Science & Cycling

SCIENCE & CYCLING 2024

26 – 27 June

University of Florence, Italy

Universidad Europea MADRID

CYCLING Health and Performance

MOVISTAR TEAM

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Strength training for cyclists: methodological novelties

WHAT IS THE REALITY OF STRENGTH TRAINING IN CYCLING?

Although the professional and scientific environment of cycling is fully aware of the adaptive ***EFFECT*** *that strength training with* ***GENERAL EXERCISES*** *produces on sports performance (I > 60% 1RM)* *(Rønnestad y Mujika, 2014; Rønnestad et al., 2010 y 2011)*

However, there are several factors that lead to **permanent opposition** from **amateur, elite and PRO cyclists** to incorporate these exercises into their routines:

1. Side effects of bodybuilding methodology.
2. Low affinity of the cyclist to enter enclosed spaces and bodybuilding rooms.
3. Low levels of upper body and abdominal girdle preparation to withstand shear and compression stresses.
4. High prevalence of hamstring shortening.
5. Availability of necessary and accessible infrastructure during the block of training.

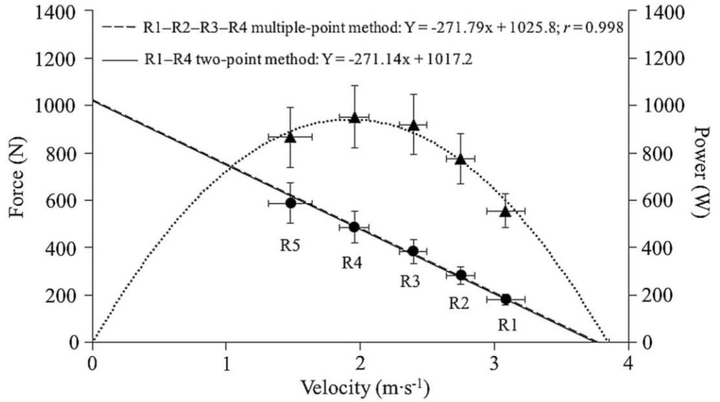
"TORQUE" TRAINING

TORQUE TRAINING

Based on the **inverse F-V relationship** (i.e., when the cadence is lower higher force values can be applied) "Torque" Training proposes:

(Kristoffersen et al., 2014; Patón et al., 2009; Whitty et al., 2016) – PRO y ELITE

- Cadences 60-70 rpm - manipulate gear and slope
- **4 min - 6 min** repetitions (total *30-70 min per session*)
- Relative intensities of **VT_1, MLSS or VT_2** (Not maximun)



INCONCLUSIVE RESULTS PUBLICATIONS / PROFESSIONAL PRACTICE - **TRIVIAL OR NON-EXISTENT EFFECTS**

1. **Can we design a procedure to identify the pedaling Maximal Dynamic Force (MDF) and the F-V profile?**
2. What is the true value of relative force demanded by Competition and Torque training efforts? **>60% MDF**?
3. Can a new procedure with SPECIFIC EXERCISES be developed that is **Effective**, **Efficient** and **Safe** for the cyclist?

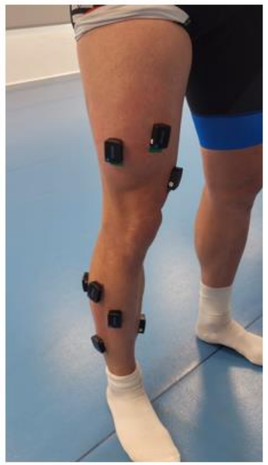
New PROJECT - Strength Training in Cycling
2021 - 2024

