Physiological response to cycling with variable versus constant power output

Keywords: Cycling, Power output variations, Physiology, Constant power, Variable power

Introduction Variable power output (VP) is one of the main characteristics of a road cycling mass-start. Executing a strategy with variable power during a time-trial also leads to a better finishing time than a strategy with constant power output (CP) when external conditions are not constant. Thus, tolerating VP during outdoor road cycling highly influences performance. Although physiological response to VP and CP has previously been investigated, there is a lack of continuous and comprehensive measurements during these two power conditions. To the author's knowledge, no previous studies have investigated this in a cohort of elite competitive cyclists, nor at an intensity corresponding to low-intensity (LIT). Accordingly, the aim of the present study was to investigate physiological response to VP vs. CP as well as the perceived exertion of these two power conditions, and to investigate if variations in power output which span above lactate threshold (LT), differ from variations below LT.

Methods 15 elite competitive cyclists (mean ± SD: age 24.9 ± 7.6 years, VO_{2max} 72.9 ± 5.1 ml/kg/min). During the season prior to this study, they participated in 34 ± 17 races. All of them participated in the national championships, whereas seven of them participated in UCI 1.2 category level or higher. They completed three test days, including one day of baseline testing and two days of main testing, consisting of four bouts of 28 min at two different intensities with VP and CP. The two intensities were termed "low" and "high", where the average intensity was 70 % of LT and 95 % of LT, respectively. VP was performed with a ± 15 % fluctuation of the average power output every second minute. The four bouts that the subjects went through were low constant (LC), low variable (LV), high constant (HC) and high variable (HV). Oxygen consumption (VO_2), respiratory exchange ratio (RER), heart rate (HR), blood lactate (LA), rating of perceived exertion (RPE), cadence (RPM) and workload (W) were measured

Results There was no significant difference in average power output between LV and LC (233 ± 20 W), nor between HV and HC (290 ± 20 W). At both low and high intensity, the VP condition induced a significantly higher VO_2 and LA than the CP condition did. RPE was similar between power conditions at high intensity. Additionally, at the high intensity, cycling with VP led to a greater increase in LA and lesser increase in RPE compared to cycling with CP.

Discussion/conclusion The results of this study show that, despite considerable differences in the demand during the VP and CP bouts, there are minor differences in physiological response to these two power conditions in a cohort of elite competitive cyclists. Since VP may, in many cases, be a more race specific training method than CP, and the fact that varying power not was reported to be more exhausting than maintaining a constant power, a practical implication of these findings is that training with VP seems to be a viable alternative to training with CP, at least at high intensity.

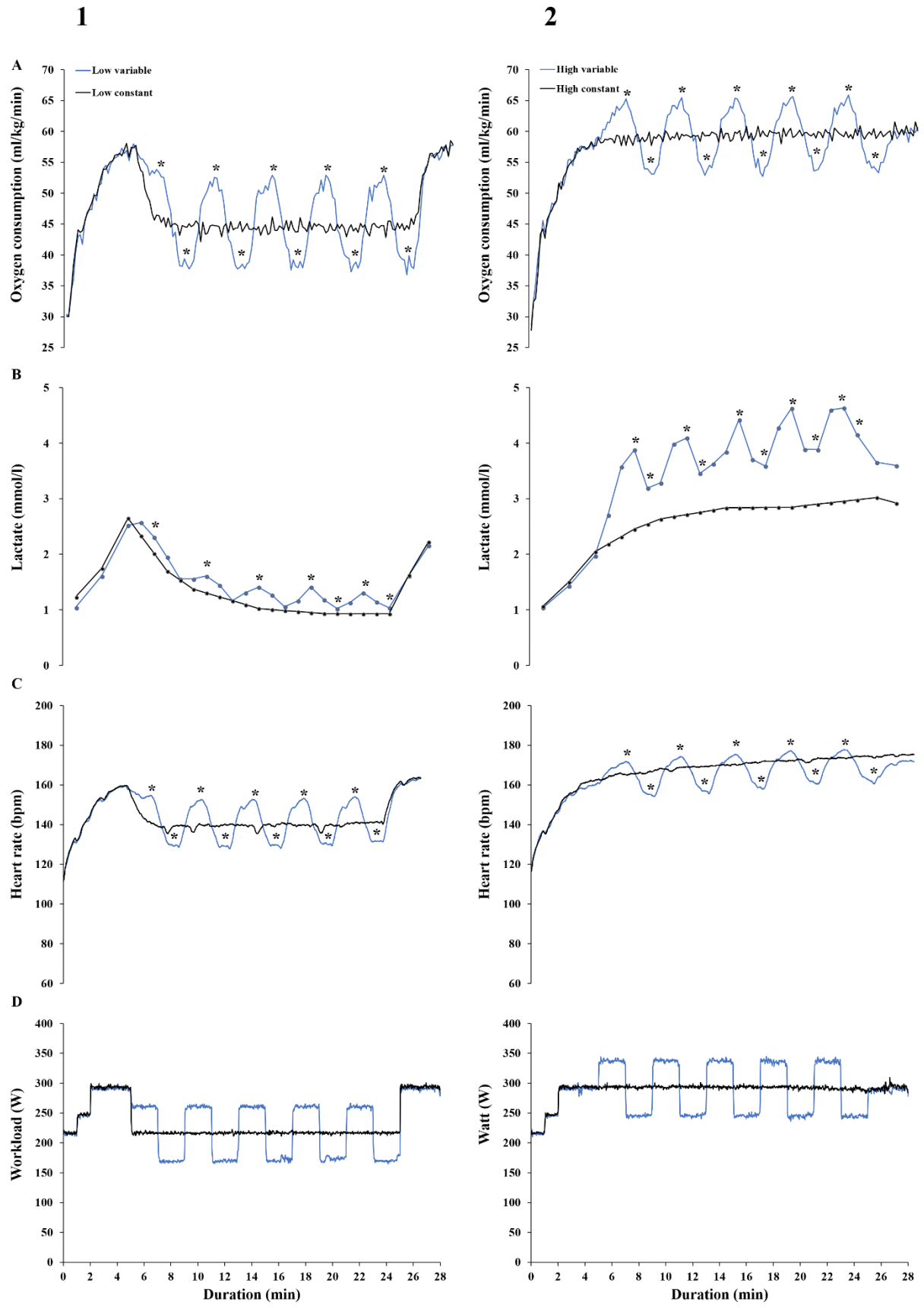
1
2
A
B
C
D
Low variable
Low constant
High variable
High constant
Oxygen consumption (ml/kg/min)
Lactate (mmol/l)
Heart rate (bpm)
Workload (W)
Watt (W)
Duration (min)

Figure 1. Mean A) oxygen consumption, B) lactate, C) heart rate, and D) workload during variable power (blue line) and constant power (black line) at 1) low intensity and 2) high intensity. * indicate a significant difference in oxygen consumption, lactate or heart rate during the variable power segment compared to the corresponding constant power segment, $p < 0.05$.