

ESCOLA DE EDUCAÇÃO FÍSICA E ESPORTE
UNIVERSIDADE DE SÃO PAULO

ASPECTOS FISIOLÓGICOS DO CICLISMO

EFE0170 - FISIOLOGIA DO ESPORTE

Danilo França
Julia Duarte
João Gabriel
Mariana Molina

Características gerais do Ciclismo

O tempo e o volume de treinamento parecem exercer papel fundamental nas adaptações fisiológicas, como por exemplo aquelas que são resultado do treinamento de alta intensidade para preparar o ciclista para uma prova de fuga ou sprint.

O maior percentual do volume total de treinamento é realizado em intensidade moderada (zona 1).

Van Erp et al. 2019

A nível competitivo é uma das modalidades que possui o maior volume de treinamento total, podendo chegar a 25-35 mil km/ano.

Mujika e Padilla (2001); Zapico et al. (2007); Seiler & Tonnenssen (2009)

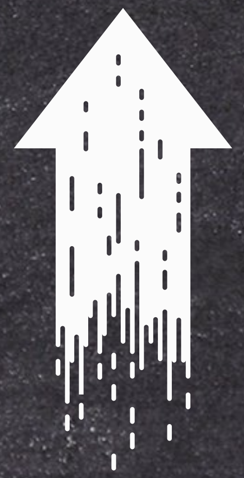
Características morfológicas

Selective training-induced thigh muscles hypertrophy in professional road cyclists (Hug et al. 2006)

versus

Estudo documentou as alterações da área de seção transversal em 11 músculos da coxa associadas a um alto volume e alta intensidade de treinamento de um grupo de ciclistas de estrada profissionais em comparação com estudantes de ciência do esporte.

Em ciclistas profissionais:



Vasto Lateral
Sartório
Adutor magno
Bíceps femoral

Adaptações crônicas do exercício aeróbio

Rodriguez et al. (2002)

Maior percentual de fibras do tipo I em ciclistas quando comparados aos sujeitos fisicamente ativos, sendo que ciclistas com 7 anos de competição possuíam mais fibras do tipo I quando comparados aos ciclistas com 5 anos de competição.

Shaw et al. (2020)

Indivíduos treinados possuíam maior densidade capilar quando comparados aos indivíduos não treinados.

Características fisiológicas

Selective training-induced thigh muscles hypertrophy in professional road cyclists (Hug et al. 2006)

versus

	Sport science students	Professional road cyclists
$\dot{V}O_2$ max ($ml\ min^{-1}\ kg^{-1}$)	55.9±4.7	74.6±5.1[a]
MPT (W)	334±24	477±28[a]
VT_1 (% MPT)	54±9	60±7[a]
VT_2 (% MPT)	80±5	89±5[a]

Adaptado de Hug et al. (2006)

Elevado VO2máx e Wmáx

Principais preditores de desempenho

VO2máx

Máxima capacidade de de absorver, transportar e utilizar o O2 para ressíntese de ATP. Atrelado à potência aeróbia.

Potência mecânica máxima (Wmáx)

Máxima potência mecânica alcançada durante um teste

Segundo limiar de lactato (2° limiar ventilatório)

Maior intensidade suportada sem o acúmulo considerável do lactato sanguíneo.

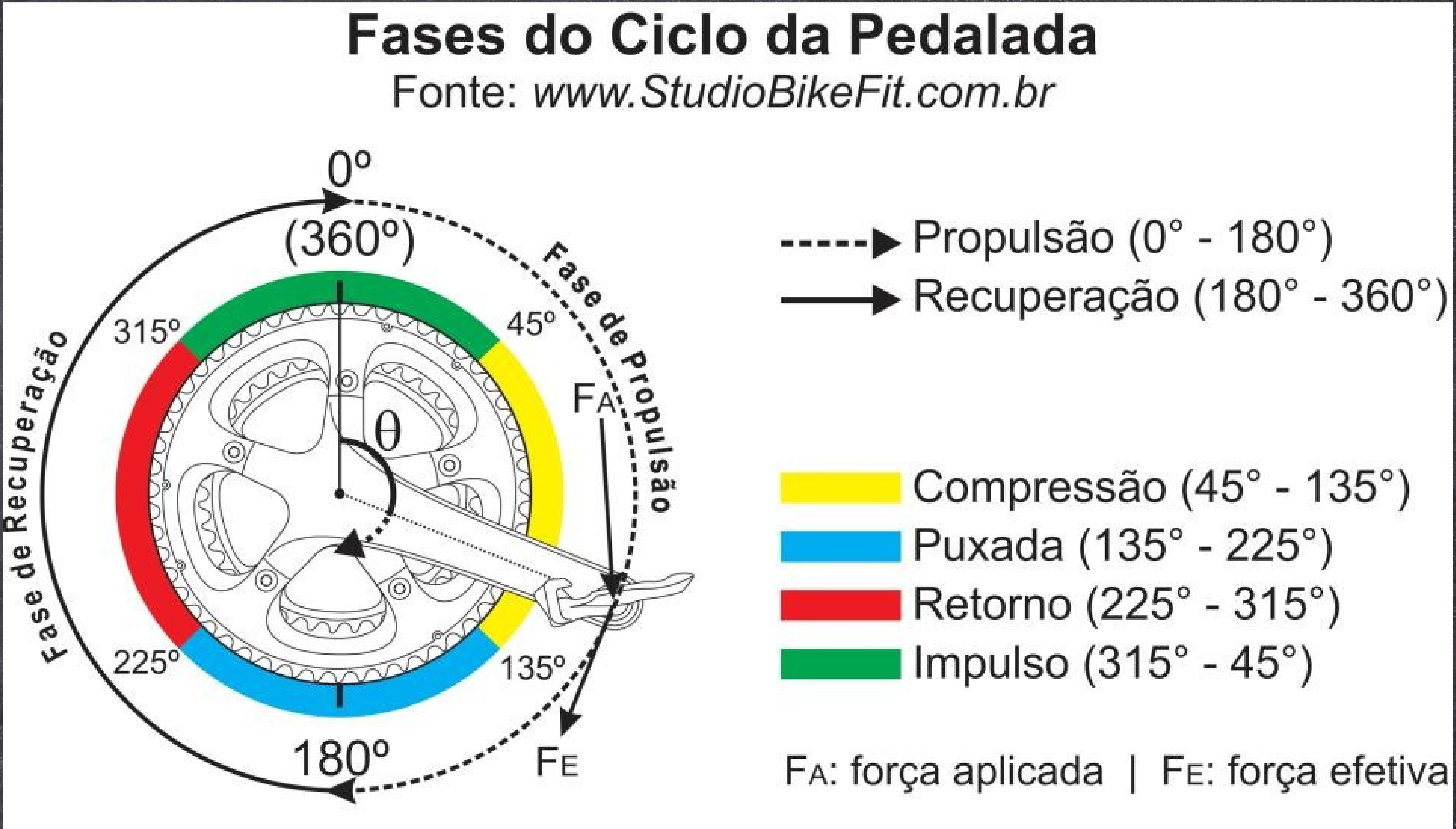
Economia de Ciclismo

Demanda energértica necessária para uma dada intensidade submáxima.

