A Comparison of the Physiological Demands of Two Commercially Available Cycle Ergometers In Trained Cyclists

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Abstract

Cycling ergometers are routinely used in a laboratory setting to evaluate physiological function and monitor changes in training status. However, the emphasis on actual cycling performance is crucial. The aim of this study was to compare the anaerobic and aerobic energy demands of two commercially available cycle ergometers in trained cyclists. The first ergometer allowed full adjustment of cycling position and was electromagnetically braked (EB). The second ergometer allowed for saddle height adjustment only and was resistance braked (RB). Methods: Ten trained male cyclists were recruited to perform three experiments with a 14 day period between the same conditions. Subjects performed a 30 second Wingate maximal sprint test followed by a continuous incremental step test on either the EB or RB cycle ergometer, in a random order. The Wingate test was performed at 0% of body mass and for 5 seconds with a 5 second speed up period. The incremental test started at 100W and increased in resistance by 50W every 3 minutes until volitional exhaustion. Heart rate (HR), VO2, power output and blood lactate were measured during the incremental test. Results: The results showed a significant difference (p<0.01) for the Wingate test between the EB and RB in terms of peak power output (POmax) and mean power output (POmean) with subjects generating greater power outputs on the EB. During the incremental test, significant differences (p<0.01) were found between EB and RB for submaximal workload, heart rate, and VO2 at both lactate threshold 1 (LT1) and 2 (LT2) (see below); and in terms of blood lactate accumulation (Figure 1). Data presented in Table 1. Conclusion: Overall it was shown that significant differences in physiological demands were present between the two ergometers under both anaerobic and aerobic conditions. This may be in part explained by the different positions adopted on each ergometer. Further research is required to confirm the findings of the current study with actual cycling performance.

Results

Table 1. Subject Characteristics and Anthropometric Variables

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Subject 1</th>
<th>Subject 2</th>
<th>Subject 3</th>
<th>Subject 4</th>
<th>Subject 5</th>
<th>Subject 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>23.4 (1.6)</td>
<td>25.8 (1.8)</td>
<td>25.7 (1.6)</td>
<td>23.8 (1.7)</td>
<td>24.0 (1.8)</td>
<td>24.6 (1.7)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>178.2 (7.9)</td>
<td>176.6 (7.5)</td>
<td>176.0 (7.6)</td>
<td>177.9 (7.8)</td>
<td>175.9 (7.7)</td>
<td>174.8 (7.6)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>78.0 (6.5)</td>
<td>80.3 (6.8)</td>
<td>79.4 (6.7)</td>
<td>80.7 (6.6)</td>
<td>79.2 (6.6)</td>
<td>78.8 (6.7)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>24.4 (1.5)</td>
<td>25.3 (1.6)</td>
<td>24.5 (1.5)</td>
<td>25.0 (1.6)</td>
<td>24.6 (1.6)</td>
<td>25.1 (1.5)</td>
</tr>
<tr>
<td>Blood lactate (mmol)</td>
<td>1.5 (0.4)</td>
<td>1.6 (0.4)</td>
<td>1.5 (0.4)</td>
<td>1.6 (0.4)</td>
<td>1.5 (0.4)</td>
<td>1.6 (0.4)</td>
</tr>
</tbody>
</table>

Figure 1 Comparison of Mean Blood Lactate responses

Figure 2 Comparison of Mean Heart Rate Responses

Discussion

During the anaerobic test it is proposed that adoption of a position that the cyclists were more used to allowed them to generate a greater power output. This may be attributed to several factors including muscle recruitment patterns, familiarity with the position, and body orientation. However, the test itself is not applied with the cyclist seated so it can only be concluded that peak power output under anaerobic conditions and not a measure of sport performance. This is due to the fact that most cycle ergometry is performed out of the saddle. Further research is required to establish the effect of the above factors. Differences in the lactate threshold were found between the EB and RB both in terms of peak power output (POmax) and mean power output (POmean) with subjects generating greater power outputs on the EB. During the incremental test, significant differences were observed for both lactate thresholds on the EB. As such, it is likely that the ergometer used may have altered the subjects' physiological responses which could in turn affect the findings of this study concerning cycling performance.

Conclusions

Overall, although both ergometers were valid for assessment of maximal aerobic capacity, cycling, significant differences were observed for other maximal indices including VO2peak, time to exhaustion and POmax. Similarly, a number of submaximal parameters were also shown to be significantly different between the two ergometers indicating differences in the physiological demands, which may be in part explained by the variability of cycling position adopted and the ergometer itself. Further research is required to compare the findings of this study with actual cycling performance.

References


Acknowledgements

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