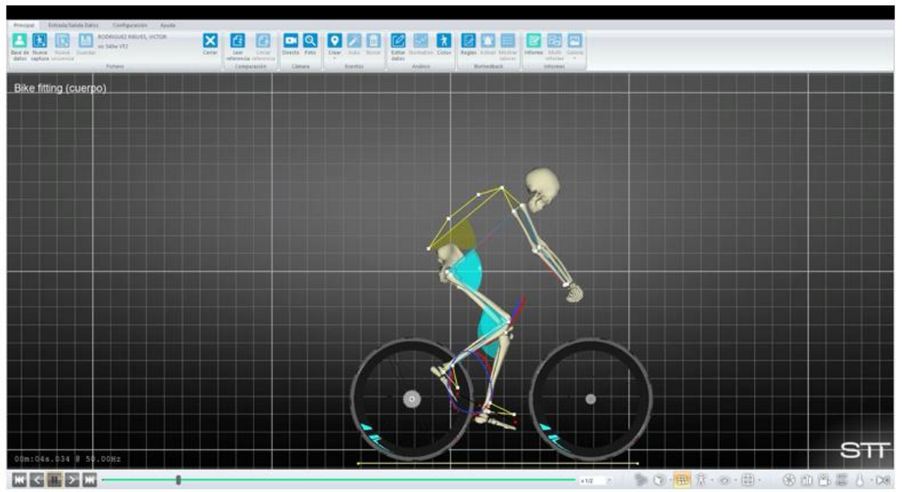
Incremental pedaling force test

- Friction resistance ergometer (Monark© 874E)
- Dual crank powermeter (2INpower, Rotor)
- Calibrated discs (Eleiko)

PROTOCOL
- Standarized warm up (15 min 80% VT_1)
- Initial load 2 kp – increments of 0.5-3.0 kp
- Efforts of 5 s *all out effort (each load)*
- Max. 8 trials until determinate MDF (360º)
- Rest: 5’ between loads

CLIP





DETERMINATIONS
- MDF (N)
- Maximum torque (N·m; N·m·kg^{-1})
- Power (W)
- Cadence (rpm)

Incremental pedaling force test

N = 52 cyclists - 64 ml/kg/min

SEE General Curve = 9 rpm

Individual Curve Adjustment **=** 0.980 ± 0.013

- Low loads = < 60% MDF / > 80 rpm **ALL OUT**
- Medium loads = 60-80% MDF / 80 - 40 rpm **ALL OUT**
- High loads = >80% MDF / < 40 rpm **ALL OUT**

