

- ¿Es necesario el entrenamiento de fuerza?
- ¿Por qué?
- ¿Qué determina el rendimiento en un deporte de resistencia?



Endurance exercise performance: the physiology of champions

Michael J. Joyner¹ and Edward F. Coyle²

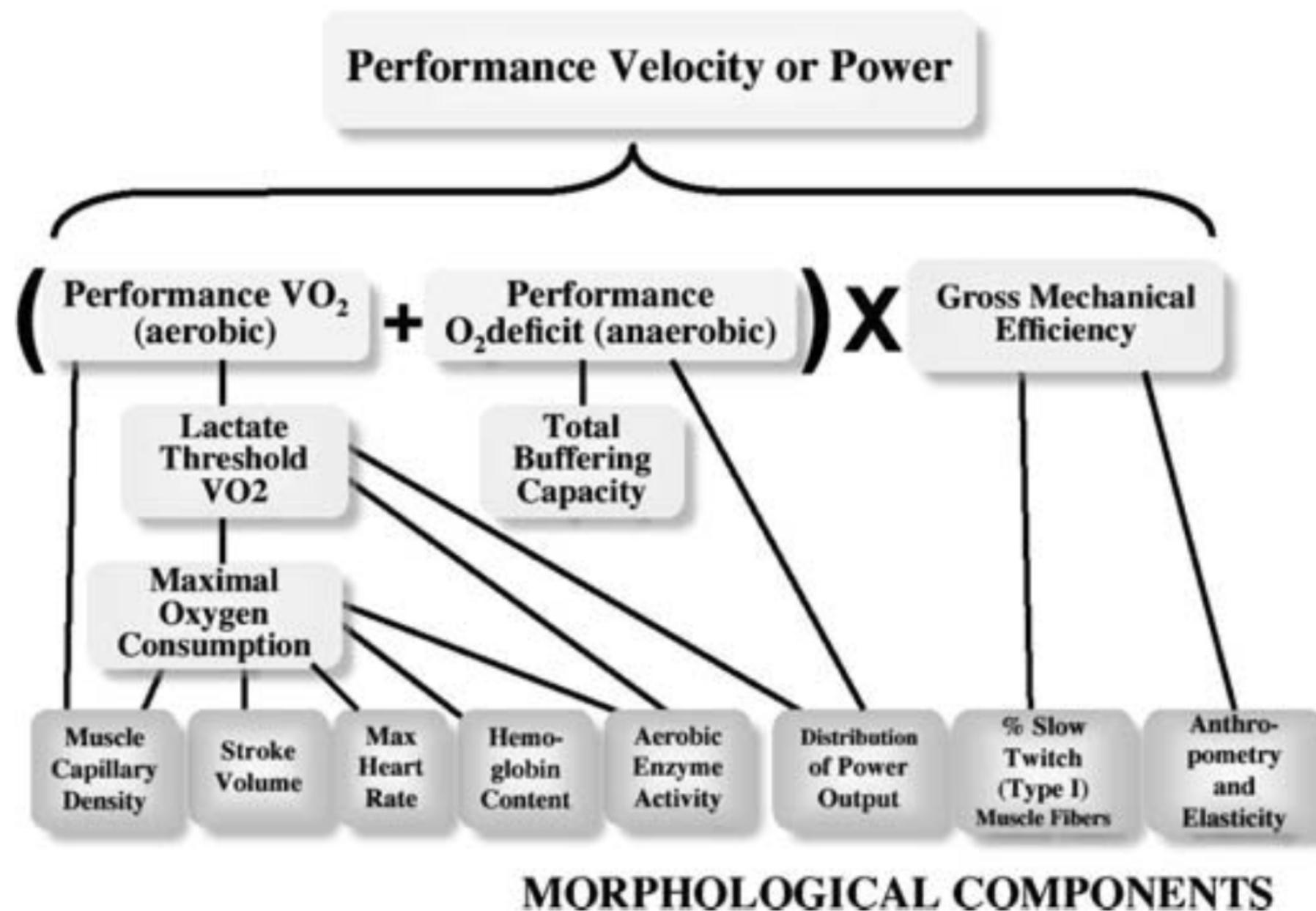


Figure 2. Overall schematic of the multiple physiological factors that interact as determinants of performance velocity or power output

This figure serves as the conceptual framework for the ideas discussed in this review.

Endurance training

LSD, tempo, intervals

Strength training

Maximal-, explosive- and reactive-strength
(incl. sprint / speed training)

Aerobic power & capacity

- O₂ transport
- O₂ utilization

Anaerobic power & capacity

- Glycolysis and lactic acid
- PCr store and utilization
- Buffer capacity

Neuromuscular capacity

- Morphological factors
- Musculotendinous stiffness
- Motor unit recruitment
- Intra/Intermuscular coordination

VO_{2max}

Lactate threshold

Economy

'Muscle power' factors
($\sqrt{\text{MART}}$)

$\sqrt{\text{VO}}_{2\text{max}}$

Endurance performance

Paavolainen et al., (1999); Baettie et al., (2014)



VO₂max

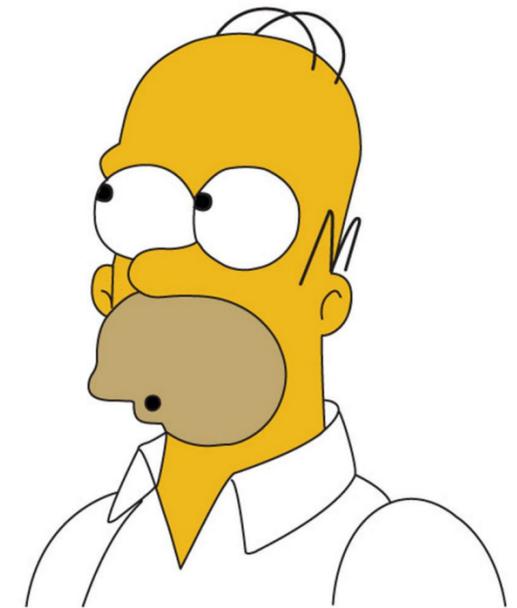
- **Poca evidencia de que el entrenamiento de fuerza deba usarse para mejorar esta variable. Efectos triviales con concurrente** ((Hickson et al., 1988; Bishop et al., 1999; Bastiaans et al., 2001; Levin et al., 2009; Rønnestad et al., 2010a, 2010b; Sunde et al., 2010; Aagaard et al., 2011))



UL/UAN/Vt2

Resultados contradictorios:

- **Pequeños cambios** ((Paavolainen et al., 1999; Hoff & Helgerud, 2002; Støren et al., 2008; Mikkola et al., 2011)
- **Grandes cambios** (Mikkola et al., 2007a, 2011; Guglielmo et al., 2009; Taipale et al., 2013)
- **Sin efectos** (Bishop et al., 1999; Sunde et al., 2010; Aagaard et al 2011)
- **Ningún estudio encontró efectos NEGATIVOS**



Economía

- **Mejoras tras Fza Máxima** (Johnston et al., 1997; Hoff & Helgerud, 2002; Millet et al., 2002; Storen et al., 2008; Guglielmo et al., 2009; Taipale et al., 2010)—8-14 semanas
- **Mejoras tras comb exp y max** Paavolainen et al., 1999; Spurrs et al., 2003; Turner et al., 2003; Saunders et al., 2006; Taipale et al., 2010). Mikkola et al. (2007a)

**2-3 sesiones
(mínimo-máximo)**



Maximal Leg-Strength Training Improves Cycling Economy in Previously Untrained Men

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TABLE 2. $\Delta\dot{V}O_2/\Delta WR$ ($\text{mL}\cdot\text{min}^{-1}\cdot\text{W}^{-1}$) values calculated between power outputs below the GET and when the power output was increased from below the GET to above the GET.

	Pretraining	Posttraining
Power outputs below GET		
30% GET to 60% GET	9.7 ± 0.6	10.3 ± 0.4
30% GET to 90% GET	10.4 ± 0.4	10.9 ± 1.2
60% GET to 90% GET	11.1 ± 0.5	11.4 ± 0.3
Power outputs below to above GET		
30% GET to 120% GET	11.3 ± 0.2	11.1 ± 0.2
60% GET to 120% GET	13.3 ± 0.2	$11.6 \pm 0.3^*$
90% GET to 120% GET	13.1 ± 0.6	$11.7 \pm 0.6^*$

Values presented are means \pm SEM. $\Delta\dot{V}O_2/\Delta WR$, change in O_2 uptake divided by the change in power output (economy); GET, gas-exchange threshold; % GET, power output at the indicated percentage of the power output achieved at GET.

*Significantly different from pretraining; $P < 0.05$.

MAXIMAL STRENGTH TRAINING IMPROVES CYCLING ECONOMY IN COMPETITIVE CYCLISTS

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TABLE 2. Physiological results in intervention and control groups.*†

Variables	Intervention group (I) (n = 8)			Control group (C) (n = 5)		
	Pre-training	Post-training	Difference	Pre-training	Post-training	Difference
Weight (kg)	72.5 ± 7.3	72.6 ± 7.1	0.1 ± 1.1	75.4 ± 11.1	75.2 ± 11.1	-0.2 ± 2.2
$\dot{V}O_{2max}$						
ml·kg ⁻¹ ·min ⁻¹	63.4 ± 6.0	63.9 ± 5.6	0.5 ± 2.3	58.7 ± 8.8	58.0 ± 10.8	-0.7 ± 3.3
ml·kg ^{-0.67} ·min ⁻¹	260.0 ± 24.0	262.6 ± 24.6	2.6 ± 10.9	244.3 ± 41.6	241.7 ± 51.9	-2.6 ± 16.1
L·min ⁻¹	4.6 ± 0.6	4.6 ± 0.6	-0.1 ± 0.2	4.5 ± 1.1	4.4 ± 1.3	-0.3 ± 0.4
LT						
% $\dot{V}O_{2max}$	77.3 ± 4.9	74.7 ± 4.5	-2.6 ± 2.2	83.8 ± 5.3	84.4 ± 5.9	0.6 ± 1.8
W	243 ± 44	248 ± 42	5.0 ± 9.3	258 ± 74	262 ± 78	4.6 ± 11.7
MAP						
time (s)	360 ± 101	422 ± 115	62 ± 59‡	567 ± 214	597 ± 244	30 ± 39
CE 70						
W	217 ± 26	232 ± 36	15 ± 17‡	215 ± 57	216 ± 65	1 ± 13
ml·kg ⁻¹ ·W ⁻¹	0.205 ± 0.022	0.199 ± 0.023	-0.007 ± 0.003‡§	0.196 ± 0.033	0.195 ± 0.033	-0.001 ± 0.002
ml·kg ^{-0.67} ·W ⁻¹	0.840 ± 0.065	0.800 ± 0.078	-0.04 ± 0.03‡§	0.815 ± 0.102	0.804 ± 0.091	-0.01 ± 0.01
ml·W ⁻¹	14.75 ± 0.43	14.04 ± 0.79	-0.7 ± 0.6‡§	14.71 ± 0.6	14.46 ± 0.63	-0.2 ± 0.2‡
< _C (b·min ⁻¹)	147 ± 12	143 ± 9	-4 ± 6	142 ± 15	141 ± 11	-1 ± 7
WE (%)	21.1 ± 0.7	22.1 ± 1.2	1.0 ± 1.0‡§	21.5 ± 0.9	21.8 ± 0.7	0.3 ± 0.3‡
RPM	95 ± 10	94 ± 10	-1 ± 5	95 ± 5	94 ± 5	-1 ± 5
Strength						
1RM Squat 90° (kg)	155.0 ± 40.6	177.5 ± 50.7	22.5 ± 19.7‡§	151.0 ± 36.0	154.0 ± 39.3	3.0 ± 6.7
RFD Squat 90° (W)	802.6 ± 141.0	936.6 ± 170.0	134.0 ± 171.6‡§	872.4 ± 201.4	849.8 ± 202.6	-22.6 ± 48.8
Training						
Tot. cycling (min)	311 ± 318	273 ± 288	-39 ± 45‡§	361 ± 321	401 ± 326	40 ± 46‡
Tot. training (min)	600 ± 212	588 ± 208	-12 ± 4	589 ± 316	599 ± 318	10 ± 6

* $\dot{V}O_{2max}$ = maximal oxygen consumption; LT = lactate threshold; MAP = maximal aerobic power; <_C = heart rate; CE 70 = cycling economy measured on cycle ergometer at 70% of $\dot{V}O_{2max}$; WE = work efficiency; W = watts; RPM = cadence in rounds per minute; 1RM = 1 repetition maximum; RFD = rate of force development; Tot. cycling = total cycling time in minutes per week; Tot. training = total training time in minutes per week.

†Values are mean ± SD.

‡p < 0.05, significant difference from before to after intervention.

§p < 0.05, significantly different from Δ control value.