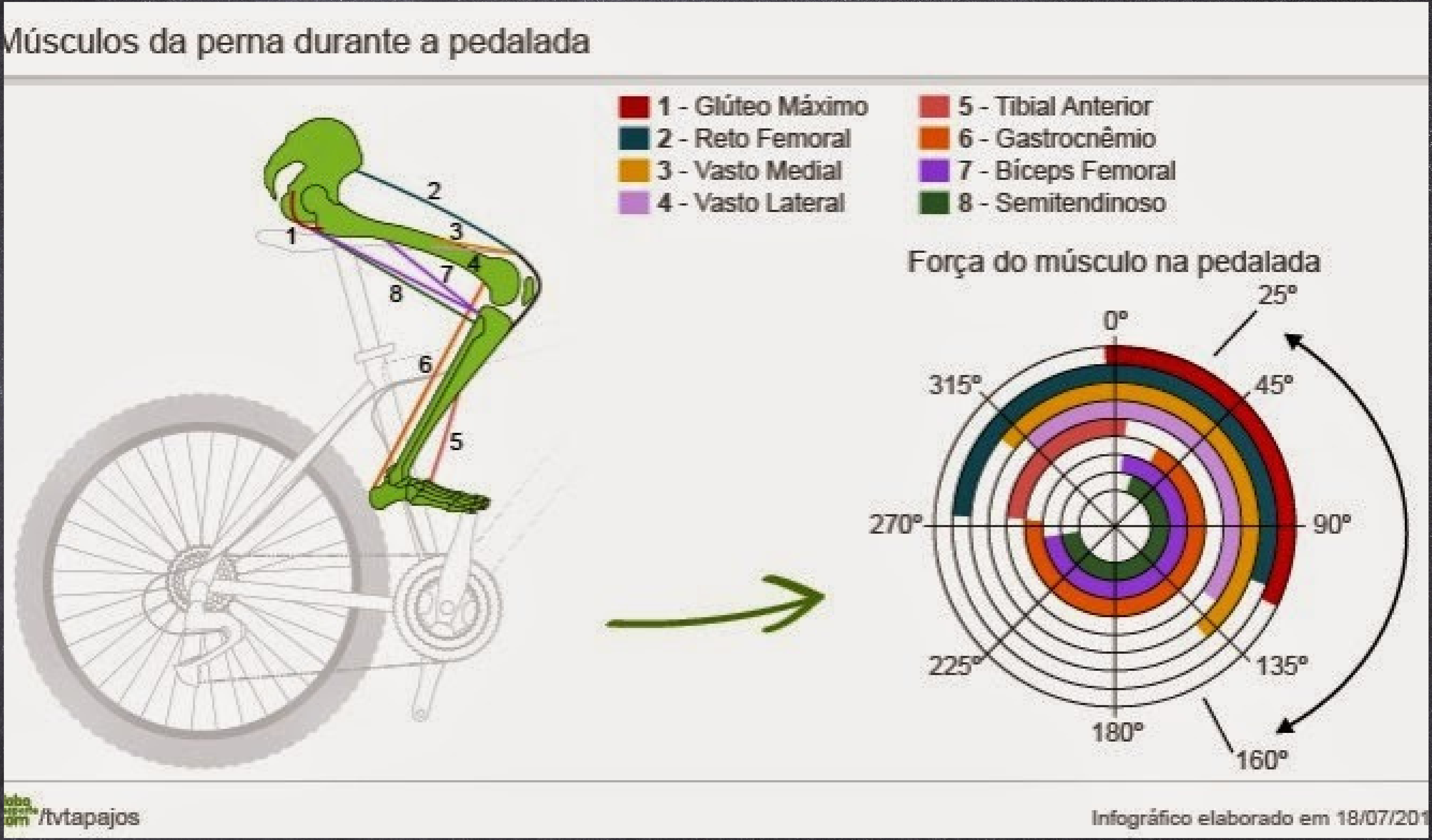
%VO2máx

Capacidade de sustentar alta porcentagem do VO2máx.

Mujika e Padilla (2001)



Adaptado de Stapelfeldt & Mornieux (2005)



Adaptado de Jorge & Hull (1985)

Maximal Strength Training Improves Cycling Economy in Competitive Cyclists

Arnstein Sunde,[1] Øyvind Støren,[1,2] Marius Bjerkaas,[1] Morten H. Larsen,[1] Jan Hoff,[2,3] and Jan Helgerud[2,4]

- 8 semanas
- 3x/semana
- 4 séries de 4RM (meio agachamento)
- 3 minutos de intervalo