ABSOLUTE RELIABILITY STUDY

N = 10 - *PRE-POST 48 h*

RELIABILITY AFTER TRAINING

N = 11 - *T1 – T2 10 wk*

MDF ↑ 3%

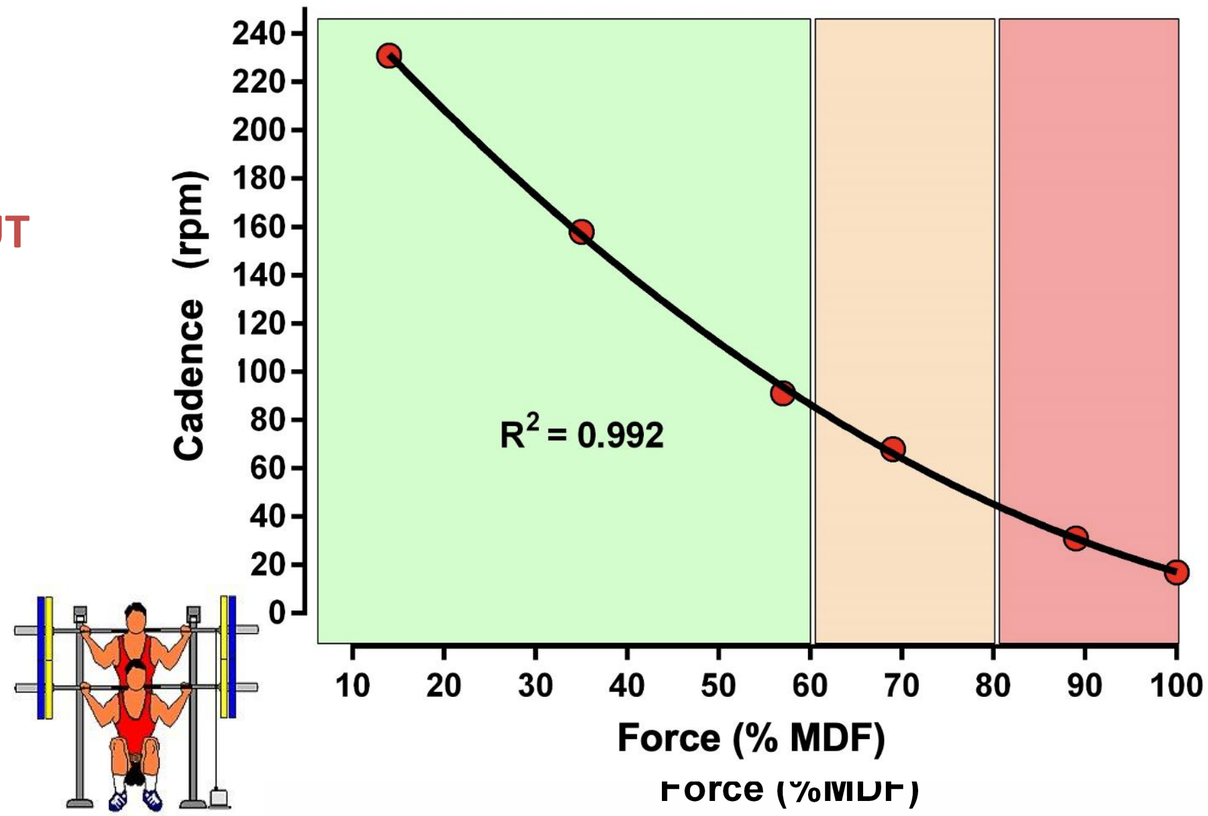
SEM = 3-4 rpm

Sensors (Basel). 2024 Mar 21;24(6):1997. doi: 10.3390/s24061997.

Torque-Cadence Profile and Maximal Dynamic Force

RELATIONSHIP CADENCE – RELATIVE INTENSITY

inidivudal



What %MDF does Torque Training achieve?

- **The relative intensity (%MDF) at which specific strength training (Torque) is being performed has been studied in the international literature**

❑ **Nimmeritcher et al. (2012)**: 6 x 5 min **VT_2** 60 rpm / 5 min

❑ **Kristoffersen et al. (2014)**: 5 x 6 min **MLSS** 40 rpm / 3 min

❑ **Whitty et al. (2016)**: 4-6 x 4 min **VT_1** 50 rpm /2 min

❑ **Kristoffersen et al. (2018 y 2019)**: 3-4 **Sprints**, 6-8 s all out (2kp aprox)

❑ **Valenzuela et al. (2021)**: 3-4 **Sprints**, 6-8 s all out (1kp aprox)

- **The relative intensity (%MDF) at which specific strength training (Torque) is being performed in the professional field has been studied.**

❑ **PRO A**: 6 x 10 **"starts"** semi stationary on flat / 5 min

❑ **PRO B**: 10 x 2 min **VT_1** a 40 rpm / 2 min

❑ **PRO C**: 4 x 1 min **VT_2** a 60 rpm / 2 min

❑ **PRO D**: 3 x 8 (30 s **VT_2** 50-60 rpm / 90 s VT_1 free cadence) / 10 min

❑ **PRO E**: 8 x 4 min **MLSS** a 50-60 rpm / 4 min

❑ **PRO F**: 10 min **VT_1** (30 s 60 rpm / 30 s free cadence)

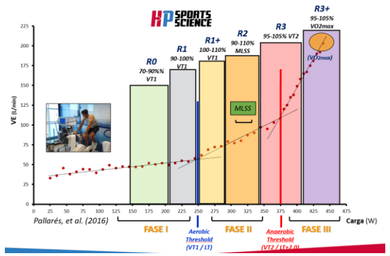
WHAT ACTUAL INTENSITIES (%MDF) DO THESE EFFORTS REPRESENT?