Otros factores

- **Tiempo hasta la extenuación** (Hickson et al., 1988; Millet et al., 2002; Støren et al., 2008; Sunde et al., 2010; Rønnestad et al., 2010a, 2010b; Taipale et al., 2010, 2013; Mikkola et al., 2011)---
Solo Fza máxima (no expl)
- **Pmax** (Rønnestad et al. 2010a)



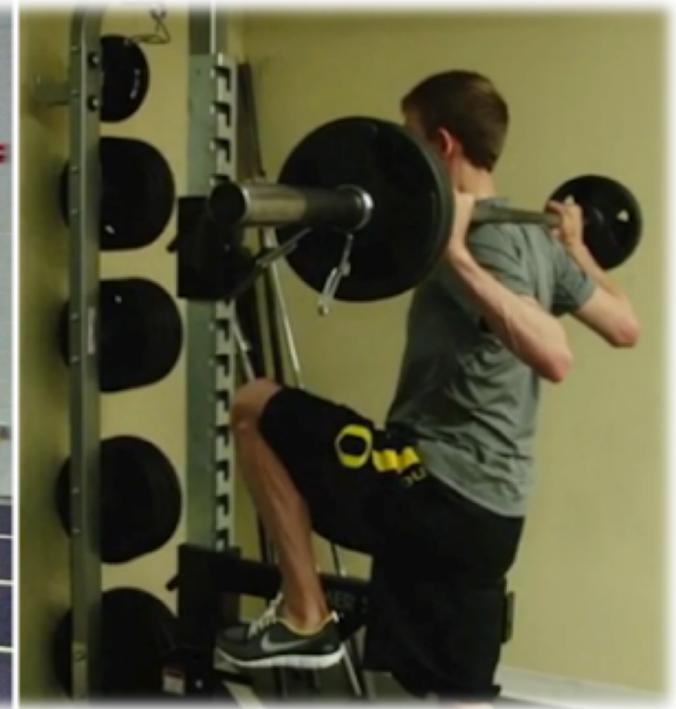
Rendimiento

Resultados contradictorios:

- **Mejoras** (Hickson et al., 1988; Koninckx et al., 2010; Rønnestad et al., 2010b; Aagaard et al., 2011)
- **Efecto trivial** (Bishop et al., 1999; Bastiaans et al., 2001; Levin et al., 2009)

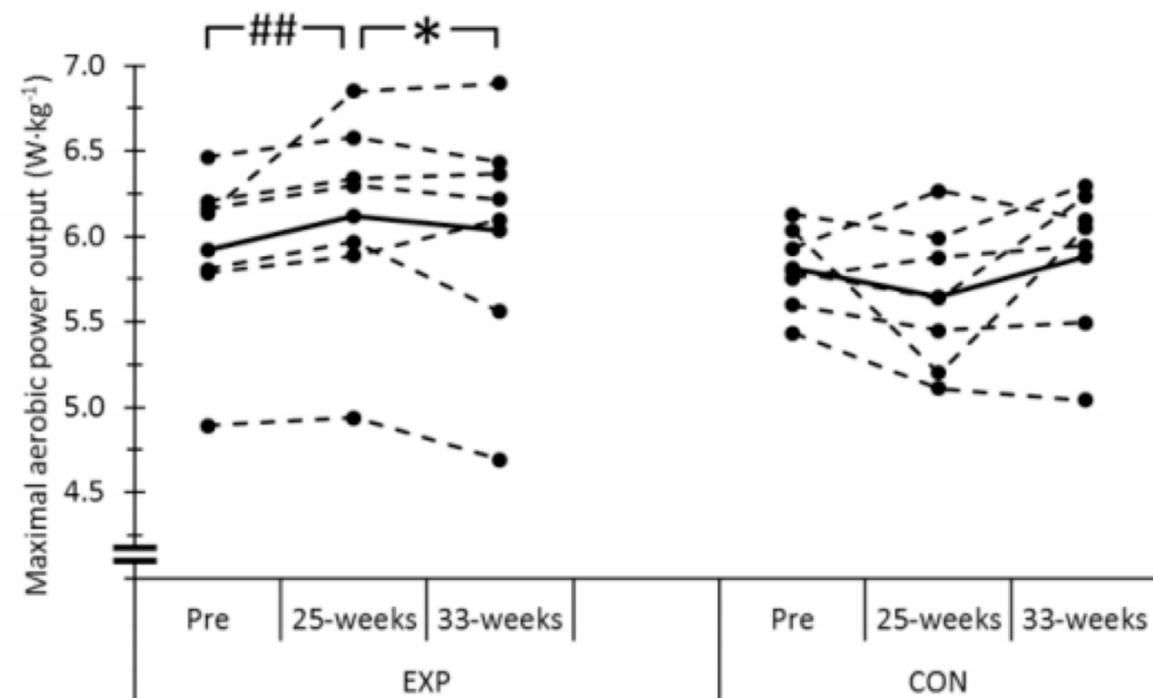
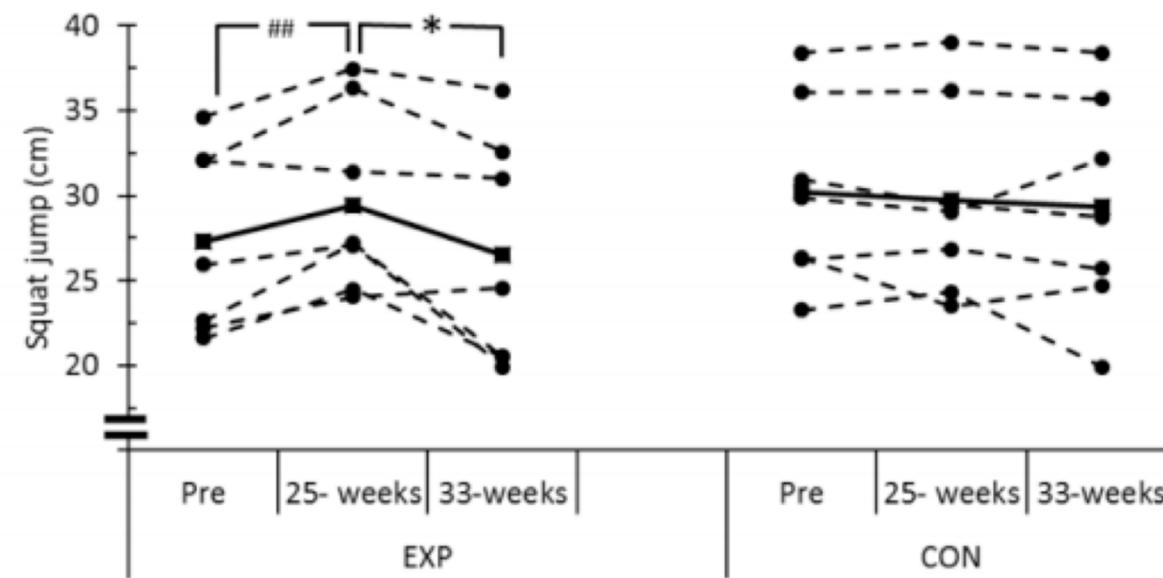
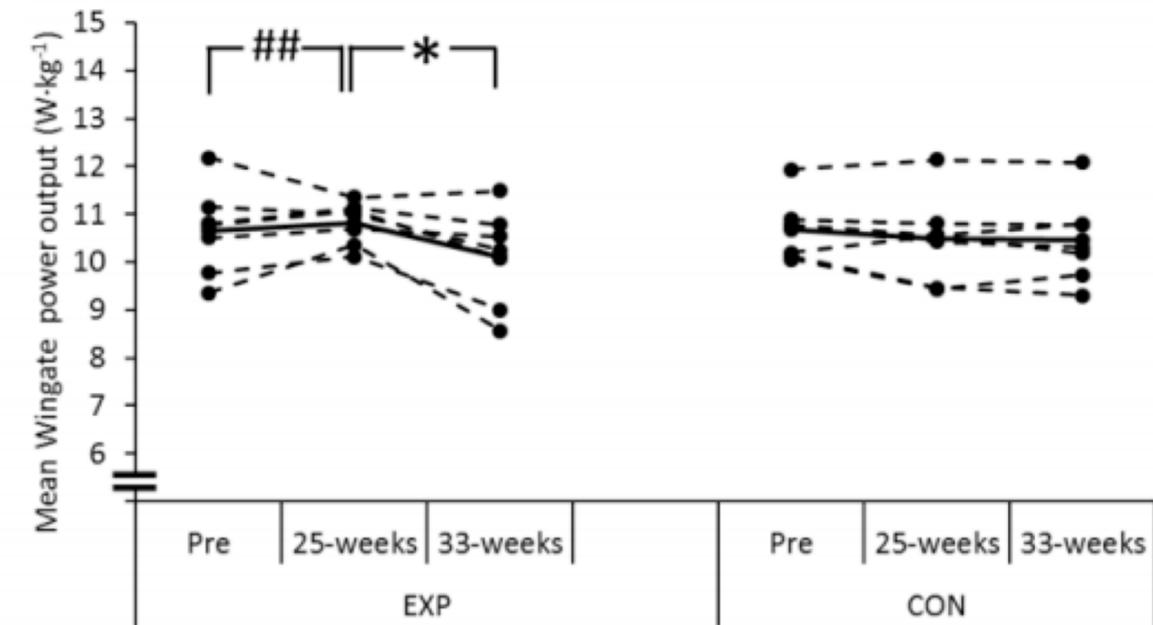
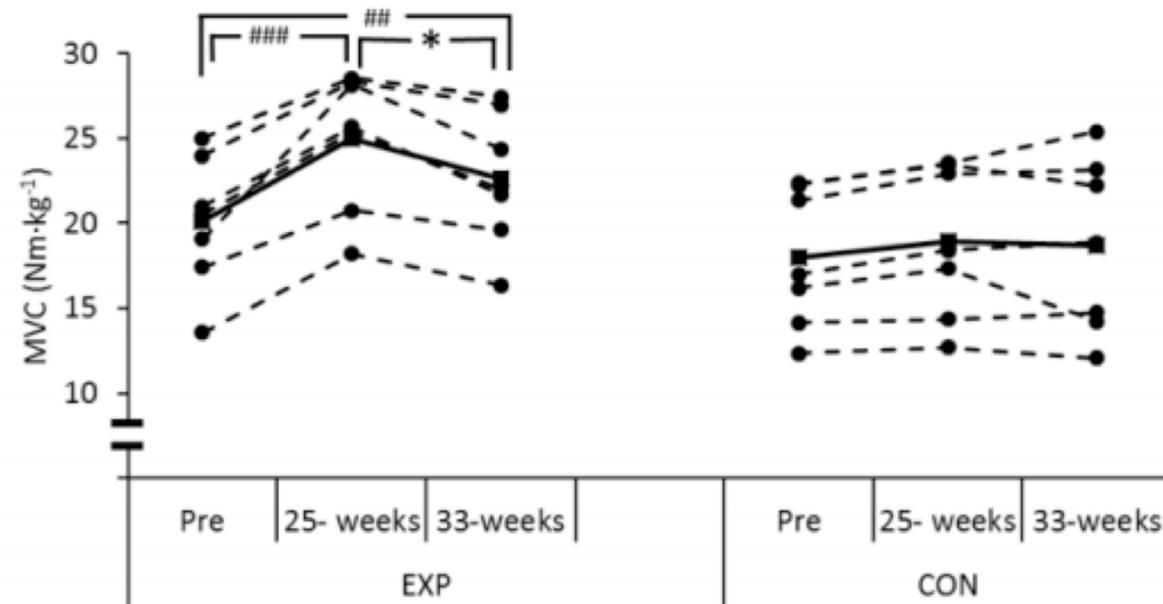
En los estudios con mayor mejora: **Multiarticular + Comb MAX y Expl**





Article Title: In-Season Strength Training Cessation Impairs Performance Variables in Elite Cyclists

Authors: Bent R. Rønnestad¹, Joar Hansen¹, Ivana Hollan², Matt Spencer³, and Stian Ellefsen¹



In-season strength maintenance training increases well-trained cyclists' performance

