

Conference Abstract

Durability is Associated with Higher Resistance to Fatigue in Elite vs Recreational Cyclists

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Abstract

Introduction: In road cycling, the ability to perform maximum intensity efforts after hours of racing, or durability, can make a difference between winning and losing [1]. Specifically, differences between World Class and Continental-level athletes are best observed in the fatigued state [2][3][4], yet the reasons behind these level-dependent variations remain unclear. The aim of this study was to clarify the effect of prolonged duration exercise with interspersed maximal efforts on performance and fatigability in recreationally-trained and elite cyclists.

Subjects: Eighteen male cyclists from different levels have completed the study, among which twelve recreational (Age: 25 ± 3.1 , Height: 180 ± 7.3 cm, Weight: 70 ± 8.8 kg, %Fat mass: $13 \pm 3.2\%$, VO₂max: 61.9 ± 7.3 mL/min/kg, Critical Power (CP): 298 ± 31 W) and six elite-level cyclists (Age: 23 ± 1.9 , Height: 179 ± 5.0 cm, Weight: 71 ± 8.6 kg, %Fat mass: $12 \pm 1.3\%$, VO₂ max: 75.8 ± 5.4 mL/min/kg, CP: 378 ± 62 W).

Methodology: Participants rode on cycle ergometer (Cyclus2, RBM electronics, Germany) in the moderate intensity domain (90% VT1) interspersed with three exhausting bouts destined to deplete W' (3-min-all-out test, 3AOT) [5] at 0, 90 and 180min elapsed. Power and heart rate (HR) were continuously monitored (Garmin HRM-Dual monitor). Blood lactate (Lactate scout, EFK Diagnostics), expired gases exchanges (Ultima CCM™) and ratings of perceived exertion (RPE, 6-20 Borg scale) were recorded every 30 min during moderate intensity bouts. Expired gases were measured during, and lactate concentration measured 30-s after each 3AOT. Knee extensor maximal voluntary contractions (MVC) were measured after warm-up, immediately after each 3AOT, and again 10 minutes post each 3AOT (Strain Gauge, Tedea Huntleigh).

Statistics: The normality of the distribution was assessed using a Shapiro-Wilk test, followed by an evaluation of variance homogeneity using a Levene test. Time and group effects in CP, W', Peak power, VO₂max and lactate concentration were assessed using analysis of variance models (ANOVAs). Significant main effects were followed-up by Bonferroni post-hoc procedures. Significance was set at $p < 0.05$.

Results: Elite cyclists were characterised by higher CP (378 ± 62 vs 298 ± 31 W), VO₂max (75.8 ± 5.4 vs 61.9 ± 7.3 mL/min/kg), peak power (721 ± 96 vs 591 ± 98 W) and VT1 (244 ± 45 vs 199 ± 29 W) than recreational cyclists. During moderate intensity cycling, there were no significant group or time differences in VO₂, [La], RPE and HR. There were also no group differences in carbohydrate (CHO) consumption (2.3 ± 0.5 vs 2.2 ± 0.4 g/min) despite the higher absolute intensity and energy



cost (20 ± 3 vs 17 ± 2 kcal.min⁻¹) in the elite group. There were significant alterations from 1st to 3rd 3AOT, in total work (elite: 75 ± 9 vs 81 ± 10 kJ; recreational: 59 ± 10 vs 62 ± 9 kJ) and [La] (elite: 13.4 ± 3.2 vs 8.0 ± 2.9 mmol.L⁻¹; recreational: 9.2 ± 3.9 vs 7.6 ± 2.9 mmol.L⁻¹). However, W' decreased significantly only in recreational cyclists (10.1 ± 1.4 vs 12.4 ± 9.1 kJ). There were no significant changes in CP or VO₂peak during the three 3AOT for both groups. Knee extensor MVC decreased notably only in recreational group at the end of the session (122 ± 29 vs 104 ± 32 Nm) and after each all-out test. No differences in relative voluntary activation were found in either group.

Conclusion: The main finding of this study highlighted the increased fatigue experienced by recreational athletes compared to elite cyclists during extended exercise. These results are consistent with prior research [6], indicating a decrease in W' among recreational-trained cyclists. However, this decline is not observed in elite athletes, who demonstrate superior ability to repeat all-out efforts. This heightened fatigability is characterized by a greater degree of peripheral fatigue among recreational cyclists. Despite elite athletes demonstrating higher total work, greater work output during each 3AOT, and expending more of their W' reserve during each 3AOT, there were no differences in initial force and W' between the groups afterward. Moreover, elite cyclists exhibited similar CHO consumption but a greater contribution of fat to total energy expenditure at moderate intensity compared to recreational athletes.

Keywords: Road Cycling, Fatigue, Durability, Critical Power, W'

References

1. Mateo-March, Manuel, Xabier Muriel, Pedro L. Valenzuela, Mikel Zabala, Alejandro Lucia, Jesús G. Pallares, et David Barranco-Gil. « Durability and repeatability of professional cyclists during a Grand Tour ». *European Journal of Sport Science* 0, n° ja (29 septembre 2021): 1-15. doi: [10.1080/17461391.2021.1987528](https://doi.org/10.1080/17461391.2021.1987528).
2. Mateo-March, Manuel, Pedro L. Valenzuela, Xabier Muriel, Alexis Gandia-Soriano, Mikel Zabala, Alejandro Lucia, Jesús Pallarés, et David Barranco-Gil. « The Record Power Profile of Male Professional Cyclists: Fatigue Matters ». *International Journal of Sports Physiology and Performance*, 3 mars 2022, 1-6. doi: [10.1123/ijsp.2021-0403](https://doi.org/10.1123/ijsp.2021-0403).
3. Erp, Teun van, et Dajo Sanders. « Demands of Professional Cycling Races: Influence of Race Category and Result ». *European Journal of Sport Science*, 16 juillet 2020, 1-12. doi: [10.1080/17461391.2020.1788651](https://doi.org/10.1080/17461391.2020.1788651).
4. Muriel, Xabier, Pedro L. Valenzuela, Manuel Mateo-March, Jesús G. Pallarés, Alejandro Lucia, et David Barranco-Gil. « Physical Demands and Performance Indicators in Male Professional Cyclists During a Grand Tour: WorldTour Versus ProTeam Category ». *International Journal of Sports Physiology and Performance*, 3 août 2021, 1-9. doi: [10.1123/ijsp.2021-0082](https://doi.org/10.1123/ijsp.2021-0082).
5. Burnley, Mark, Jonathan H. Doust, et Anni Vanhatalo. « A 3-Min All-out Test to Determine Peak Oxygen Uptake and the Maximal Steady State ». *Medicine and Science in Sports and Exercise* 38, no 11 (novembre 2006): 1995-2003. doi: [10.1249/01.mss.0000232024.06114.a6](https://doi.org/10.1249/01.mss.0000232024.06114.a6).
6. Clark, Ida E., Anni Vanhatalo, Christopher Thompson, Charlotte Joseph, Matthew I. Black, Jamie R. Blackwell, Lee J. Wylie, et al. « Dynamics of the Power-Duration Relationship during Prolonged Endurance Exercise and Influence of Carbohydrate Ingestion ». *Journal of Applied Physiology* 127, no 3 (1 septembre 2019): 726-36. doi: [10.1152/japplphysiol.00207.2019](https://doi.org/10.1152/japplphysiol.00207.2019).