CAN IMPROVEMENTS IN MDF BE EXPECTED WITH THIS TYPE OF STIMULI?

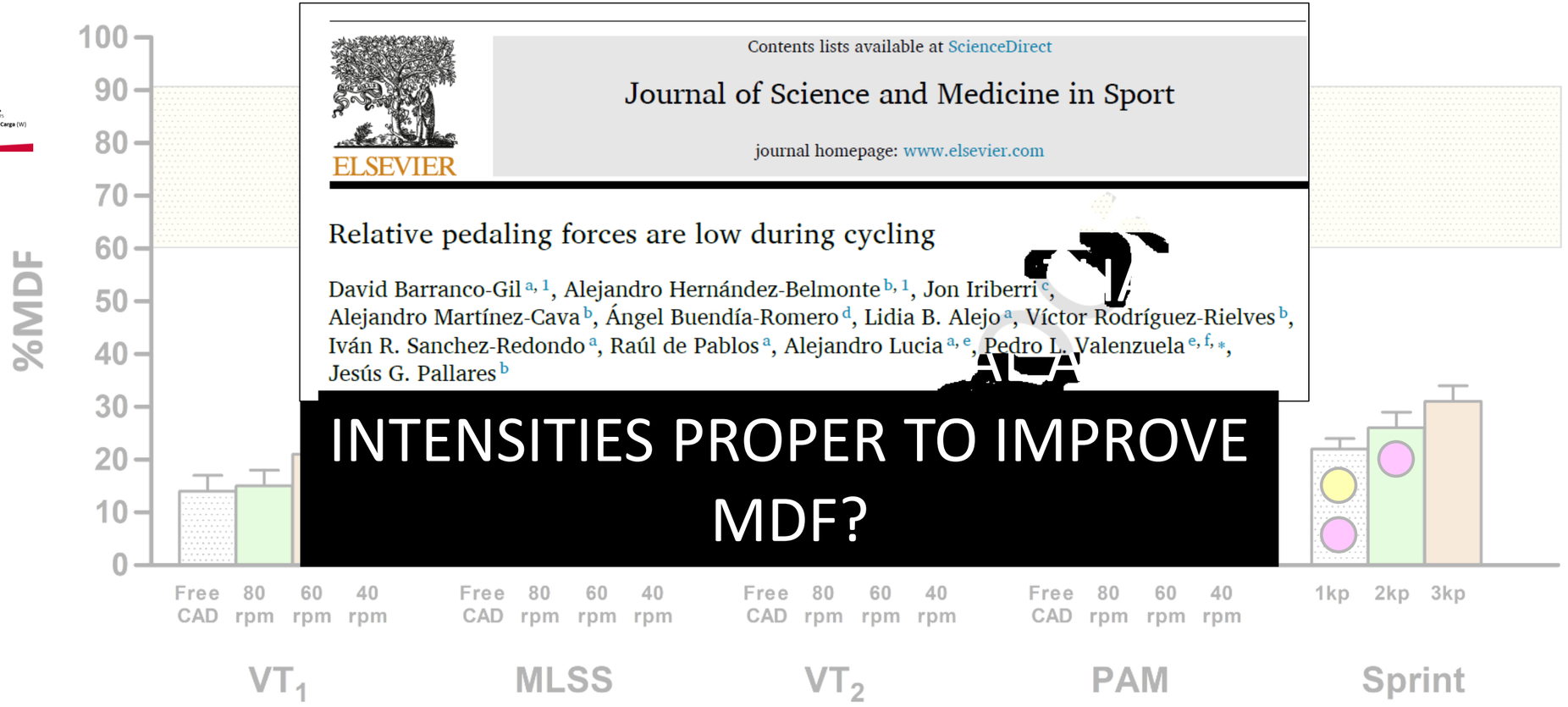
What %MDF does Torque Training achieve?