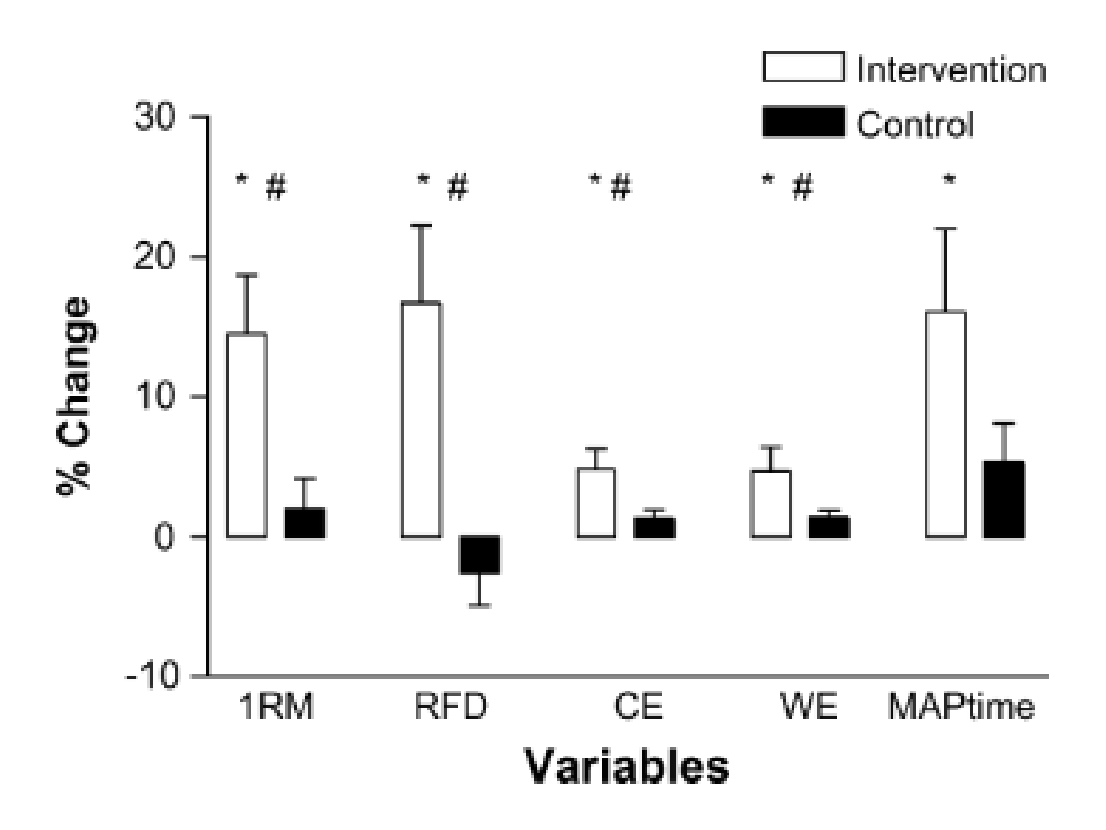


Figure 1. Percent changes from before to after intervention in the intervention group (n = 8) and the control group (n = 5). 1RM = 1 repetition maximum half-squat; RFD = rate of force development half-squat; CE = cycling economy (ml·kg$^{-0.67}$·W^{-1}); WE = work efficiency; tMAP = time to exhaustion at pre-intervention maximal aerobic power. *$p < 0.05$, changes from before to after in the intervention group. #$p < 0.05$, between group differences.

Strength training improves 5-min all-out performance following 185 min of cycling

B. R. Rønnestad[1], E. A. Hansen[2], T. Raastad[2]

- 12 semanas
- 2x/semana
- Meio agachamento, leg press unilateral, flexão de quadril unilateral e dorsiflexão

1 a 3: 10RM | 6RM
4 a 6: 8RM | 5RM
7 a 12: 6RM | 4RM

Rønnestad et al.

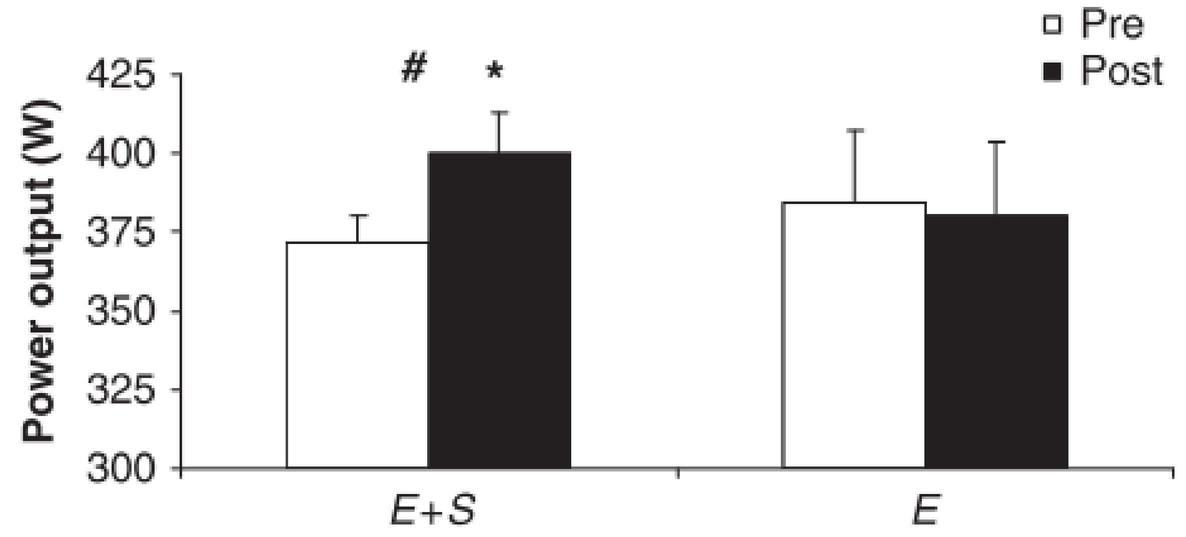


Fig. 5. Mean power output during the 5-min all-out trial performed following 185 min of cycling at 44% of baseline W_{max} before (pre) and after (post) 12 weeks of combined endurance and heavy strength training (*E+S*) or endurance training only (*E*). *Different from Pre ($P<0.01$). #Difference between groups in relative change from pre-test to post-test ($P<0.01$).

Strength training improves cycling performance, fractional utilization of VO_{2max} and cycling economy in female cyclists

O. Vikmoen[1]*, S. Ellefsen[1]*, Ø. Trøen[1], I. Hollan[2]*, M. Hanestadhaugen[3]*, T. Raastad[4], B. R. Rønnestad[1]*

- 11 semanas
- 2x/semana
- Meio agachamento, leg press unilateral, flexão de quadril unilateral e flexão plantar

1 a 3: 10RM | 6RM
4 a 6: 8RM | 5RM
7 a 11: 6RM | 4RM

Table 3. Data from the maximal oxygen consumption (VO_{2max}) and Wingate tests before (pre) and after (post) the intervention period for cyclists adding strength training to their normal endurance training (E+S) and cyclists performing normal endurance training only (E)

	E+S		E		Cohen's *d*
	Pre	Post	Pre	Post	
W_{max} (W/kg)	4.0 ± 0.3	4.2 ± 0.3	4.0 ± 0.4	4.2 ± 0.2	0.21
VO_{2max} (mL/kg/min)	53.5 ± 3.6	52.5 ± 4.2	54.6 ± 3.4	53.5 ± 1.8	0.05
HR_{peak} (beats/min)	188 ± 9	186 ± 8	182 ± 8	182 ± 6	–
RPE	19.5 ± 0.5	19.8 ± 0.4	19.4 ± 0.7	19.3 ± 0.6	–
$[la^-]_{peak}$ (mmol/L)	10.8 ± 3.2	10.4 ± 2.9	9.8 ± 2.4	9.7 ± 2.3	–
Peak power Wingate (W/kg)	17.0 ± 2.0	19.1 ± 2.5*	17.7 ± 1.4	18.7 ± 1.7	0.49
Mean power Wingate (W/kg)	8.1 ± 0.7	8.4 ± 0.6*	8.1 ± 0.5	8.1 ± 0.6	0.83

Values are mean ± SD.
*Larger than pre ($P < 0.05$).
HR_{peak}, peak heart rate; $[la^-]_{peak}$, peak blood lactate concentration; RPE, rate of perceived exertion.