Bent R. Rønnestad · Ernst Albin Hansen ·
 Truls Raastad

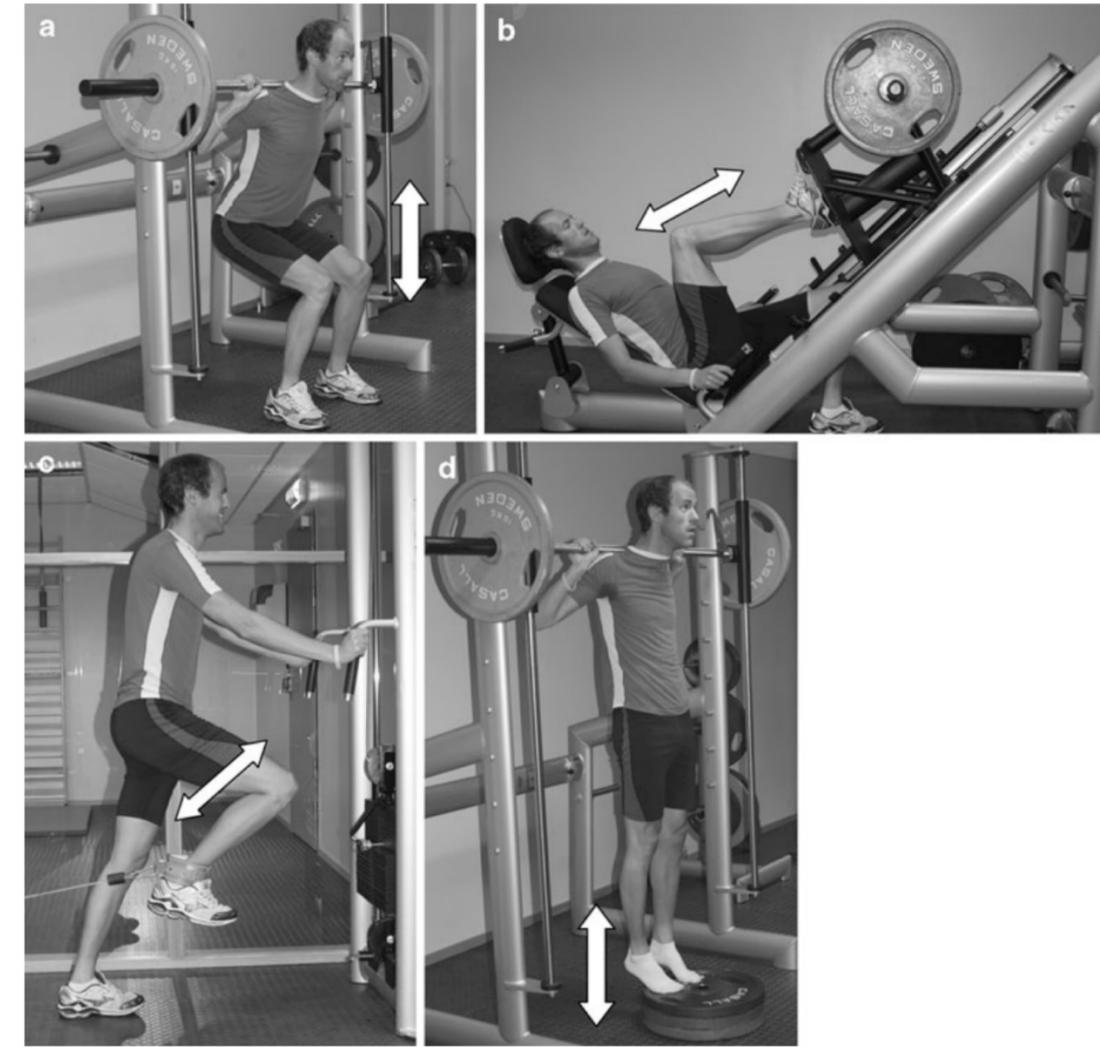


Table 1 Strength training program for the cyclists who performed heavy strength training

	Preparatory period						Competition period
	Week 1–3		Week 4–6		Week 7–12		Week 13–25
	1. Bout	2. Bout	1. Bout	2. Bout	1. Bout	2. Bout	1. Bout
Half squat	3 × 10RM	3 × 6RM	3 × 8RM	3 × 5RM	3 × 6RM	3 × 4RM	2 × 5 reps@80–85% of 1RM
One-legged leg press	3 × 10RM	3 × 6RM	3 × 8RM	3 × 5RM	3 × 6RM	3 × 4RM	2 × 5 reps@80–85% of 1RM
One-legged hip flexion	3 × 10RM	3 × 6RM	3 × 8RM	3 × 5RM	3 × 6RM	3 × 4RM	1 × 6RM
Ankle plantar flexion	3 × 10RM	3 × 6RM	3 × 8RM	3 × 5RM	3 × 6RM	3 × 4RM	1 × 6RM

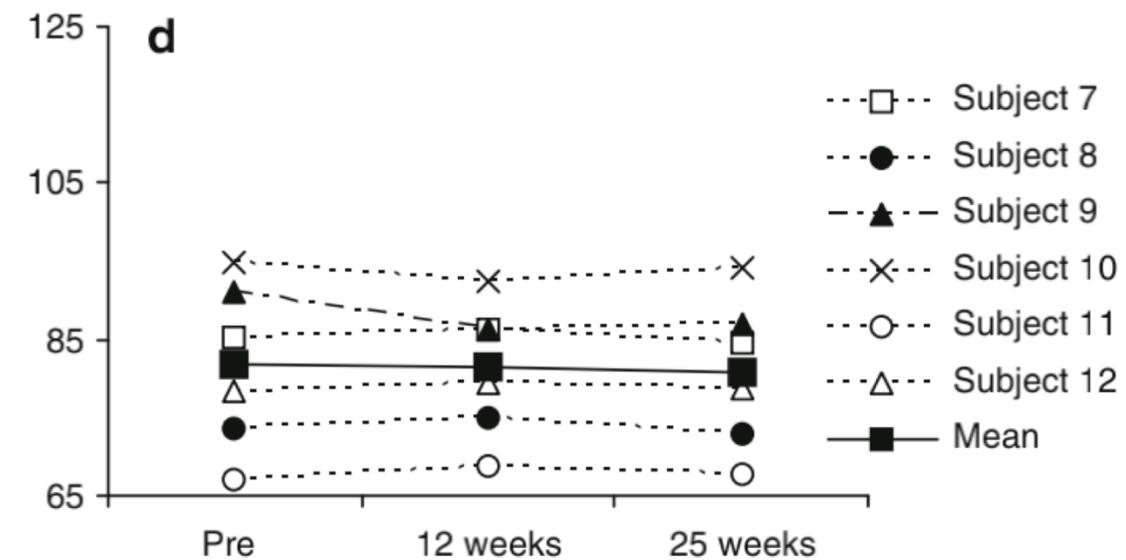
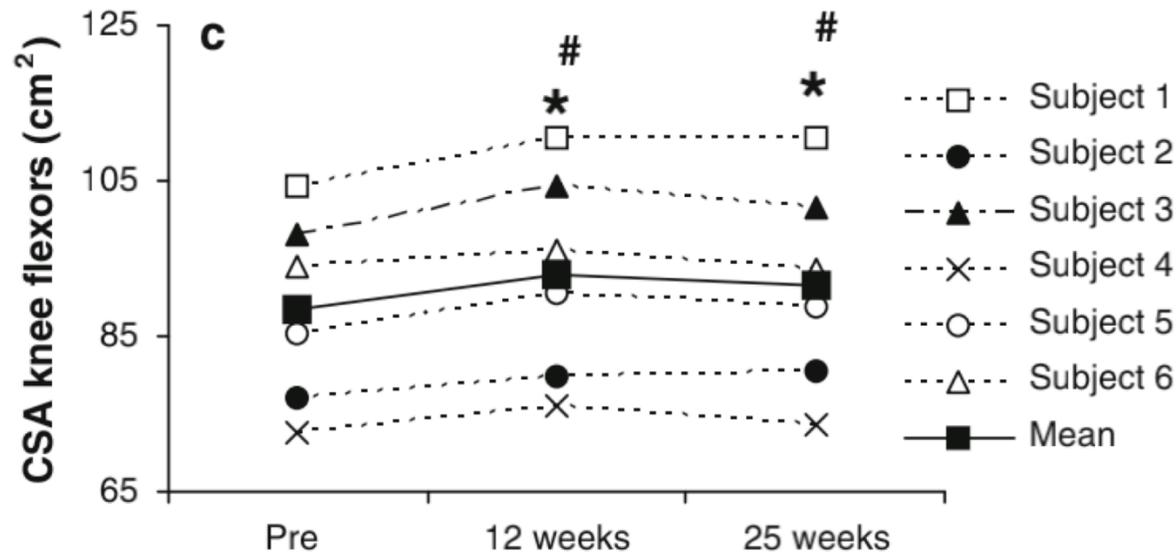
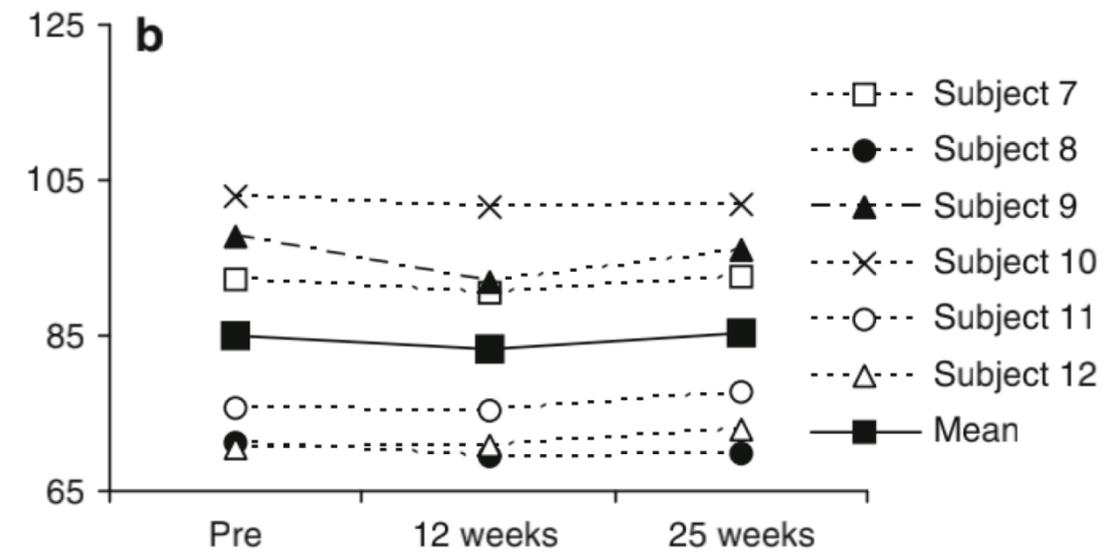
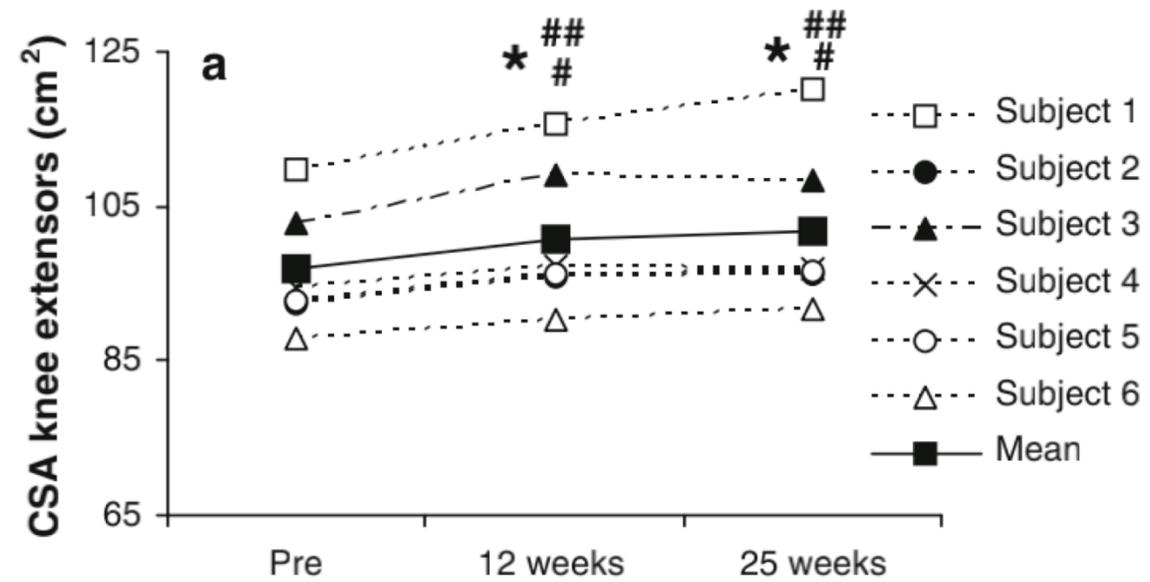


Fig. 2 Thigh muscle cross-sectional area (CSA) separated into area of knee extensors (*upper panels*) and knee flexors (*lower panels*) before the preparatory period (Pre), after the preparatory period (12 weeks), and 13 weeks into the competition period (25 weeks). One group of cyclists added heavy strength training to their endurance

training ($E + S$; $n = 6$, **a** and **c**) while cyclists in the other group simply performed their usual endurance training (E ; $n = 6$, **b** and **d**). Mean and each individual data points are presented. *Larger than at Pre ($p < 0.05$). #The relative change from Pre is larger than in E ($p < 0.05$). ##Larger than in E ($p < 0.01$). ###Larger than in E ($p < 0.05$)

Røonestad et al. (2010)