Experimental study to know the %MDF at which the cyclists pedals at each physiological milestone and "Torque" training.

❑**VT_1:** TLIM 3 h – 8h ❑**MLSS:** TLIM 70-80 min ❑**VT_2:** TLIM 10-14 min ❑**PAM:** TLIM 3-4 min ❑**Sprint** (1 kp, 2kp, 3 kp)



Free Cadence - 80 rpm - 60 rpm - 40 rpm



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ELSEVIER

Relative pedaling forces are low during cycling

David Barranco-Gil [a, 1], Alejandro Hernández-Belmonte [b, 1], Jon Iriberri [c], Alejandro Martínez-Cava [b], Ángel Buendía-Romero [d], Lidia B. Alejo [a], Víctor Rodríguez-Rielves [b], Iván R. Sanchez-Redondo [a], Raúl de Pablos [a], Alejandro Lucia [a, e], Pedro L. Valenzuela [e, f, *], Jesús G. Pallares [b]

INTENSITIES PROPER TO IMPROVE MDF?

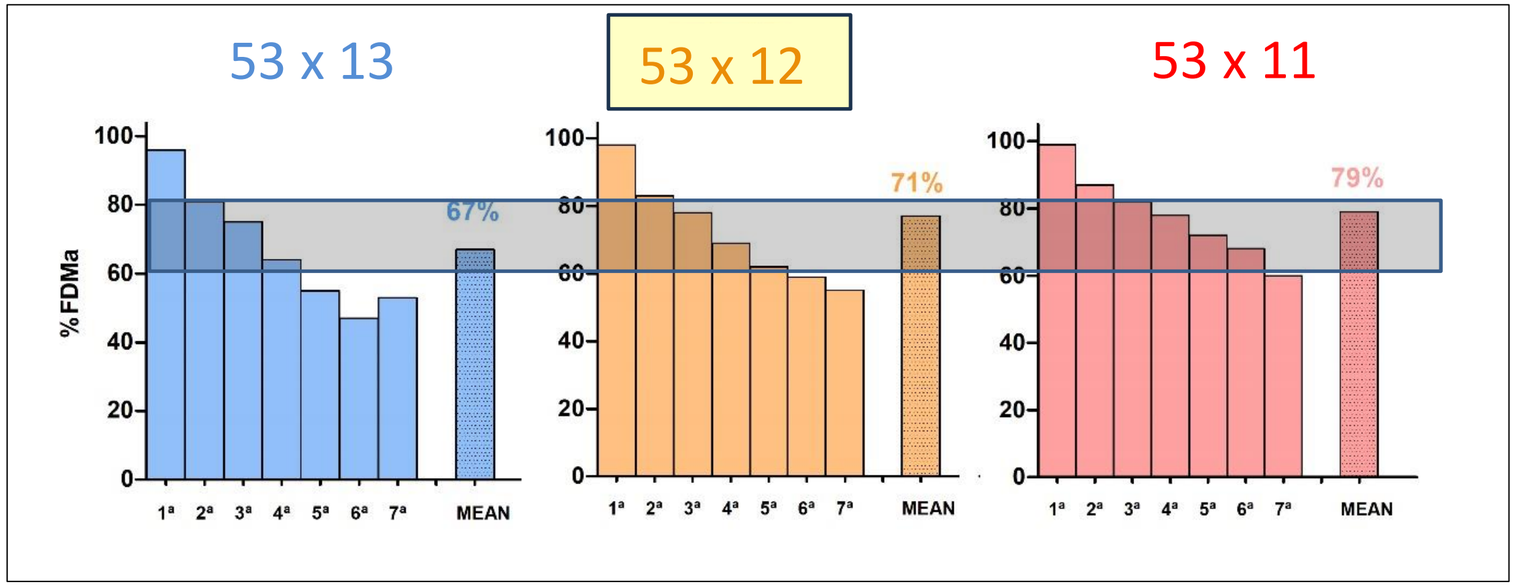
“Starts” - (On-bike Resistance Training)