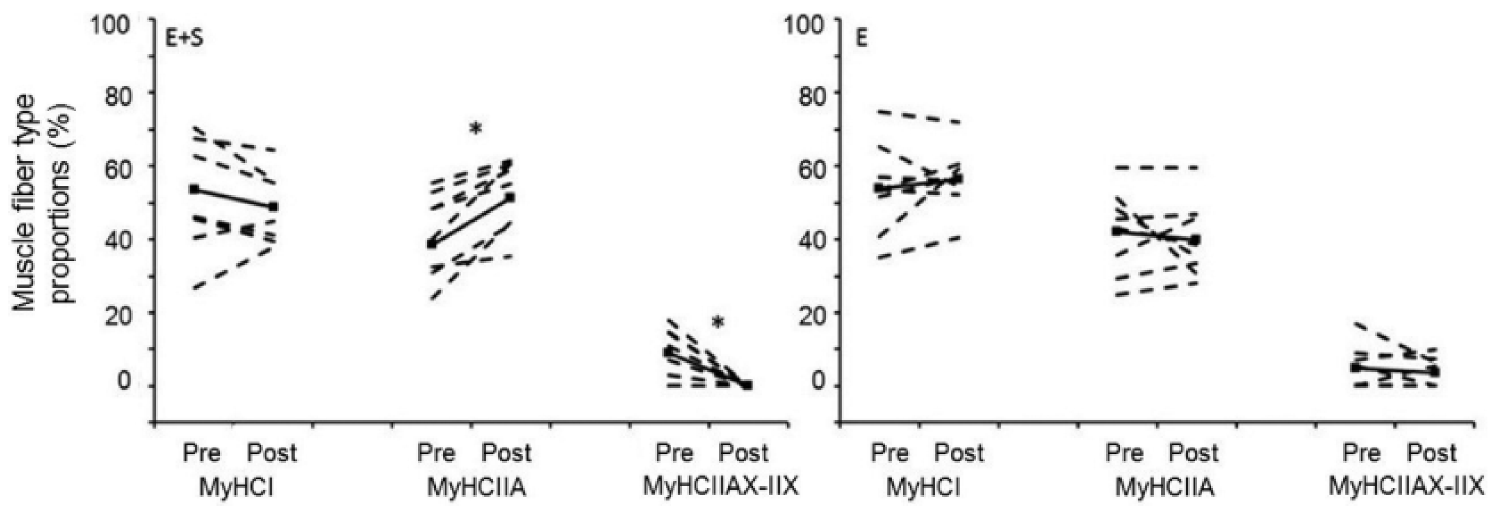
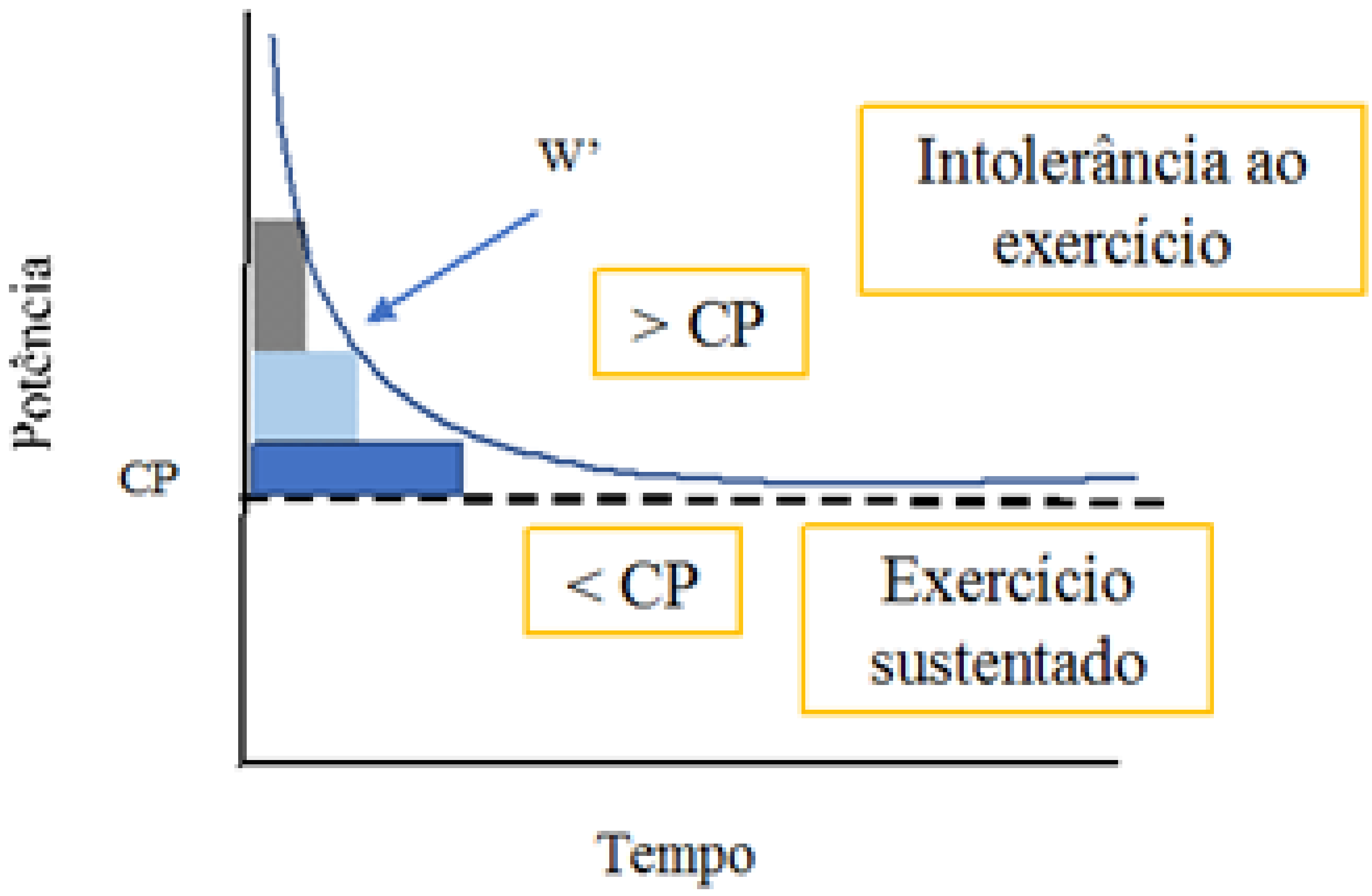


Fig. 2. Individual values (dotted lines) and mean values (solid lines) before (pre) and after (post) the intervention period for cyclists adding strength training to their normal endurance training (E+S) and cyclists performing normal endurance training only (E). Immunohistochemistry determined muscle fiber proportions, presented as percentage of overall fiber abundance. *Different from pre ($P < 0.05$).