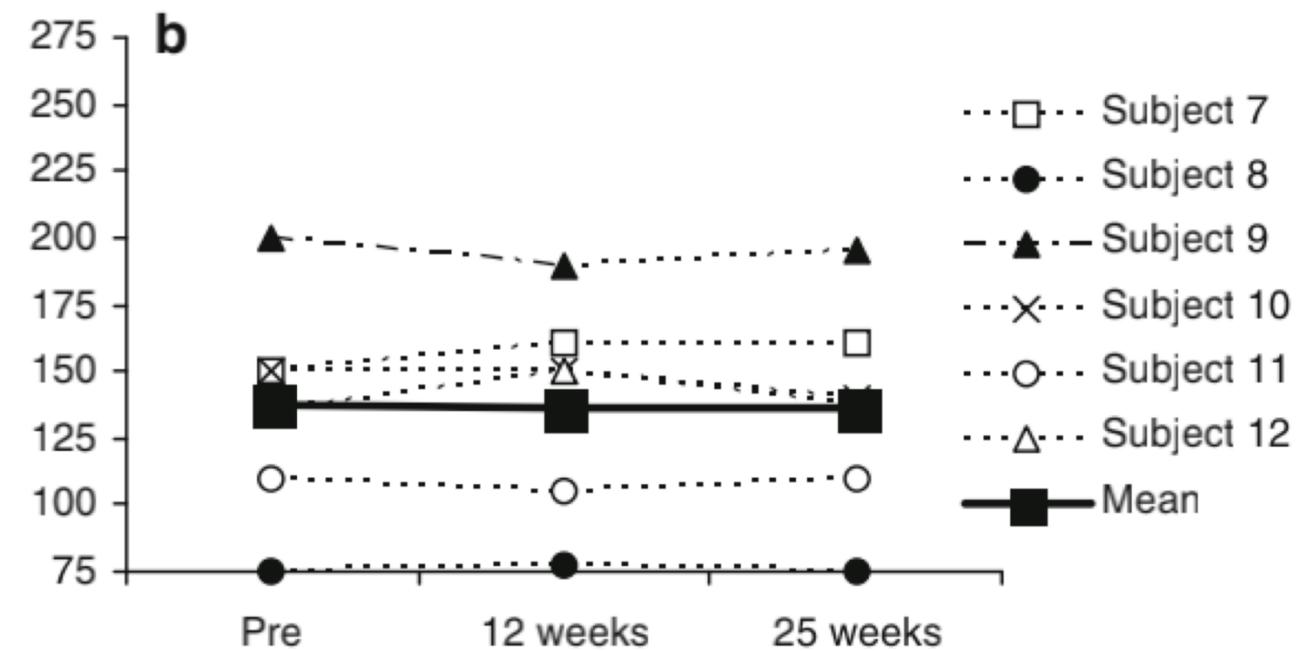
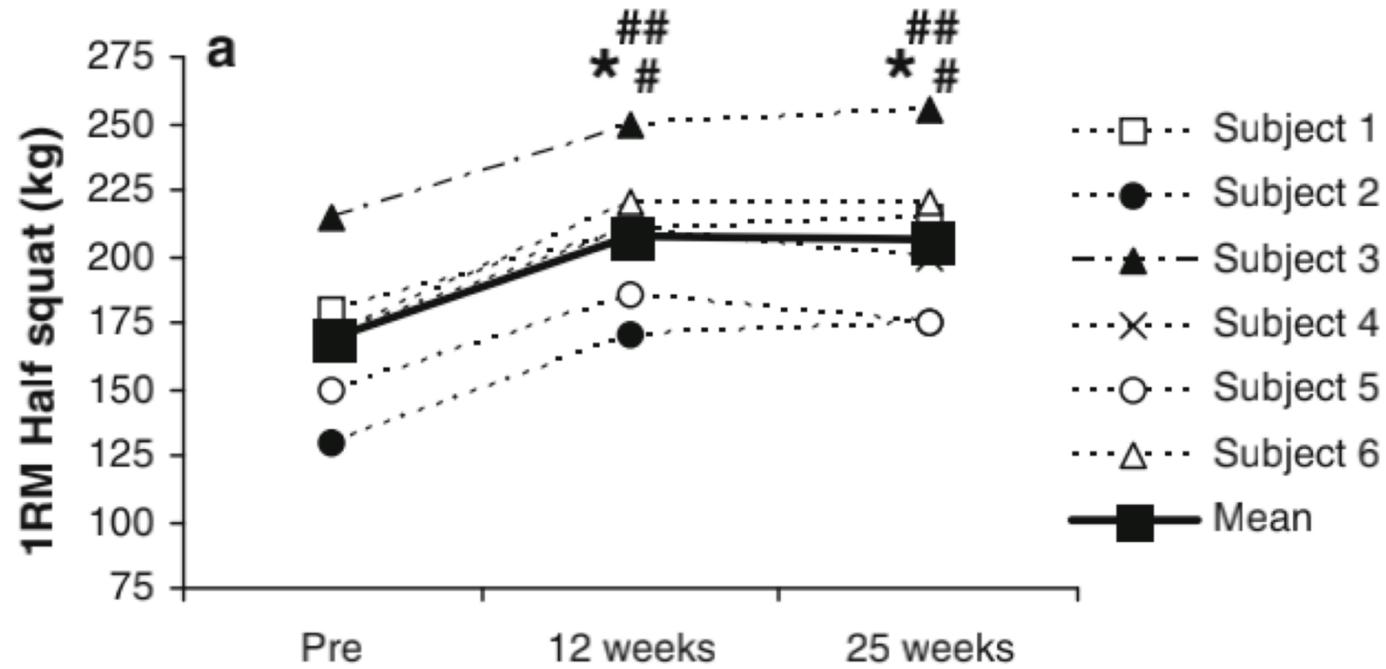


Fig. 3 1RM in half squat before (Pre), after the 12 week preparatory period (12 weeks), and 13 weeks into the competition period (25 weeks). For explanation of $E + S$ (a) and E (b), the reader is

referred to Fig. 2. Mean and each individual data points are presented. *Larger than at Pre ($p < 0.01$). #The relative change from Pre is larger than in E ($p < 0.01$). ##Larger than in E ($p < 0.01$)

Table 2 Results from the incremental cycle test for measurement of maximal oxygen consumption before (Pre), after the preparatory period (12 weeks), and 13 weeks into the competition period (25 weeks) in the group that had heavy strength training added to their endurance training (*E + S*) and the group which performed usual endurance training only (*E*)

	<i>E + S</i> (<i>n</i> = 6)			<i>E</i> (<i>n</i> = 6)		
	Pre	12 weeks	25 weeks	Pre	12 weeks	25 weeks
VO_{2max} (L min ⁻¹)	5.20 ± 0.28	5.53 ± 0.36*	5.65 ± 0.36*,§	5.00 ± 0.45	5.28 ± 0.42*	5.27 ± 0.45*
(ml kg ⁻¹ min ⁻¹)	65.2 ± 2.2	69.0 ± 2.4*	73.9 ± 3.2*,§	67.3 ± 2.7	72.5 ± 2.7*	73.4 ± 3.1*
W_{max} (W)	420 ± 15	442 ± 22	454 ± 19*,#	401 ± 37	412 ± 34	399 ± 33
RER	1.10 ± 0.01	1.07 ± 0.02	1.06 ± 0.01	1.08 ± 0.01	1.06 ± 0.01	1.05 ± 0.01
HR_{max} (beats min ⁻¹)	186 ± 4	187 ± 4	186 ± 4	183 ± 3	183 ± 3	182 ± 4
[La ⁻] (mmol l ⁻¹)	12.9 ± 0.7	14.1 ± 0.6	13.6 ± 0.8	12.0 ± 1.3	12.4 ± 0.8	12.0 ± 0.8
RPE	19.2 ± 0.2	19.0 ± 0.3	19.0 ± 0.0	19.0 ± 0.3	18.7 ± 0.2	18.7 ± 0.4

Values are mean ± SE

BM body mass; VO_{2max} maximal oxygen consumption; *RER* respiratory exchange ratio; HR_{max} maximal heart rate; [La⁻] blood lactate concentration; *RPE* rate of perceived exertion

* Larger than at Pre (*p* < 0.05)

§ Larger than at 12 weeks (*p* < 0.05)

The relative change from Pre is larger than in *E* (*p* < 0.05)

Table 3 Results from the Wingate test before (Pre), after the preparatory period (12 weeks), and 13 weeks into the competition period (25 weeks)

	<i>E + S</i> (<i>n</i> = 6)			<i>E</i> (<i>n</i> = 6)		
	Pre	12 weeks	25 weeks	Pre	12 weeks	25 weeks
Peak power output (W)	1,470 ± 51	1,557 ± 63 [§]	1,557 ± 55 ^{§,*}	1,178 ± 123	1,162 ± 140	1,157 ± 157
Peak power output, body mass-adjusted (W kg ⁻¹)	18.5 ± 0.4	19.5 ± 0.8	19.9 ± 0.8 ^{§,*}	15.7 ± 1.1	15.8 ± 1.3	16.0 ± 1.6
Mean power output (W)	828 ± 33	814 ± 29	805 ± 39	696 ± 69	683 ± 64	667 ± 68
Mean power output, body mass-adjusted (W kg ⁻¹)	10.2 ± 0.3	10.2 ± 0.3	10.2 ± 0.4	9.3 ± 0.6	9.4 ± 0.6	9.3 ± 0.7
Fatigue index (W s ⁻¹)	34.0 ± 1.2	38.0 ± 2.0 ^{#,§}	36.3 ± 3.1	25.6 ± 3.4	24.4 ± 3.8	24.6 ± 4.4

Røonestad et al. (2010)

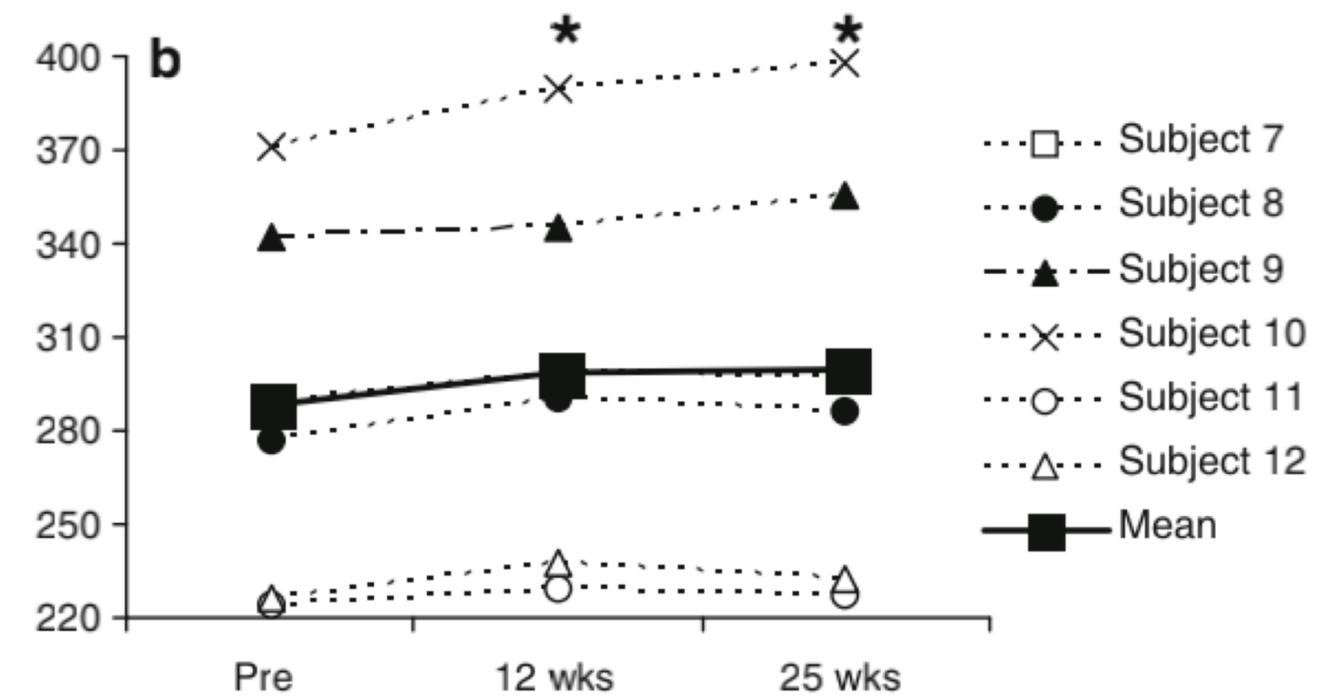
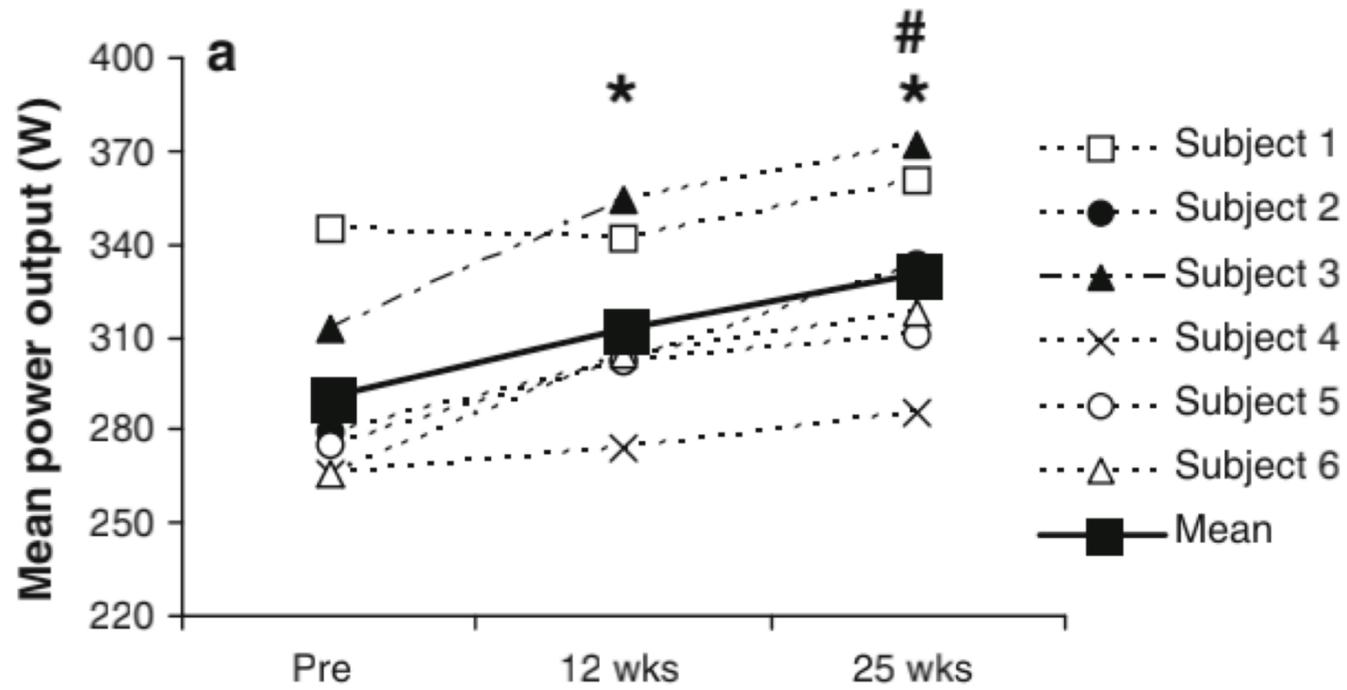