PROCEDURE

- Stable **6% slope** (~100 m distance)
- **Stop start -** dominant leg crank at 45º.
- **All-Out** Efforts
- Identification of the **gear** that produces the target %MDF (**70% MDF**):
  - **1º** 53x14
  - **2º** 53x13
  - **3º** 53x12
  - **4º** 53x11

- **7 pedaling cycles** (7 left + 7 right)
- **5 sets** per session
- **2 sessions** per week
- **4 min** of recovery between sets

CLIP



STUDY INTERVENTION

ON-bike vs. OFF-bike vs. CON

Resistance Training

N = 37

VO_{2max} = 62.1 ± 6.4

Maximum Incremental Cycloergometer Test
REQUIREMENTS
+
3 familiarization sessions

Battery Test
T1 – T2

Monday

9:00 h

- **Body Composition – DXA + WOMAC** — 30 min
- **Musculoskeletal Evaluation (Ultrasound)** — 3.0 h
- **Incremental pedaling Force Test**

Wednesday

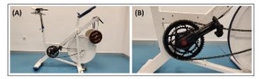
9:00 h

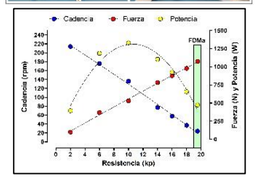
- **Efficiency Test (Fasting)** — 30 min
- **Maximal Incremental Test (Cycloergometer) VT_1-VT_2-PAM-VO_{2max}** — 3.0 h
- **Incremental load test (Squat)** — 1.0 h
- **Wingate test**

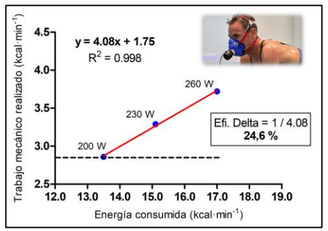
Friday

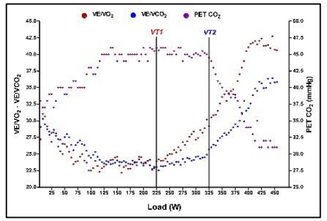
9:00 h

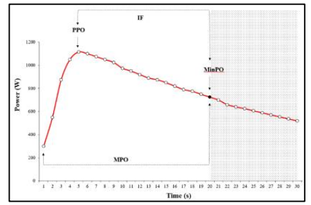
- **Tlim VT_2 Test** — 3.0 h
- **Incremental Pedaling Force Test**