Physiological Reports
Open Access
Physiological Reports ISSN 2051-817X

INVITED REVIEW

The maximal metabolic steady state: redefining the 'gold standard'

Andrew M. Jones[1], Mark Burnley[2], Matthew I. Black[1], David C. Poole[3] & Anni Vanhatalo[1]

1 Sport and Health Sciences, University of Exeter, St. Luke's Campus, Exeter, United Kingdom
2 School of Sport and Exercise Sciences, University of Kent, Medway, United Kingdom
3 Department of Kinesiology, Kansas State University, Manhattan, Kansas

Andrew M Jones PhD is Professor of Applied Physiology at the University of Exeter, UK. Jones completed his undergraduate and PhD degrees in exercise physiology at the University of Brighton before completing postdoctoral training in respiratory physiology at the University of California Los Angeles. Jones's research explores the limitations to human endurance with a focus on gas exchange kinetics, exercise bioenergetics, causes of fatigue, exercise testing, and interventions such as training and nutritional ergogenic aids that may enhance athletic performance.

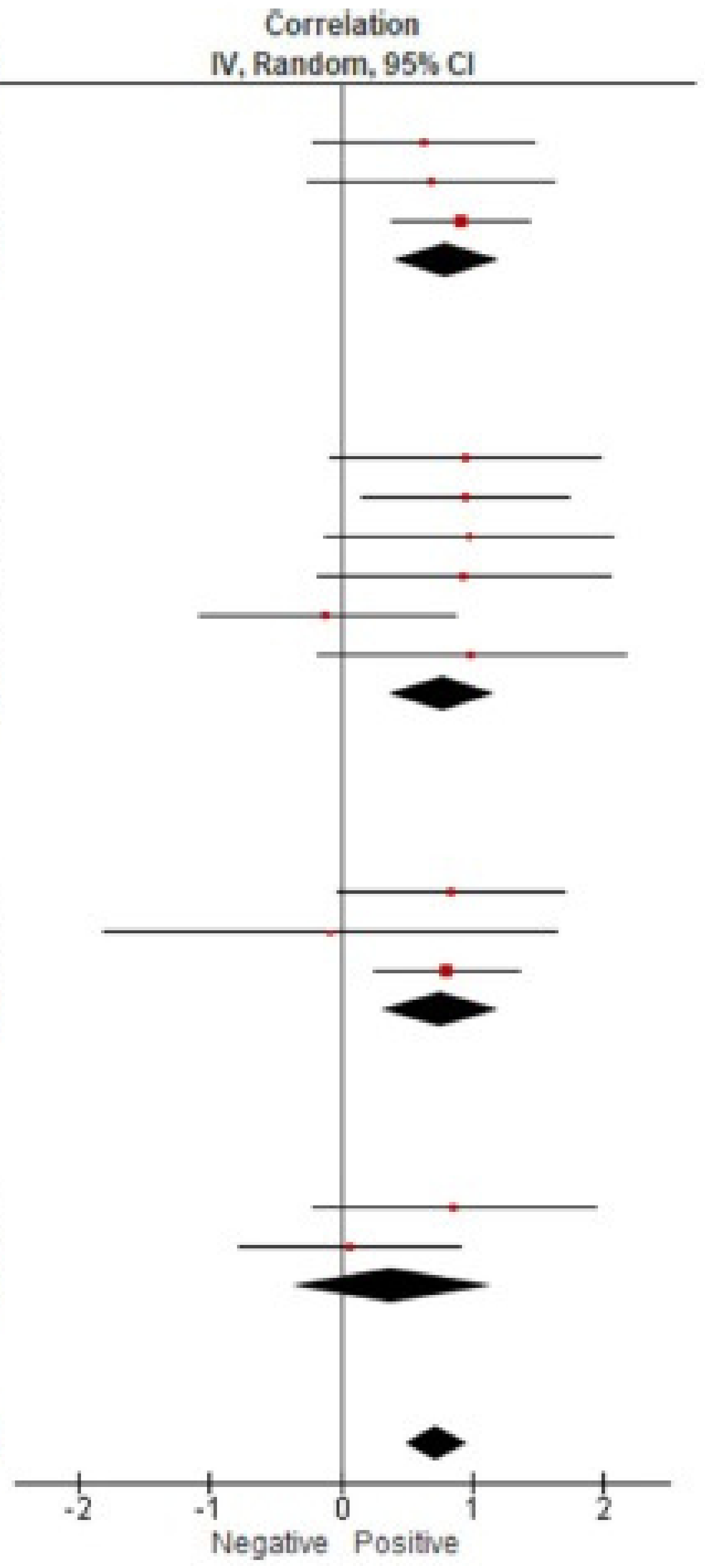
Sports Medicine
https://doi.org/10.1007/s40279-020-01314-8

SYSTEMATIC REVIEW

Relative Proximity of Critical Power and Metabolic/Ventilatory Thresholds: Systematic Review and Meta-Analysis

Miguel Ángel Galán-Rioja[1] · Fernando González-Mohíno[1,3] · David C. Poole[2] · José Mª Gon

Study or Subgroup	Correlation	SE	Weight	Correlation IV, Random, 95% CI
1.1.1 CP < RCP				
Leo et al. [21]	0.63	0.43	7.3%	0.63 [-0.21, 1.47]
Caen et al. [20]	0.69	0.48	5.8%	0.69 [-0.25, 1.63]
Bergstrom et al. a [18]	0.91	0.27	18.5%	0.91 [0.38, 1.44]
Subtotal (95% CI)			**31.6%**	**0.80 [0.40, 1.21]**
Heterogeneity: Tau² = 0.00; Chi² = 0.37, df = 2 (P = 0.83); I² = 0%				
Test for overall effect: Z = 3.90 (P < 0.0001)				
1.1.2 CP > MLSS				
Pringle and Jones. [12]	0.95	0.53	4.8%	0.95 [-0.09, 1.99]
Mattioni et al. [14]	0.95	0.4	8.4%	0.95 [0.17, 1.73]
Greco et al. b [15]	0.98	0.56	4.3%	0.98 [-0.12, 2.08]
Greco et al. a [15]	0.94	0.57	4.1%	0.94 [-0.18, 2.06]
Dekerle et al. a [17]	-0.11	0.5	5.4%	-0.11 [-1.09, 0.87]
Caritá et al. [13]	0.99	0.6	3.7%	0.99 [-0.19, 2.17]
Subtotal (95% CI)			**30.8%**	**0.77 [0.36, 1.18]**
Heterogeneity: Tau² = 0.00; Chi² = 3.78, df = 5 (P = 0.58); I² = 0%				
Test for overall effect: Z = 3.69 (P = 0.0002)				
1.1.3 CP > VT1				
Nakamura et al. a [19]	0.84	0.44	7.0%	0.84 [-0.02, 1.70]
Dekerle et al. b [17]	-0.08	0.88	1.7%	-0.08 [-1.80, 1.64]
Bergstrom et al. b [18]	0.81	0.28	17.2%	0.81 [0.26, 1.36]
Subtotal (95% CI)			**25.9%**	**0.76 [0.31, 1.21]**
Heterogeneity: Tau² = 0.00; Chi² = 0.98, df = 2 (P = 0.61); I² = 0%				
Test for overall effect: Z = 3.32 (P = 0.0009)				
1.1.4 CP < VT2				
Nakamura et al. b [19]	0.86	0.55	4.5%	0.86 [-0.22, 1.94]
Dekerle et al. c [17]	0.07	0.43	7.3%	0.07 [-0.77, 0.91]
Subtotal (95% CI)			**11.7%**	**0.39 [-0.37, 1.15]**
Heterogeneity: Tau² = 0.07; Chi² = 1.28, df = 1 (P = 0.26); I² = 22%				
Test for overall effect: Z = 1.01 (P = 0.31)				
Total (95% CI)			**100.0%**	**0.73 [0.50, 0.96]**
Heterogeneity: Tau² = 0.00; Chi² = 7.73, df = 13 (P = 0.86); I² = 0%				
Test for overall effect: Z = 6.30 (P < 0.00001)				
Test for subgroup differences: Chi² = 0.94, df = 3 (P = 0.82), I² = 0%				