Fig. 5 Mean power output (W) during the 40-min all-out trial before (Pre), at the end of the preparatory period (12 weeks), and 13 weeks into the competition period (25 weeks). For explanation of

E + S (**a**) and *E* (**b**), the reader is referred to Fig. 2. Mean and each individual data points are presented. *Larger than at Pre ($p < 0.05$). #The relative change from Pre is larger than in *E* ($p < 0.01$)

Strength training improves performance and pedaling characteristics in elite cyclists

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Table 1. Duration (in hours per week) of the endurance training performed during the 10-week strength development phase (week 1–10) and the 15-week strength maintenance period (week 11–15) in the group that performed endurance and strength training (ES) and the group that performed only endurance training (E)

Intensity zone	ES		E	
	Week 1–10	Week 11–25	Week 1–10	Week 11–25
Intensity zone I (60–82% of HR _{max})	7.9 ± 2.0	12.3 ± 3.1	10.1 ± 2.6	13.4 ± 3.7
Intensity zone II (83–87% of HR _{max})	1.2 ± 0.6	1.4 ± 0.9	1.1 ± 0.5	1.2 ± 0.6
Intensity zone III (88–100% of HR _{max})	0.7 ± 0.4	0.8 ± 0.4	0.6 ± 0.4	0.7 ± 0.4
Heavy strength training	1.4 ± 0.1	0.6 ± 0.1	0	0
Total training time	11.3 ± 1.5	15.2 ± 3.1	11.7 ± 3.1	15.3 ± 3.9

Values are mean ± SD.
HR_{max}, maximal heart rate.

Table 2. Data from the maximal oxygen consumption (VO_{2max}) and Wingate tests before (Pre) and after the intervention period (Post) in the endurance and strength training group (ES) and the endurance training group (E)

	ES (n = 9)		E (n = 7)	
	Pre	Post	Pre	Post
VO _{2max} test				
VO _{2max} (mL kg ⁻¹ min ⁻¹)	78 ± 6	80 ± 6	73 ± 5	75 ± 7
HR _{peak} (beats·min ⁻¹)	197 ± 6	197 ± 7	194 ± 6	194 ± 5
[La ⁻] (mmol L ⁻¹)	13.3 ± 2.0	13.7 ± 1.8	11.7 ± 2.1	11.1 ± 2.2
RPE	19 ± 1	19 ± 1	19 ± 1	19 ± 1
Wingate test				
Peak Wingate power (W kg ⁻¹)	23.6 ± 2.9	24.2 ± 3.4*	22.9 ± 2.4	22.6 ± 1.7
Mean Wingate power (W kg ⁻¹)	10.9 ± 0.9	10.9 ± 1.1	10.7 ± 0.7	10.5 ± 0.9

*Tendency toward being larger than Pre (*P* = 0.07).

HR_{peak}, peak heart rate; [La⁻], blood lactate concentration; RPE, rate of perceived exertion.

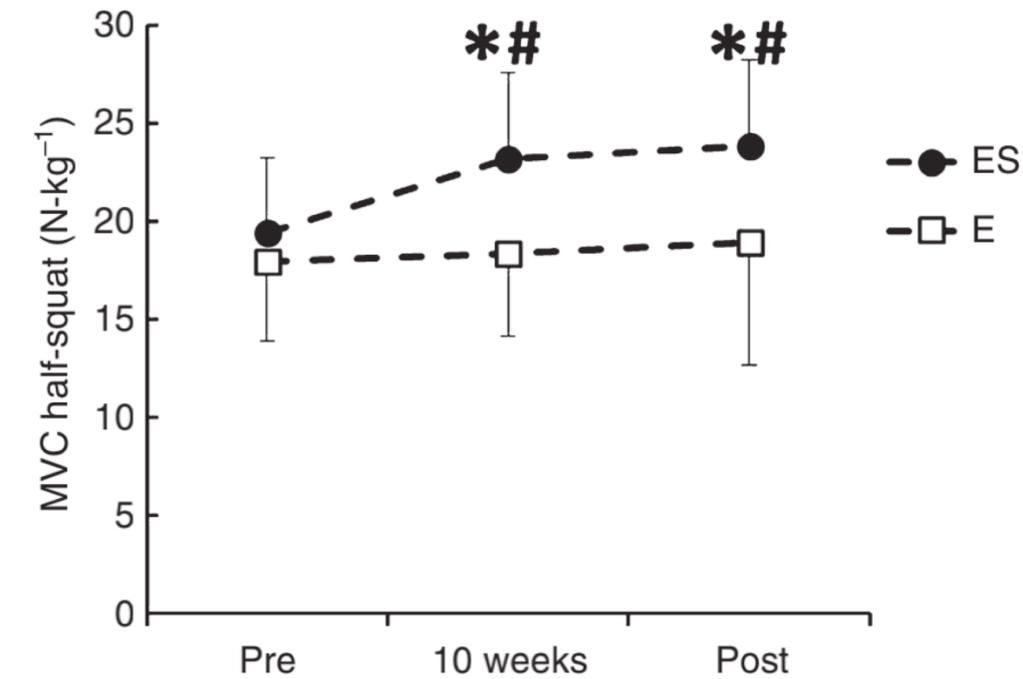
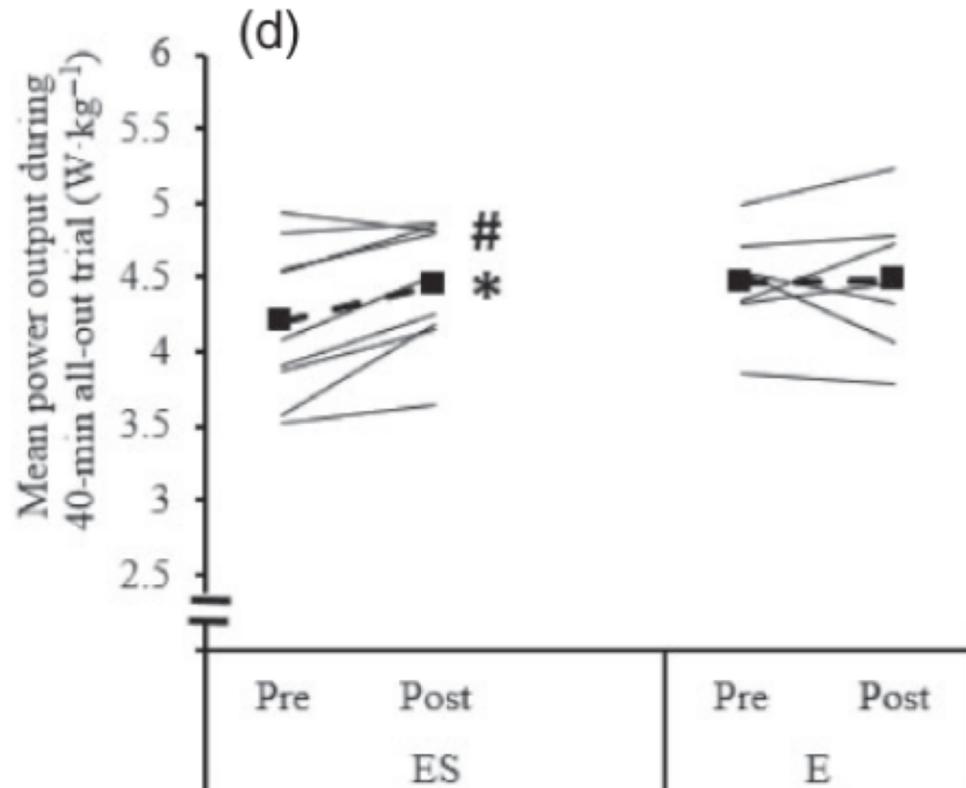
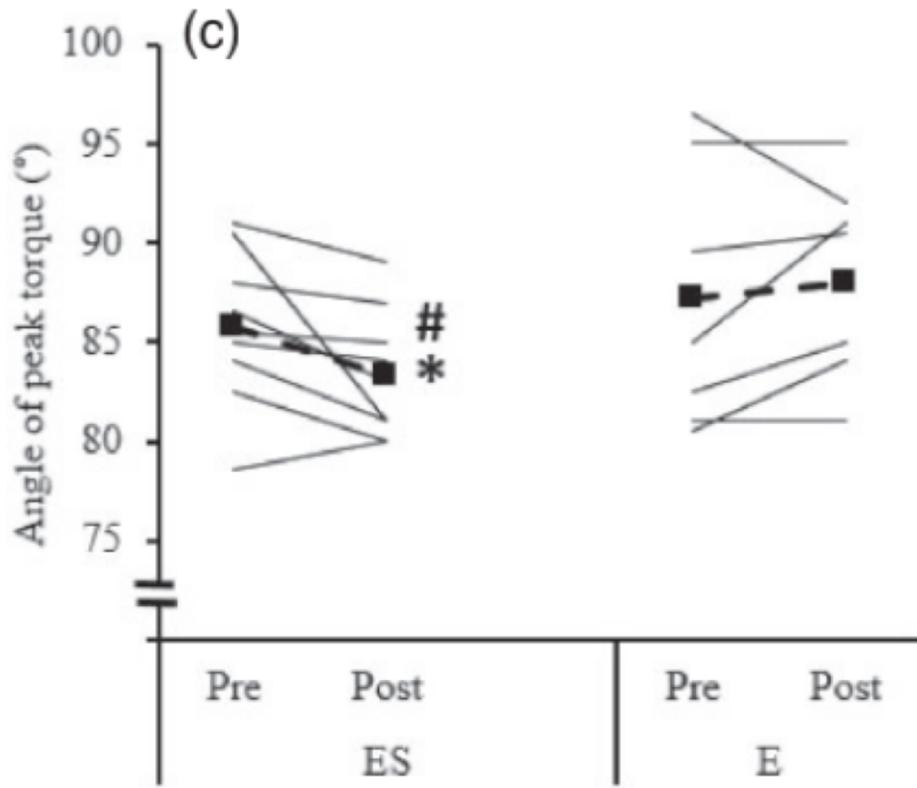
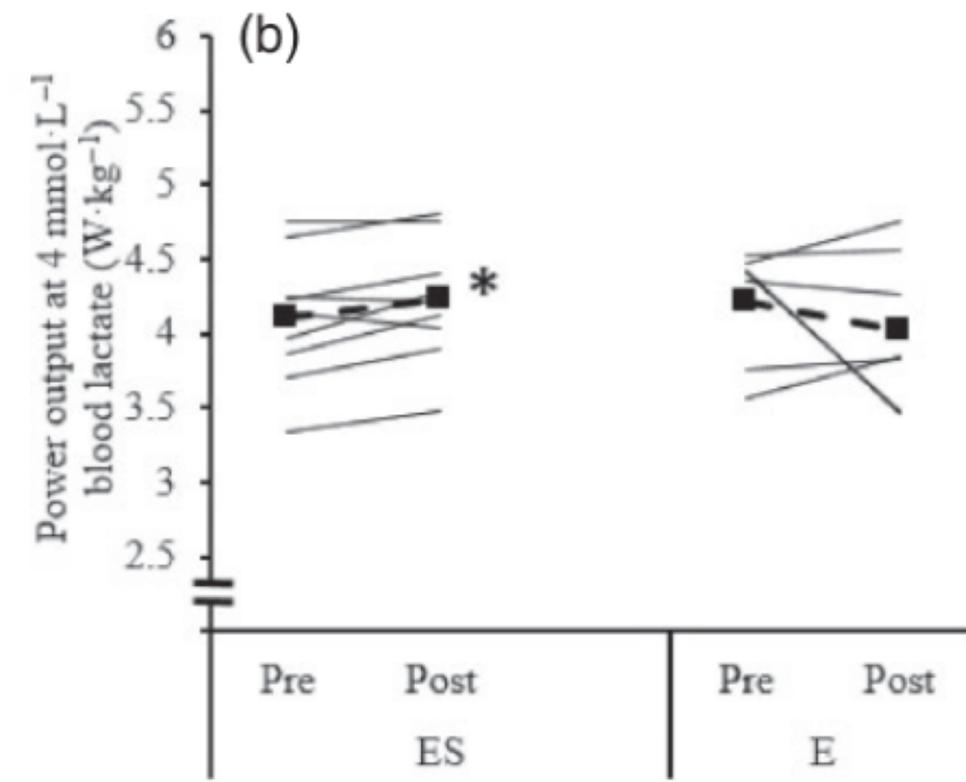
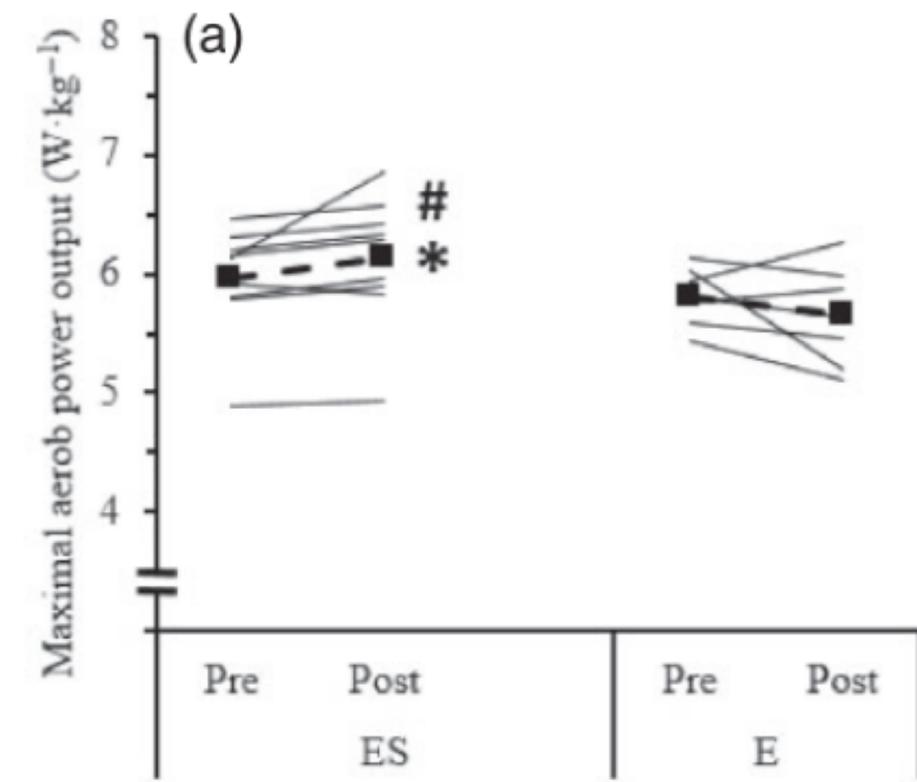


