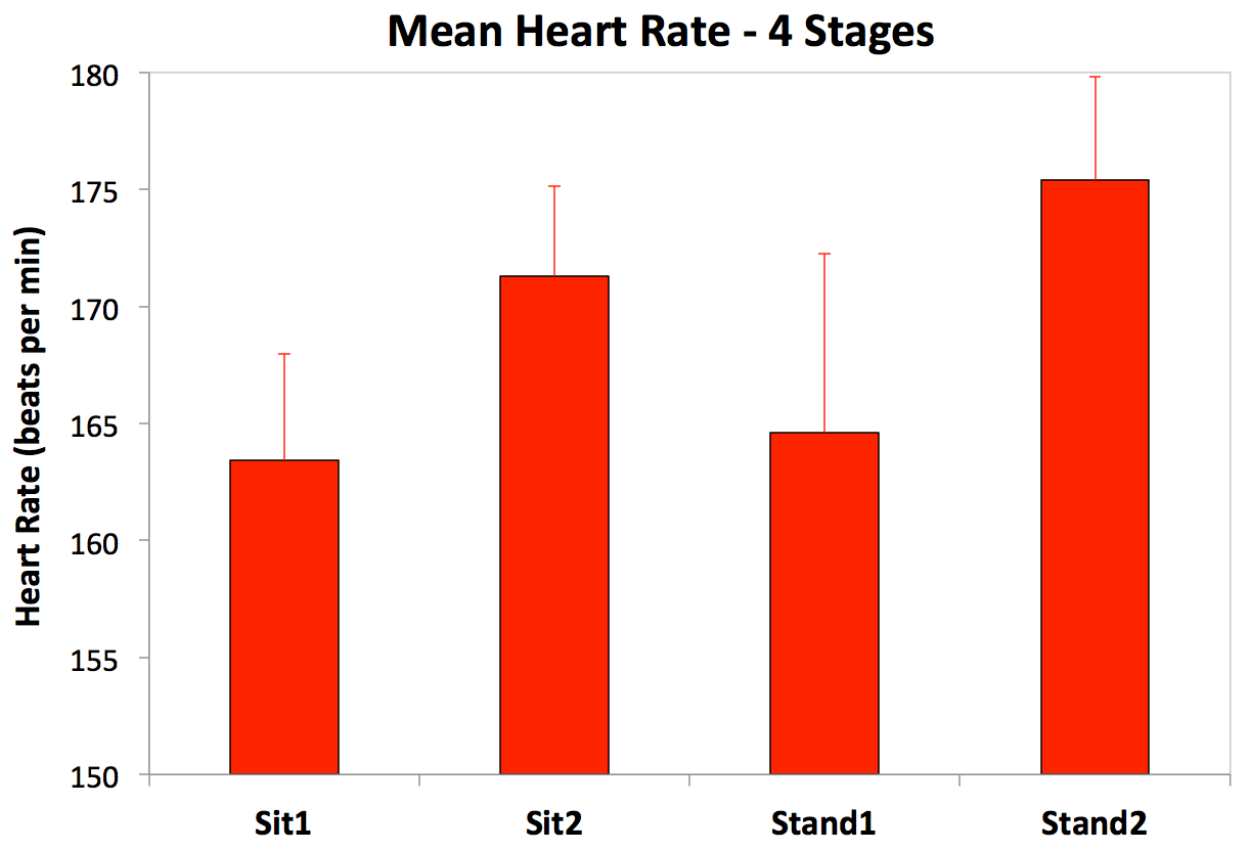

Figure 1: Heart Rate (HR) was recorded throughout each trial. Mean values of heart rate across subjects are shown for each stage. Each rider had significantly greater HR when standing compared to the seated condition.

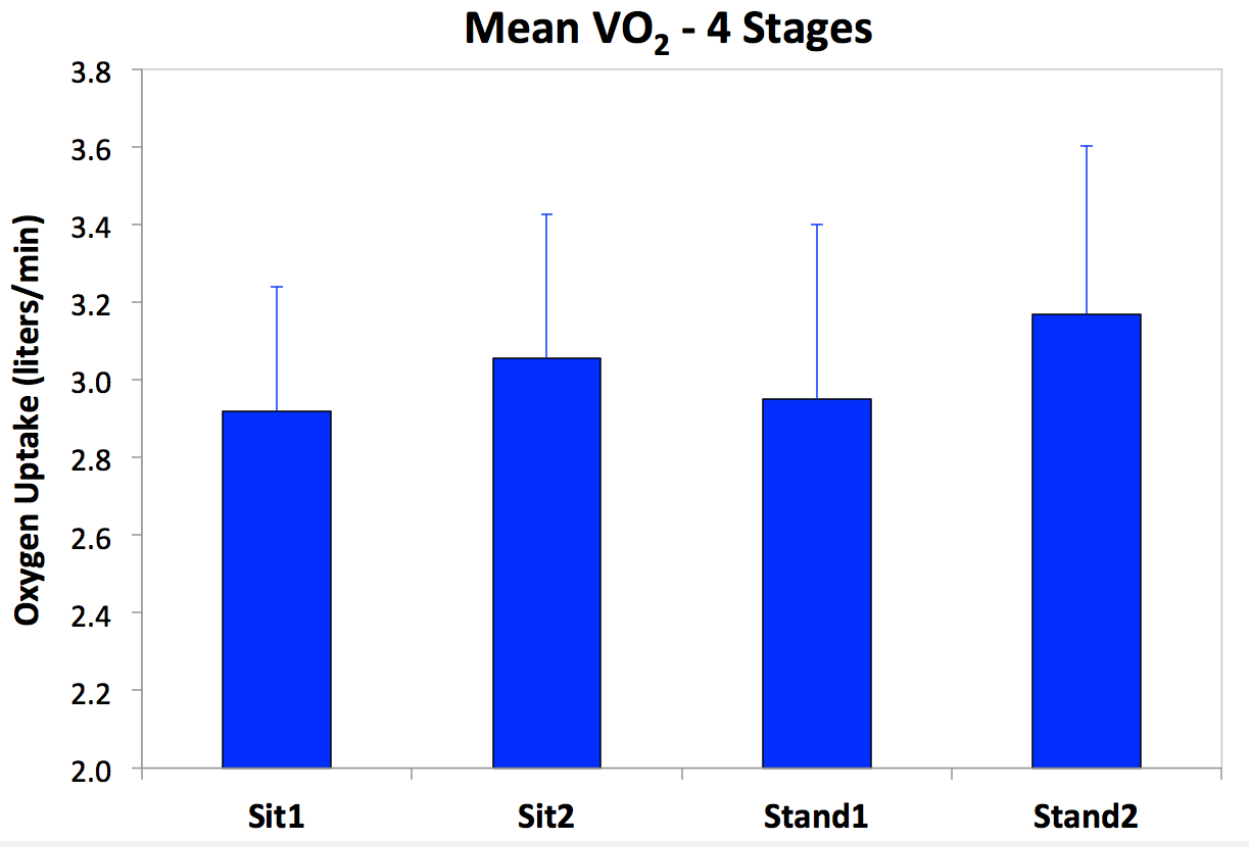

Figure 2: Oxygen Uptake (VO2) was recorded throughout each trial. Mean values of VO2 are shown for each stage. Each rider had significantly greater VO2 when standing compared to seated.

Key words: Heart Rate, Uphill Cycling, Position

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