2 Forest Plot of the pooled correlation coefficient of CP and Metabolic/Ventilatory Thresholds. Negative correlation, Positive correlation, onfidence interval, *SE* standard error, *IV* weighted correlation

TOUR DE FLANDRES

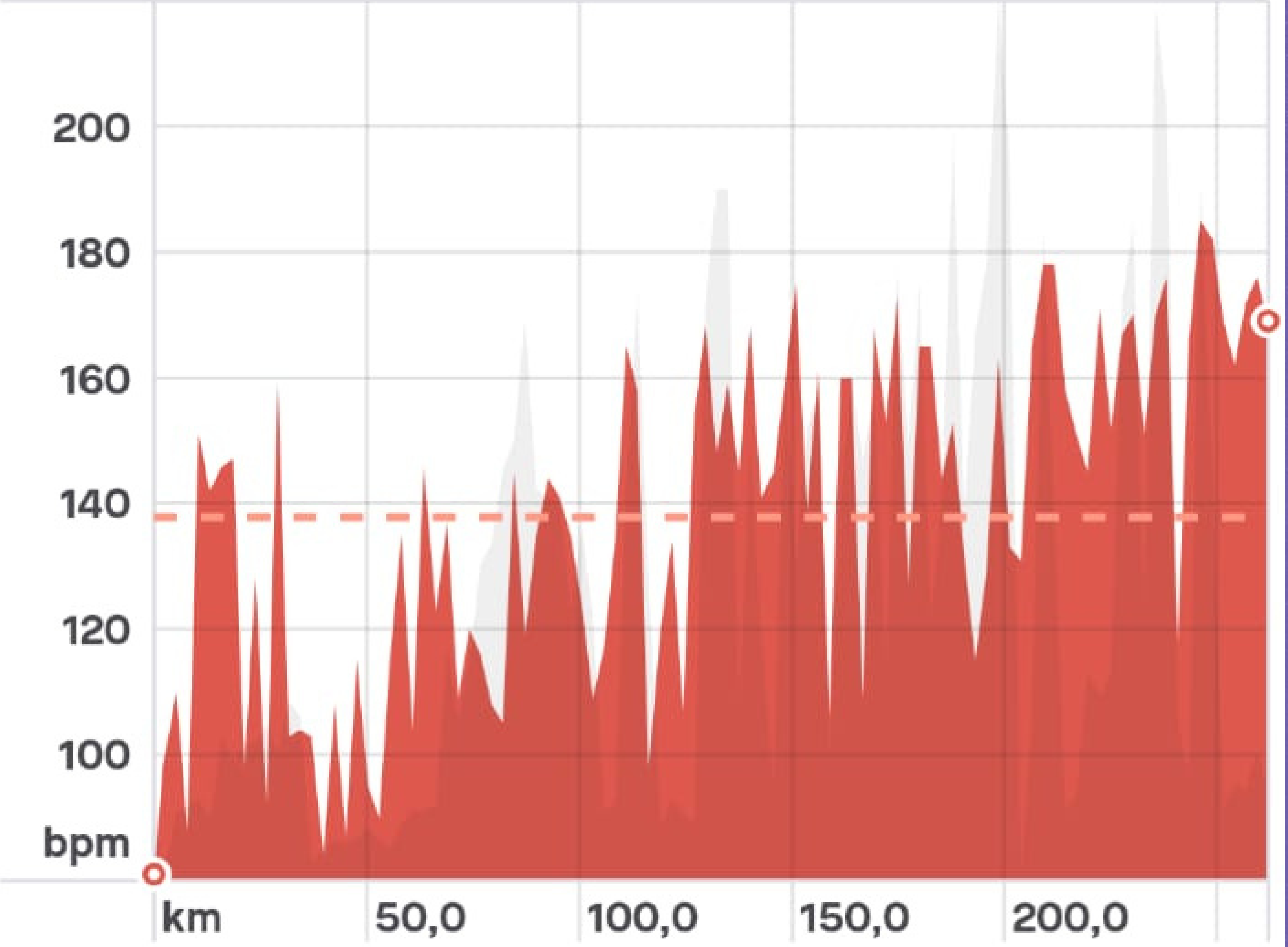
Mathieu Van der poel

4 de abril de 2021 às 10:00 · Antwerp, Bélgica

Ronde Van Vlaanderen 🥈

Distância	Ganho de elevação
262,63 km	2.223 m
Tempo de movimentação	**Potência média**
6:15:54	270 W
Velocidade média	**Calorias**
41,9 km/h	6.059 Kcal