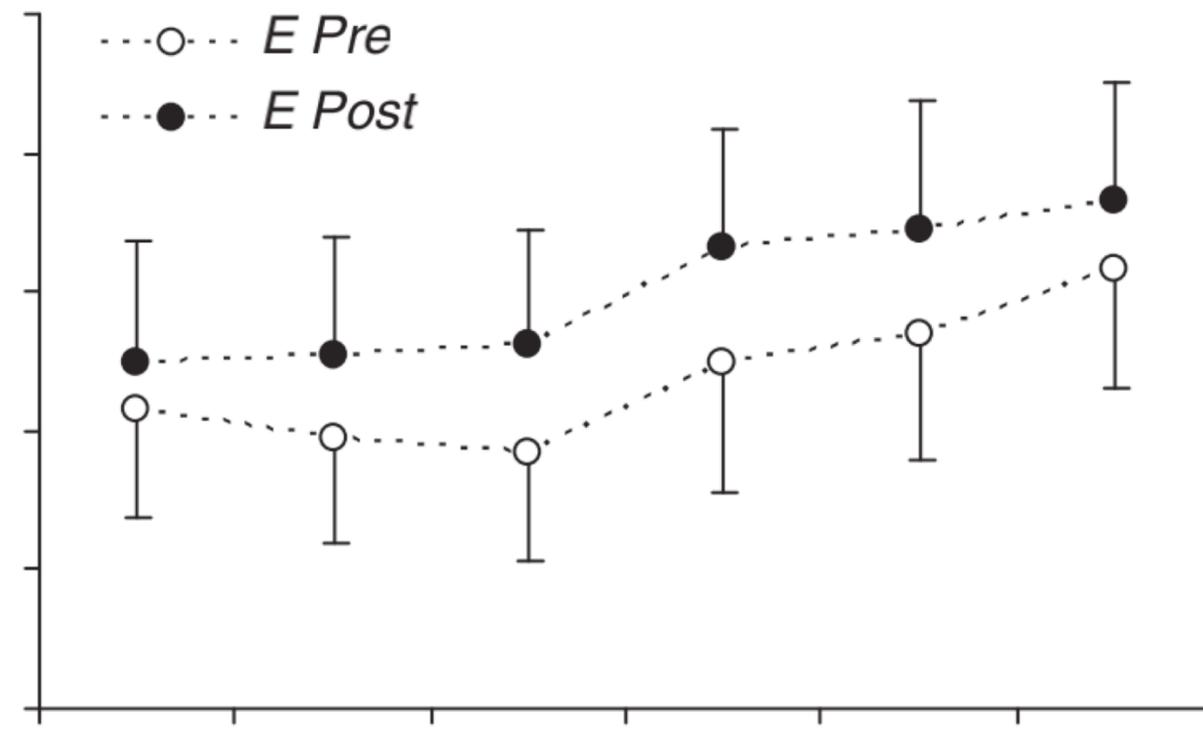
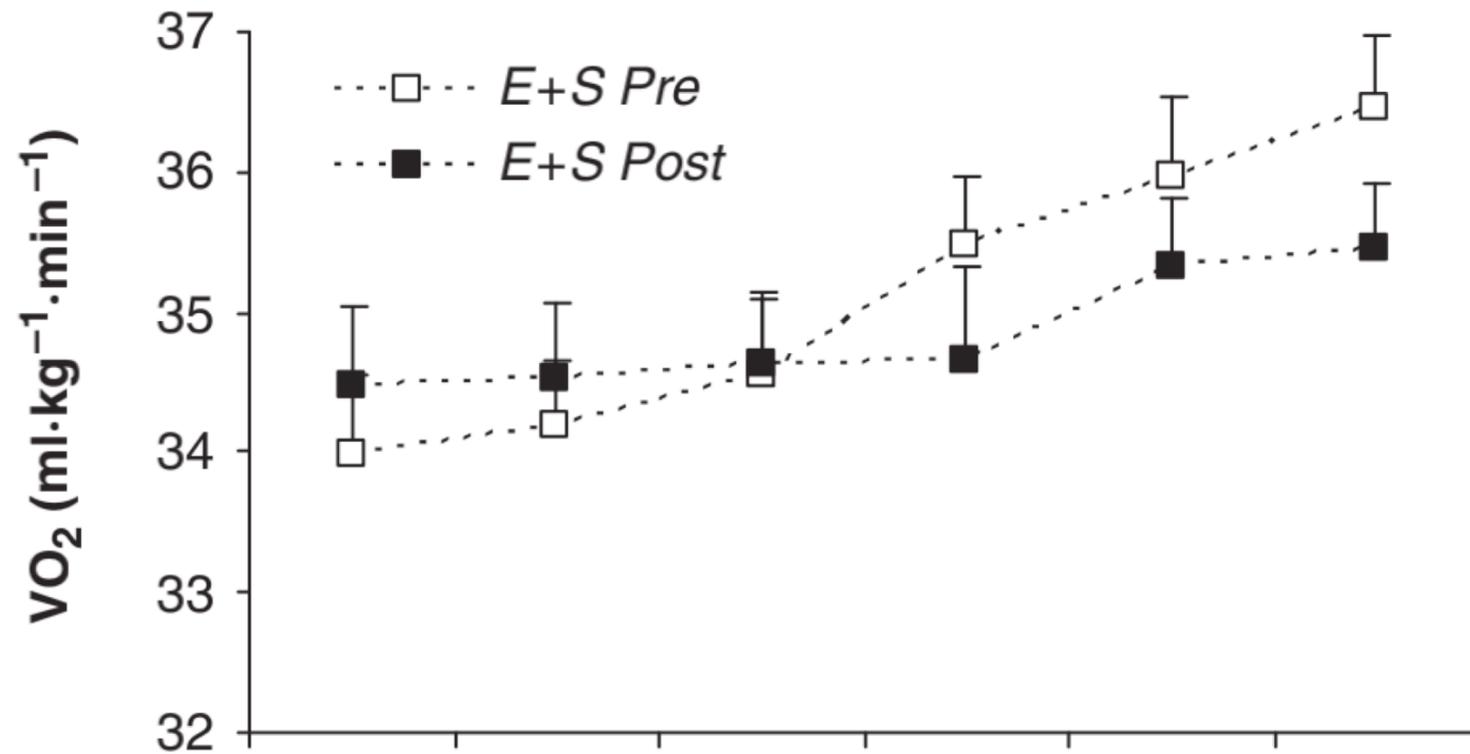
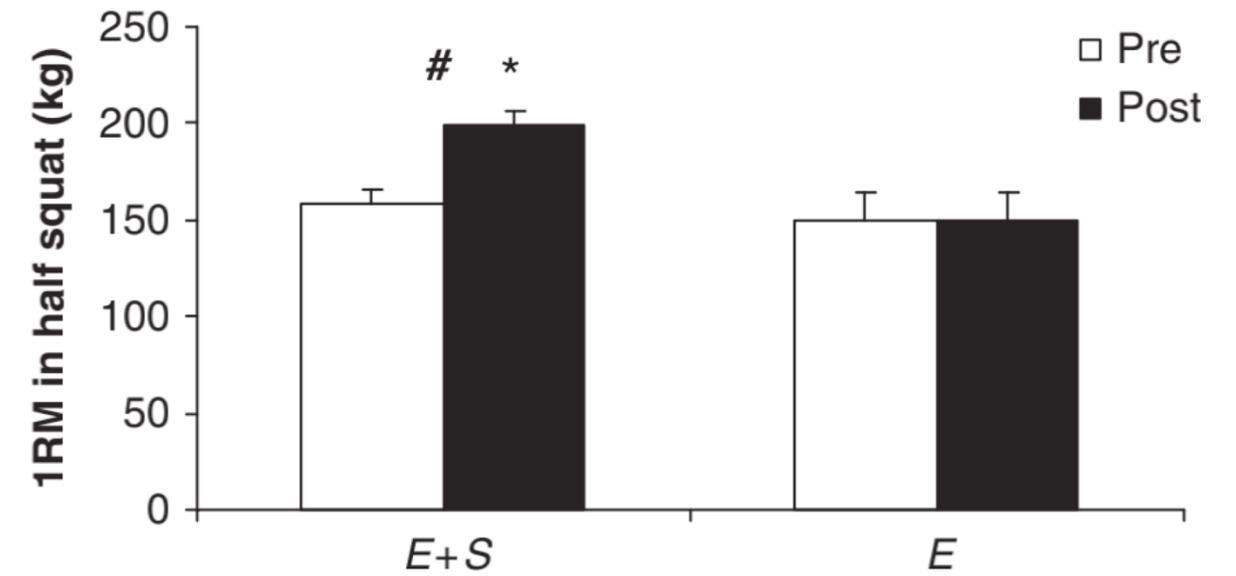
Fig. 1. Maximal strength in isometric half squat at before the intervention period (Pre), after the 10-week strength development period (10 weeks), and after the 15-week strength maintenance period (Post) for the cyclists performing endurance training and strength training (ES) and the cyclists performing endurance training only (E). *Larger than at Pre (*P* < 0.01), #the relative change from Pre is larger than in E (*P* < 0.01).