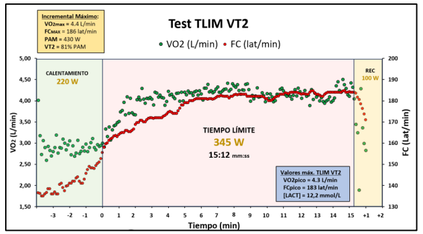












STUDY INTERVENTION

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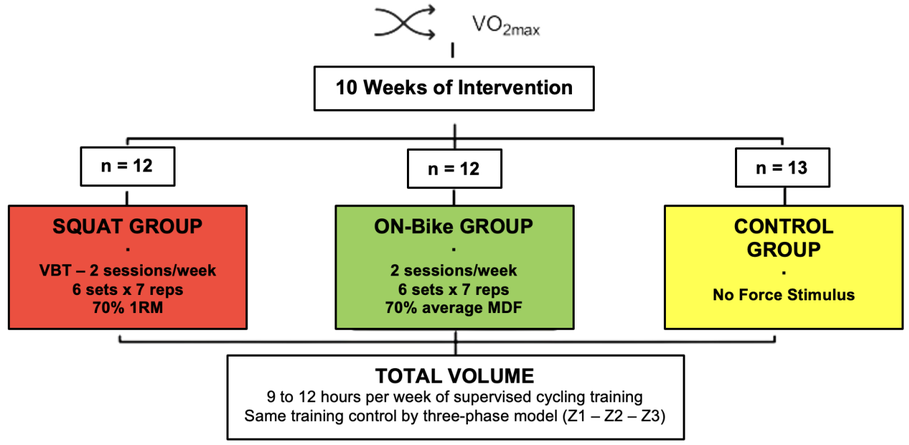
Resitance Training

N = 37

VO_{2max} = 62.1 ± 6.4



ENDURANCE TRAINING CONTROL

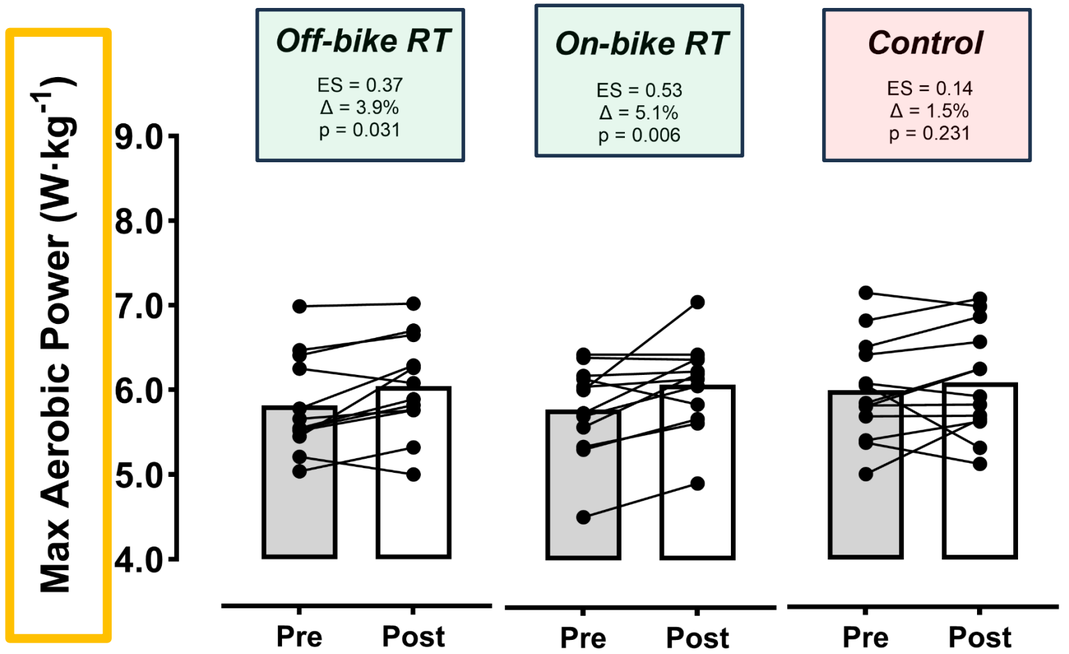
- Three-phase Model– VT_1 y VT_2
- TOTAL Volume per WEEK of training= 9-12 h
- Pyramidal Distribution:
  - ❑ Zone 1: 65-75% / *Ej.* 7 h
  - ❑ Zone 2: 15-25% / *Ej.* 2 h
  - ❑ Zone 3: 5%-15% / *Ej.* 1 h
- Controllled by external load (W; no HR) to avoid overestimating Time in Z2 and Z3
- TrainingPeaks and WKO