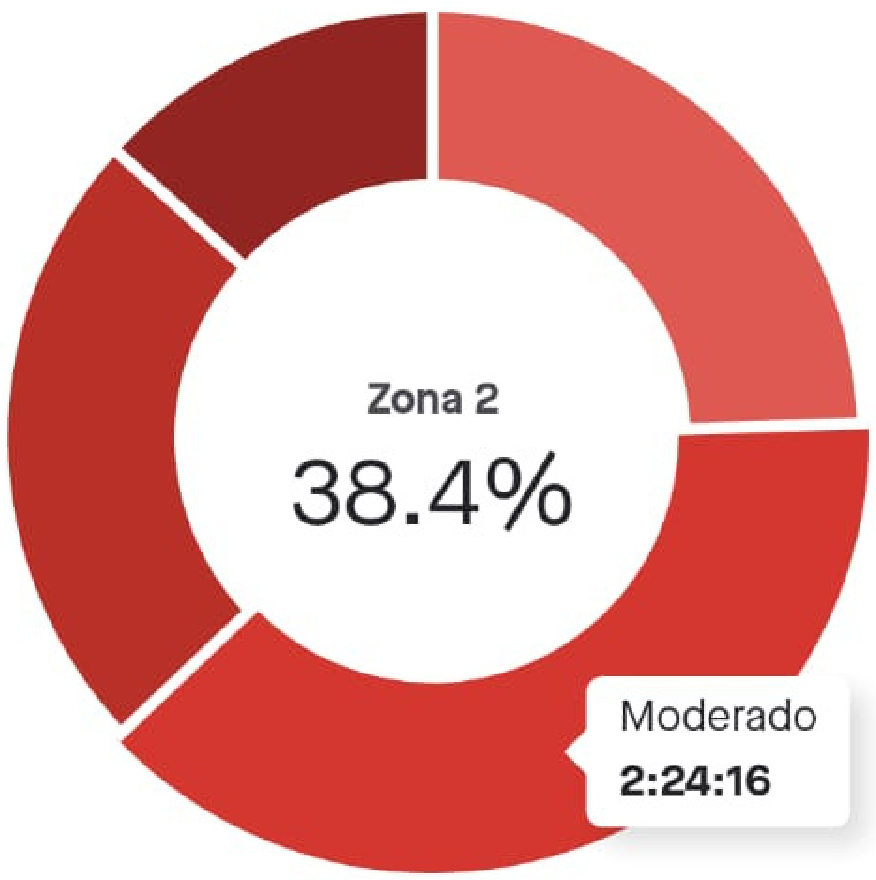
Frequência cardíaca



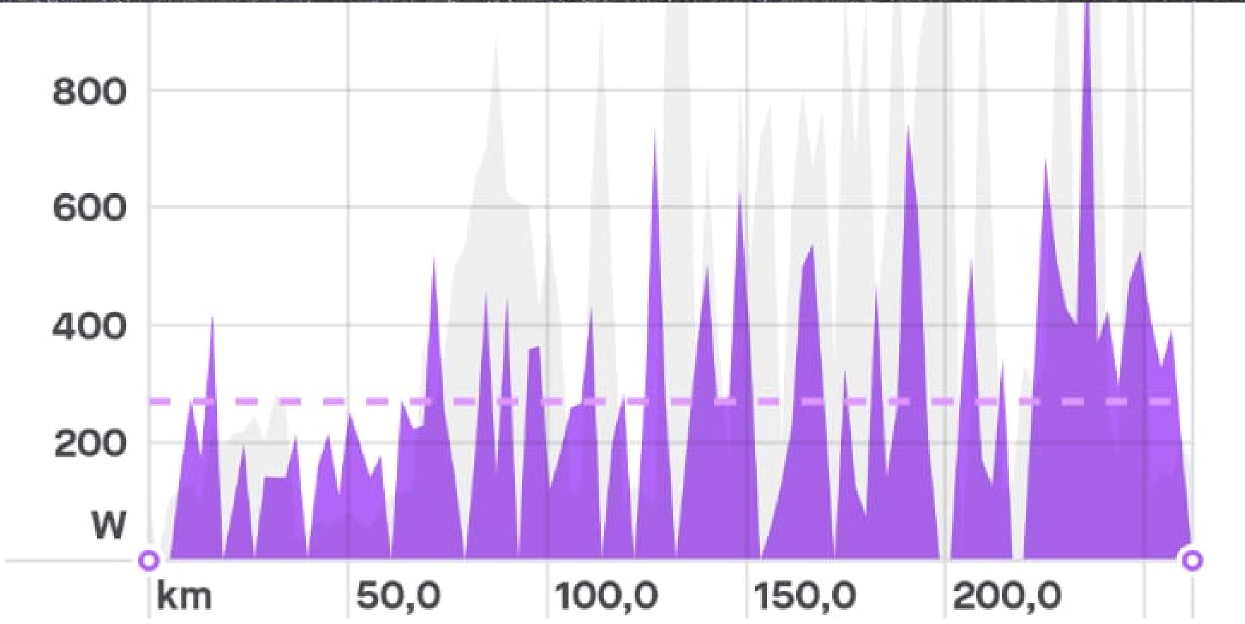
Freq. cardíaca média	138 bpm
Frequência cardíaca máxima	189 bpm

Zonas de frequência cardíaca

Com base na frequência cardíaca máxima dessa pessoa.



0-115	115-152	152-170	170-189	> 189

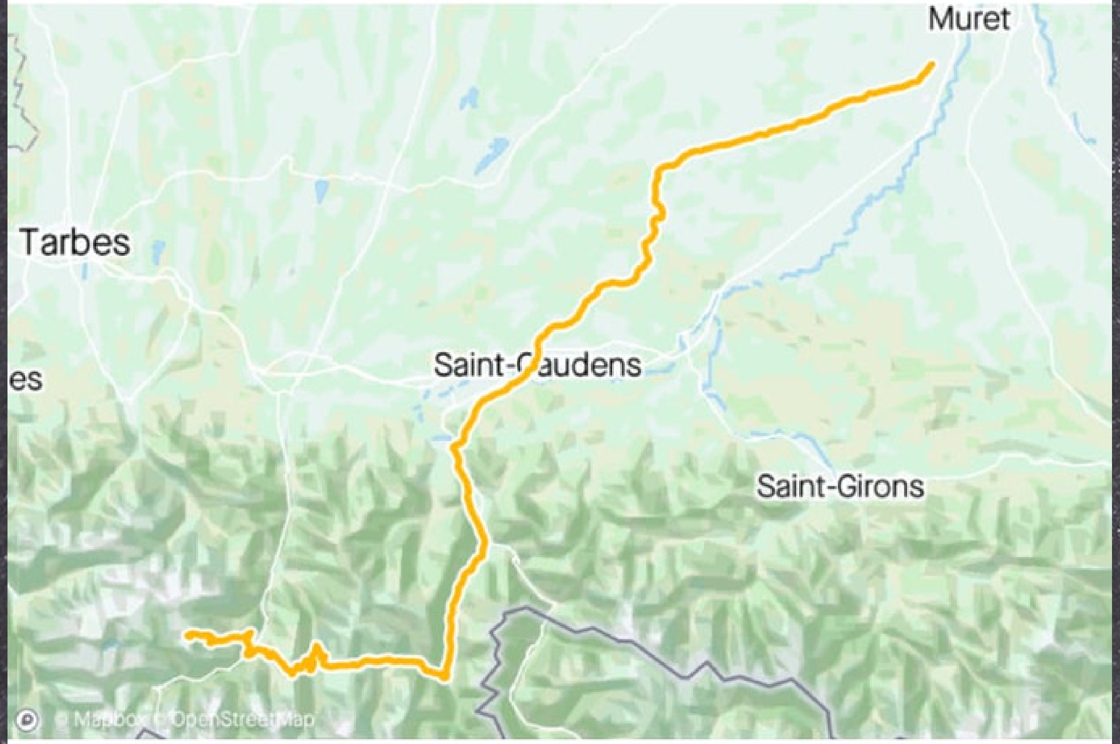


Potência média	270 W
Total de trabalho	6.082 kJ
Potência máxima	1.470 W
Média ponderada de potência	328 W