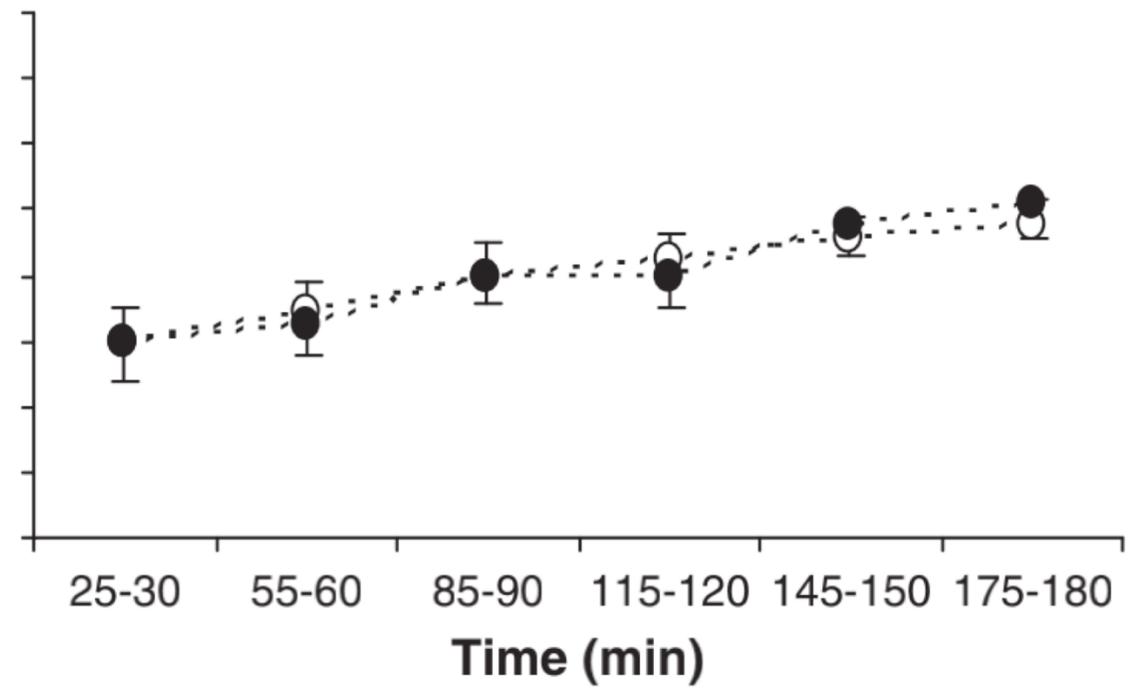
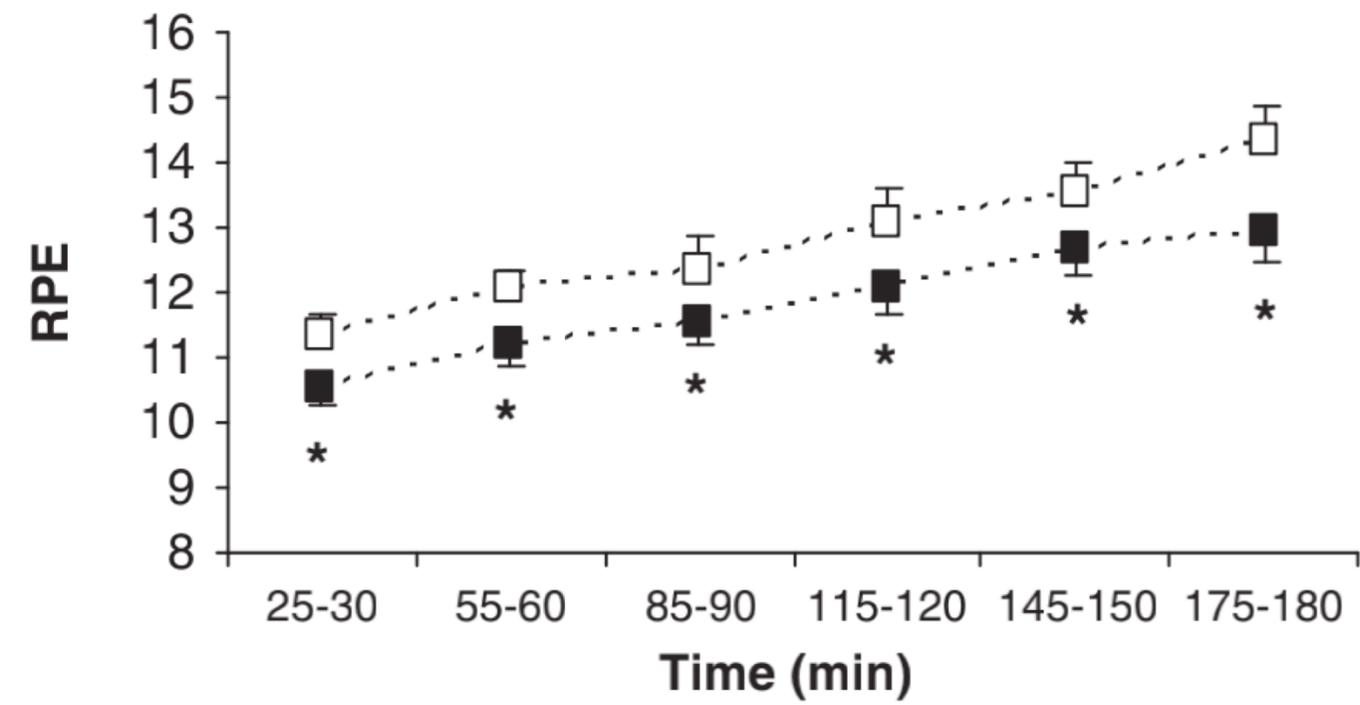
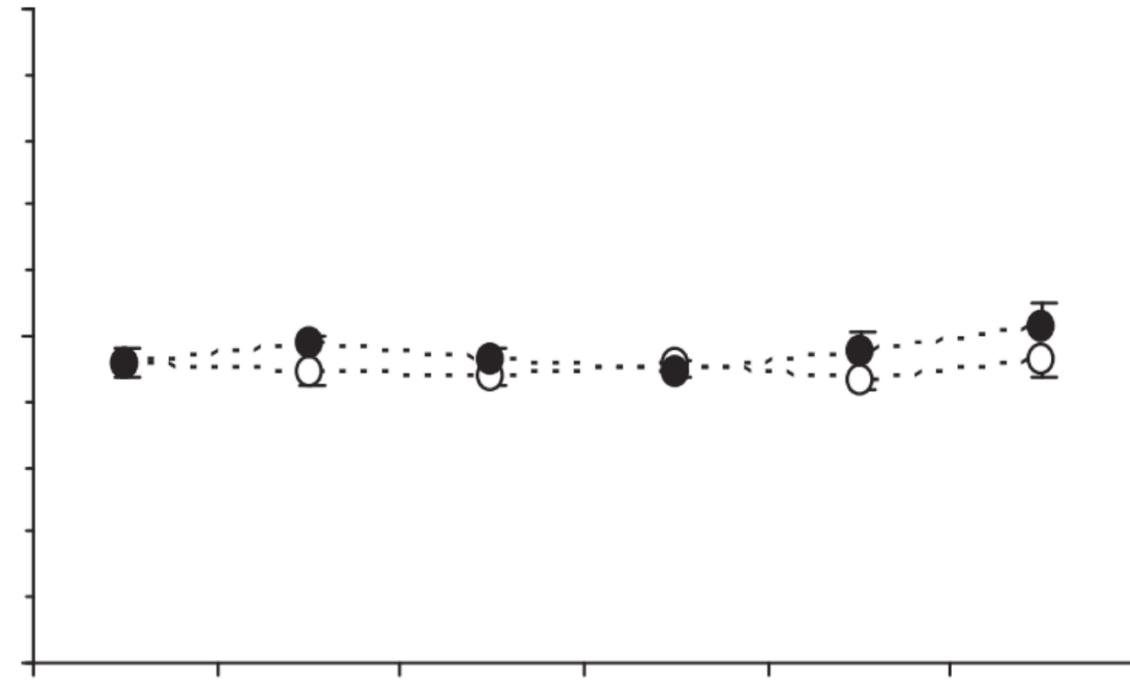
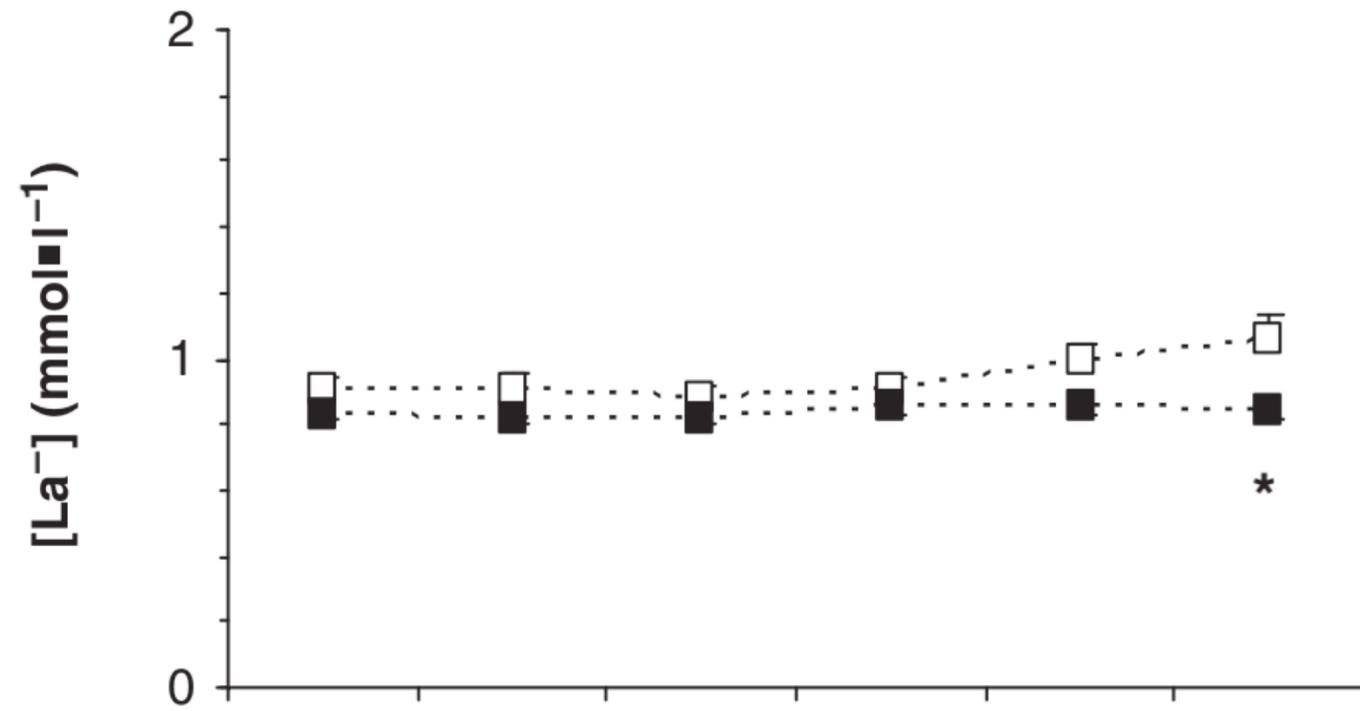


Strength training improves 5-min all-out performance following 185 min of cycling

