University of Canberra

Competitive Mountain Bike and Road Cycling: Physiological Characteristics of Athletes and Demands of Competition

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STATEMENT OF COPYRIGHT

"This is a real hard sport... nothing in the Tour de France compares to this. It was much harder than I expected. It's only a two-hour race, but it was the hardest two hours of my life. I have a lot of respect for these guys"

Lance Armstrong, 1999

DEDICATION

This thesis is dedicated to my parents, the athletes and coaches with whom I have the pleasure to work and to all the people around the world who love the great outdoors.

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ABSTRACT

Despite many studies describing the physiological characteristics of professional road cyclists and recent work describing the demands of competition, there is a paucity of similar information regarding elite mountain bike (MTB) cyclists. The aim of the present work was to describe the physiological characteristics and the demands of competition for successful MTB cyclists relative to successful road cyclists. Internationally competitive cyclists from both disciplines (seven MTB and seven road) completed the following laboratory tests: anthropometric measurements, an incremental cycle ergometer test and a 30 minute laboratory time trial. In addition, the power output profile obtained in the field from a world-class MTB cyclist riding a simulated race were compared to successful road cycling performances (placing top 3) in flat (FLAT), semi-mountainous (SEMO), high-mountainous (HIMO), individual time trial (ITT) and criterium (CRIT) road races. MTB cyclists were significantly lighter (65.3 ± 6.5 vs. 74.7 ± 3.8 kg, P=0.01) and leaner than the road cyclists (sum of 7 skinfolds: 33.9 ± 5.7 vs. 44.5 ± 10.8 mm, P=0.04). The MTB cyclists produced higher power outputs relative to body mass at maximal exercise (6.3 ± 0.5 vs. 5.8 ± 0.3 $W \cdot kg^{-1}$, P=0.03), lactate threshold (5.2 ± 0.6 vs. 4.7 ± 0.3 $W \cdot kg^{-1}$, P=0.048) and during the 30 minute time trial (5.5 ± 0.5 vs. 4.9 ± 0.3 $W \cdot kg^{-1}$, P=0.02). Similarly, $\dot{V}O_{2peak}$ relative to body mass was significantly higher in the MTB cyclists (78.3 ± 4.4 vs. 73.0 ± 3.4 $ml \cdot kg^{-1} \cdot min^{-1}$, P=0.03). During the MTB race, relatively more time (57%) was spent at lower cadences (<80 rpm) compared to any of the road races (3 to 33%). This was evident across a wide range of power outputs, but particularly at higher power outputs (≥7.5 $W \cdot kg^{-1}$). Less time in absolute (26.0 vs. 62.2 to 69.5 min) and relative (19 vs. 28 to 37%) terms was spent at lower power outputs (0.75-3.74 $W \cdot kg^{-1}$) for MTB compared to the longer mass-start road races (FLAT, HIMO and SEMO). In addition, the MTB cyclist was unique for accumulating the greatest number of high intensity surges up to 7.50-8.24 $W \cdot kg^{-1}$ power output range (MTB, 201 vs. SEMO, 155; HIMO, 126; FLAT, 100; CRIT, 36; ITT, 8). These results indicate that success in international MTB racing requires high power-to-weight characteristics complemented by a light and lean physique. MTB racing is associated with greater torque at the pedal crank, a more constant effort with less time at lower power outputs and a higher frequency of high-intensity surges than road racing. Therefore coaches should take into account these unique MTB racing characteristics when devising training programs for elite athletes.

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ABREVIATIONS

AIS	Australian Institute of Sport
bpm	Beats per minute
C1	Cyclist 1
C2	Cyclist 2
C3	Cyclist 3
CK	Creatine kinase
CO_2	Carbon dioxide
CRIT	Criterium road race stage
$D\text{-}max_{mod}$	Modified D-max threshold
DS	Dual suspension
FLAT	Flat road race stage
FS	Front suspension
h	Hour
HIMO	High-mountainous road race stage
HR	Heart rate
ITT	Individual time trial road race stage
km	Kilometres
$km \cdot hr^{-1}$	Kilometers per hour
$L \cdot min^{-1}$	Litres per minute
La	Lactate
min	Minute
µL	Microlitres

$ml \cdot kg^{-1} \cdot min^{-1}$	Millilitres per kilogram of body mass per minute
mmHg	Millimetres of mercury
$mmol \cdot L^{-1}$	Millimoles per litre
MTB	Mountain bike
O_2	Oxygen
OBLA	Onset of blood lactate accumulation
rpm	Revolutions per minute
s	Second
SEMO	Semi-mountainous road race stage
SRM	Schoberer Rad Messtechnik power output measuring device
UCI	International Cycling Union
$\dot{V}E$	Ventilation per minute
$\dot{V}_{ESTPD}$	Ventilation per minute at standard temperature, pressure and dry
$\dot{V}O_2$	Oxygen uptake per minute
$\dot{V}O_{2max}$	Maximal oxygen uptake per minute (reported by other authors)
$\dot{V}O_{2peak}$	Peak oxygen uptake (documented during a maximal test)
W	Watt
$W \cdot kg^{-1}$	Watts per kilogram of body mass
W_{max}	Maximal power output achieved in a cycle ergometer test