Tadej Pogačar Pogi

14 de julho de 2021 às 12:16 · Saint-Hilaire, França

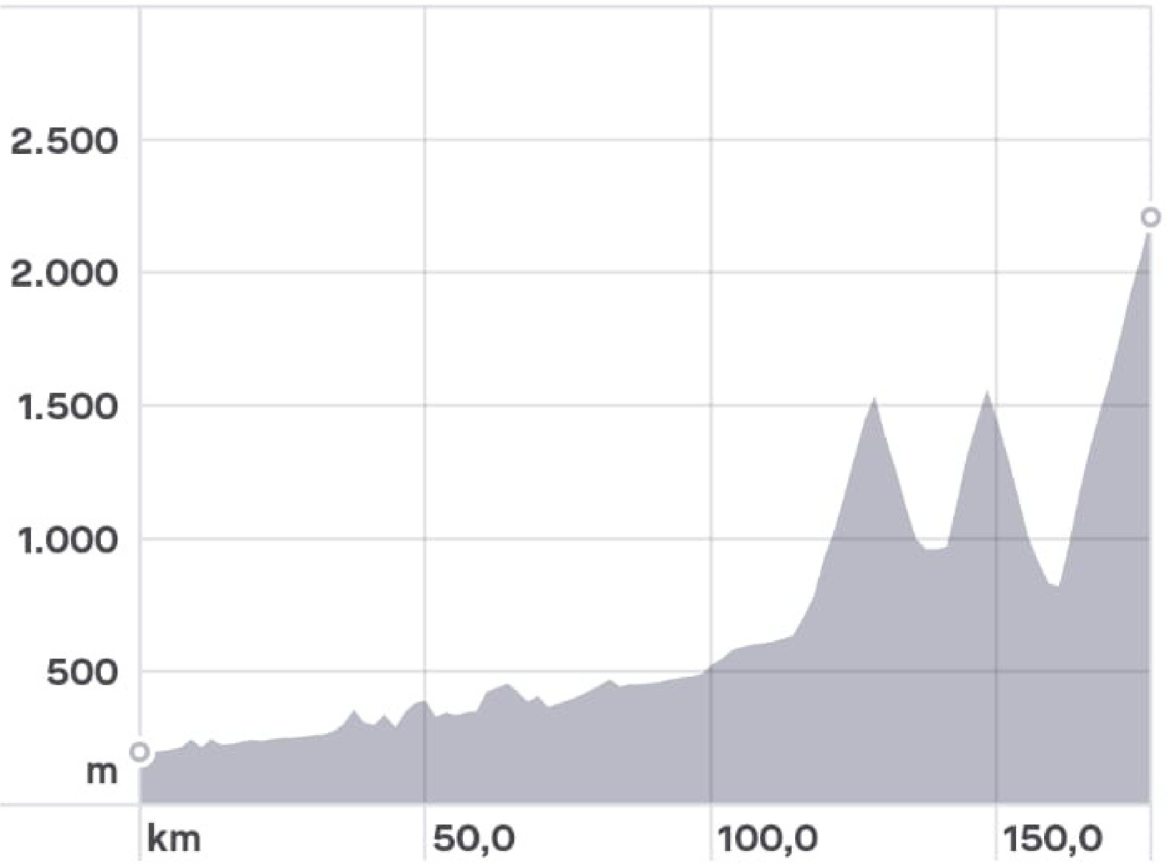
Lunch Ride



Tadej Pogačar é o King of the Day!

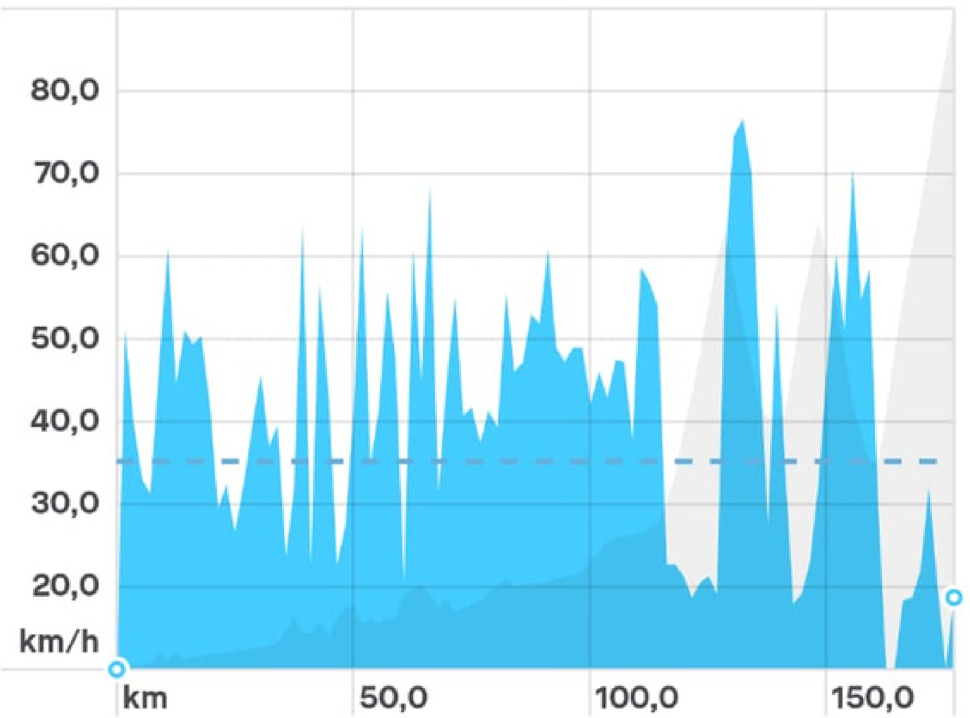
Distância	Ganho de elevação
177,63 km	4.173 m
Tempo de movimentação	**Velocidade média**
5:03:03	35,2 km/h
Cadência média	**Elevação máxima**
90 rpm	2.208 m

Elevação



Ganho de elevação	4.173 m
Elevação máxima	2.208 m

Velocidade



Velocidade média	35,2 km/h
Velocidade máx.	85,7 km/h
Tempo de movimentação	5:03:03
Tempo decorrido	5:03:44

OBRIGADA(O)