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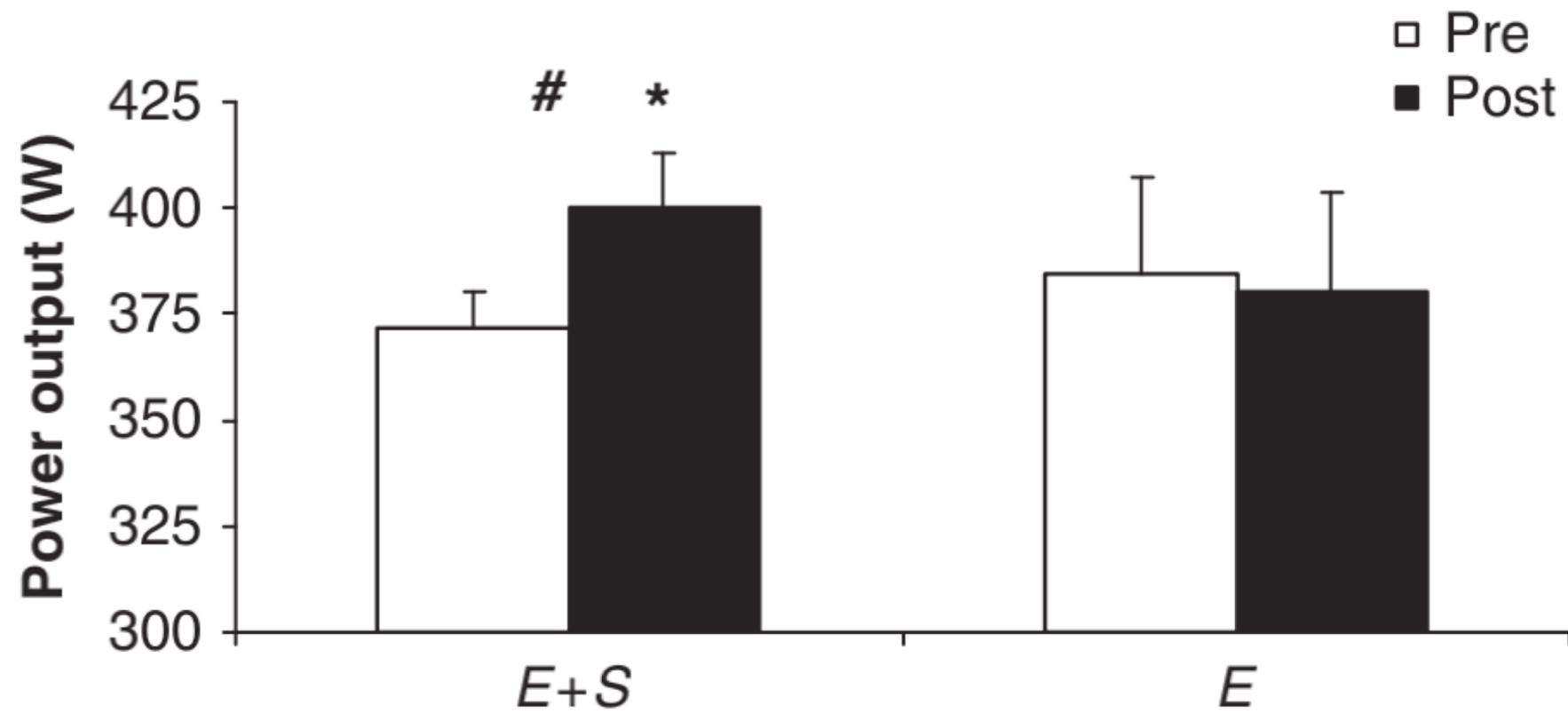


Fig. 5. Mean power output during the 5-min all-out trial performed following 185 min of cycling at 44% of baseline W_{\max} before (pre) and after (post) 12 weeks of combined endurance and heavy strength training (*E+S*) or endurance training only (*E*). *Different from Pre ($P < 0.01$). #Difference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

Mecanismos potenciales

- Mayor reclutamiento fibras motoras
- Fibras tipo 1 y tipo 2 (Tlim)
- Actividad EMG en ciclistas similares (Bieuzen et al. 2007).
- Mayor contenido en fosfocreatina y glucógeno+menor [Lac⁻](Goreham et al. 1999) tras 12w de Fza Máxima.

Table 1. The in-season (2 x week) strength training programme - maximum-strength emphasis & with explosive-strength (Day 1: Heavy maximum-strength & explosive-strength focus; Day 2: Light/Medium maximum-strength & explosive-strength focus. There were 48 hours of recovery between Day 1 and Day 2).

DAY 1 (Heavy)		Block 1				Block 2				Block 3				Block 4				Block 5			
Strength Quality	Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Explosive-strength (heavy)	Squat-jump	3x3 (7kg)	3x3 (7kg)	3x3 (7kg)	3x3 (7kg)	3x3 (7kg)	3x3 (7kg)	3x3 (7kg)	3x3 (7kg)	3x3 (17kg)	3x3 (17kg)	3x3 (17kg)	3x3 (17kg)	3x3 (17kg)	3x3 (17kg)	3x3 (17kg)	3x3 (17kg)	3x3 (20kg)	3x3 (20kg)	3x3 (20kg)	3x3 (20kg)
Maximum-strength	TB DL	3x8	3x8	3x8	2x8	3x5	3x5	3x5	2x5	3x5	3x5	3x5	2x5	3x5	3x5	3x5	2x5	3x5	3x5	3x5	2x5
Assistance 1 (Posterior)	RDL	3x5	3x5	3x5	3x5	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8
Assistance 2 (Anterior)	Goblet Squat	2x12	2x12	2x12	2x12	2x12	2x12	2x12	2x12	2x12	2x12	2x12	2x12	2x12	2x12	2x12	2x12	2x12	2x12	2x12	2x12
Core	Circuit	2 x (Front Plank, Side Plank R, Side Plank L, Curl & Bridge)				2 x (Front Plank, Side Plank R, Side Plank L, Curl & Alt. Bridge)				2 x (Alt. Front Plank, Side Plank R Abduct., Side Plank L Abduct., Curl & Alt. Bridge)				2 x (Alt. Front Plank 4s, Side Plank R Abduct. (dyn), Side Plank L Abduct. (dyn), Curl (Abduct) & Alt. Bridge (3s ISO hold))				2 x (Alt. Front Plank 4s, Side Plank R Abduct. (dyn), Side Plank L Abduct. (dyn), Curl (Abduct) & Alt. Bridge (3s ISO hold))			
DAY 2 (Light/Medium)		Block 1				Block 2				Block 3				Block 4				Block 5			
Strength Quality	Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Explosive-strength (light)	Squat-jump	2x3	2x3	3x3	3x3	3x4	3x4	3x4	3x4	3x5	3x5	3x5	3x5	3x5	3x5	3x5	3x5	3x6	3x6	3x6	3x6
Maximum-strength	TB DL*	3x8	3x8	3x8	2x8	3x8	3x8	3x8	2x8	3x8	3x8	3x8	2x8	3x8	3x8	3x8	2x8	3x8	3x8	3x8	2x8
Assistance 1 (Posterior)	RDL	2x5	2x5	2x5	2x5	2x5	2x5	2x5	2x5	2x5	2x5	2x5	2x5	2x5	2x5	2x5	2x5	2x5	2x5	2x5	2x5
Assistance 2 (Anterior)	Split-squat	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8
Core	Circuit	2 x (Front Plank, Side Plank R, Side Plank L, Curl & Bridge)				2 x (Front Plank, Side Plank R, Side Plank L, Curl & Alt. Bridge)				2 x (Alt. Front Plank, Side Plank R Abduct., Side Plank L Abduct., Curl & Alt. Bridge)				2 x (Alt. Front Plank 4s, Side Plank R Abduct. (dyn), Side Plank L Abduct. (dyn), Curl (Abduct) & Alt. Bridge (3s ISO hold))				2 x (Alt. Front Plank 4s, Side Plank R Abduct. (dyn), Side Plank L Abduct. (dyn), Curl (Abduct) & Alt. Bridge (3s ISO hold))			
	Time	W1 20s→W4 35s				W5 40s→W8 45s				W5 40s→W8 45s				W13 30s→W16 35s				W17 35s→W20 40s			
Notes:	<ul style="list-style-type: none"> - Technique emphasis on ALL lifts - Progressively load if competent - *15kg less than Day 1 Trap-bar Deadlift loads 																				
3x3: 3 sets of 3 repetitions; RDL: Romanian deadlift; R: right; L: left; TB DL: trap-bar deadlift; R: right side; L: left side; Alt: alternate; Abduct: abduction; Dyn: dynamic; W1: week 1; ISO: isometric																					

Efectos negativos

Aumento hipertrofia+

- Aumentar la distancia de difusión
- Incrementos en torno al 3-6% (Rønnestad et al., 2010a, 2012; Taipale et al., 2010; Losnegard et al., 2011; Aagaard et al., 2011)
- Efecto negativo del aumento de masa cuando se vence una resistencia

Recomendaciones basadas en la evidencia

- Realizar ejercicios que se centren en los grupos musculares utilizados en la práctica deportiva
- Realizarlos en su rango de movimiento particular
- Fase concéntrica a máxima velocidad. Tras
- 8 Semanas: Max, RFD y Eco
- Primero desarrollar una técnica correcta



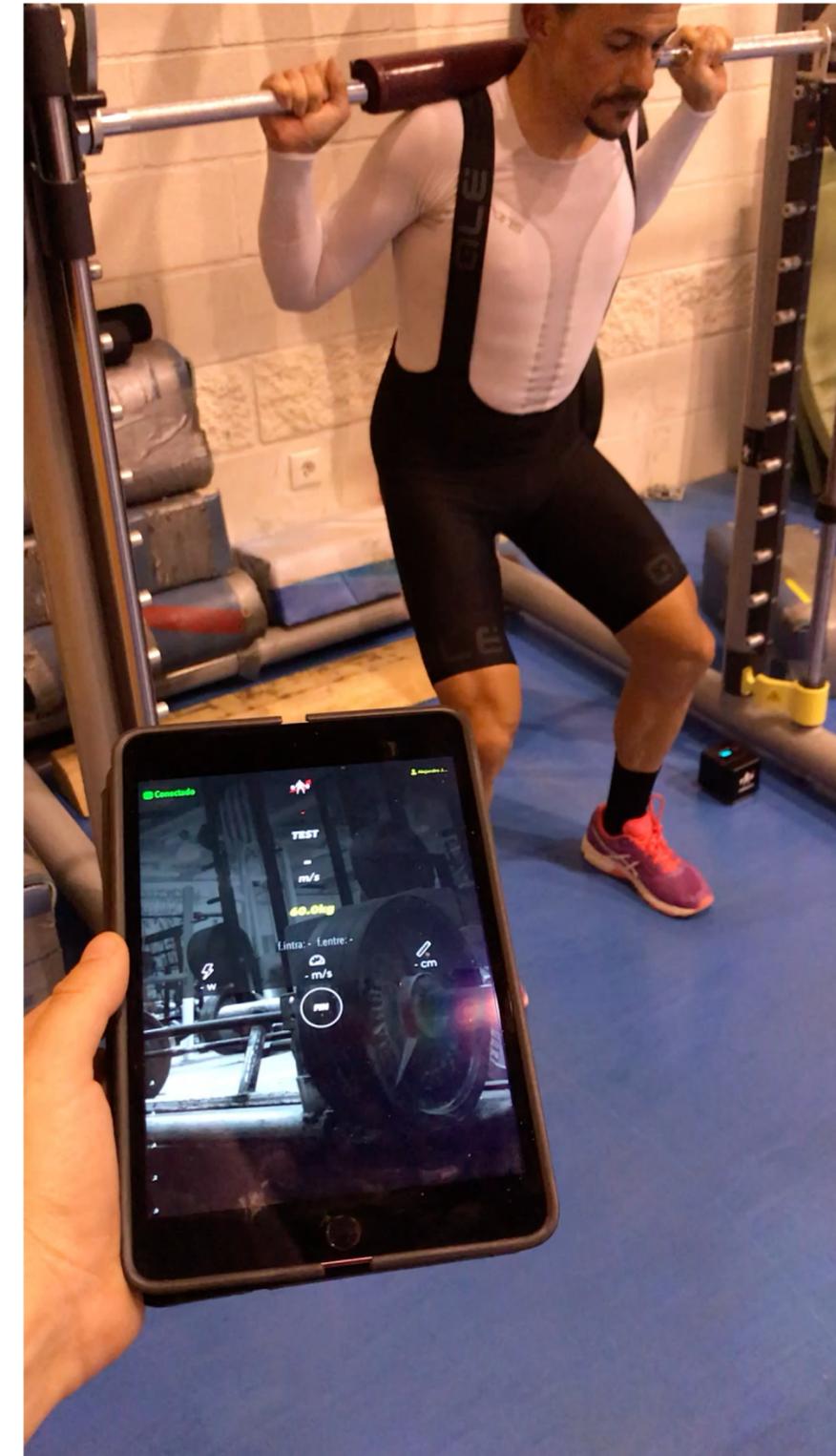
Røonestad & Mujika (2014)

Recomendaciones basadas en la evidencia

- Durante el **periodo preparatorio**: 2 sesiones de Fza máxima, 12 semanas, 4-10 RM, 2-3 series, 2-3 min
- Comenzar con 2-3 semanas de adaptación y aprendizaje
- Es normal que el ciclista tenga dolor de piernas y se sienta “pesado” al comienzo del programa de desarrollo de fuerza
- Ideal comenzar al finalizar el periodo competitivo: El entrenamiento específico de resistencia no es prioritario
- En el **periodo competitivo**: 1 sesión/semana de alta intensidad MANTENIMIENTO

*Røonestad &
Mujika (2014)*

- Hacía dónde vamos
- ¿Cómo optimizar e individualizar el entrenamiento de fuerza?
- Tecnología





UNIVERSITAS

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