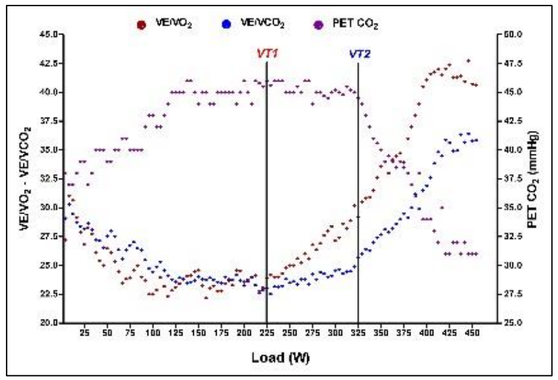
STUDY INTERVENTION

ON-bike vs. OFF-bike vs. CON

Resistance Training

MAIN FINDINGS





No differences between RT Interventions

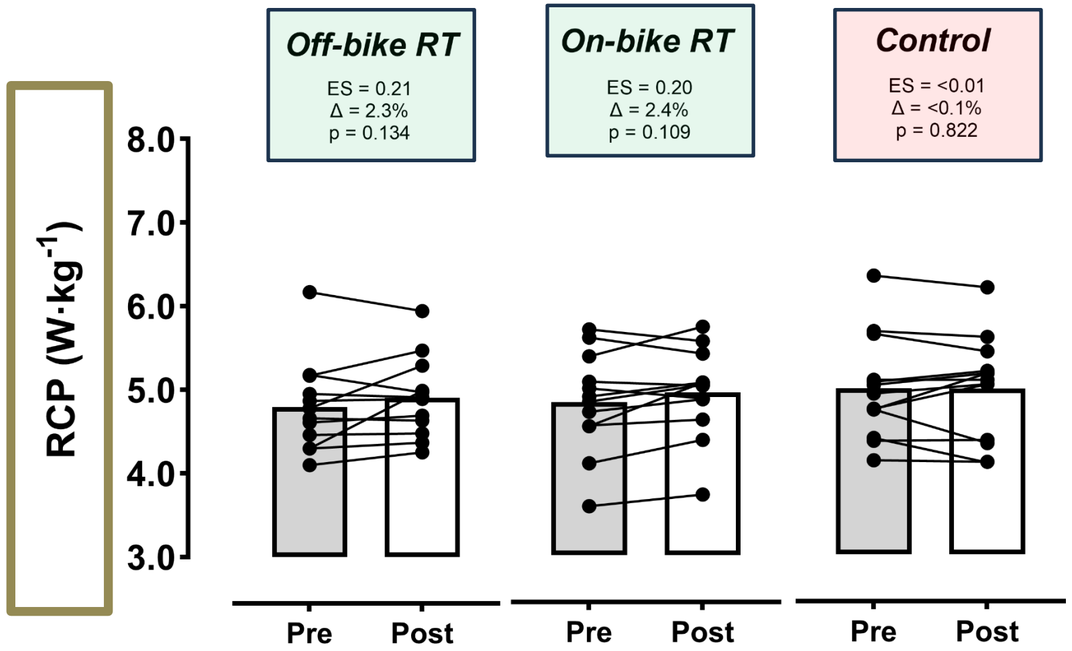
Relevant Effect Sizes

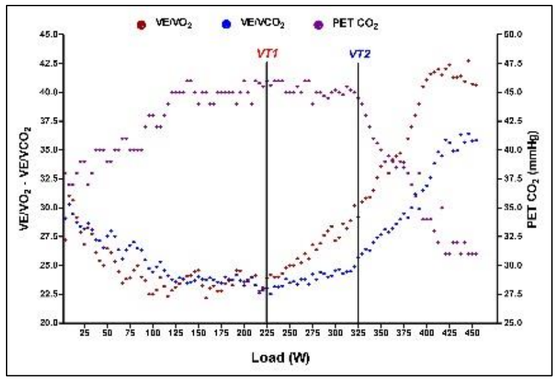
STUDY INTERVENTION

ON-bike vs. OFF-bike vs. CON

Resistance Training

MAIN FINDINGS





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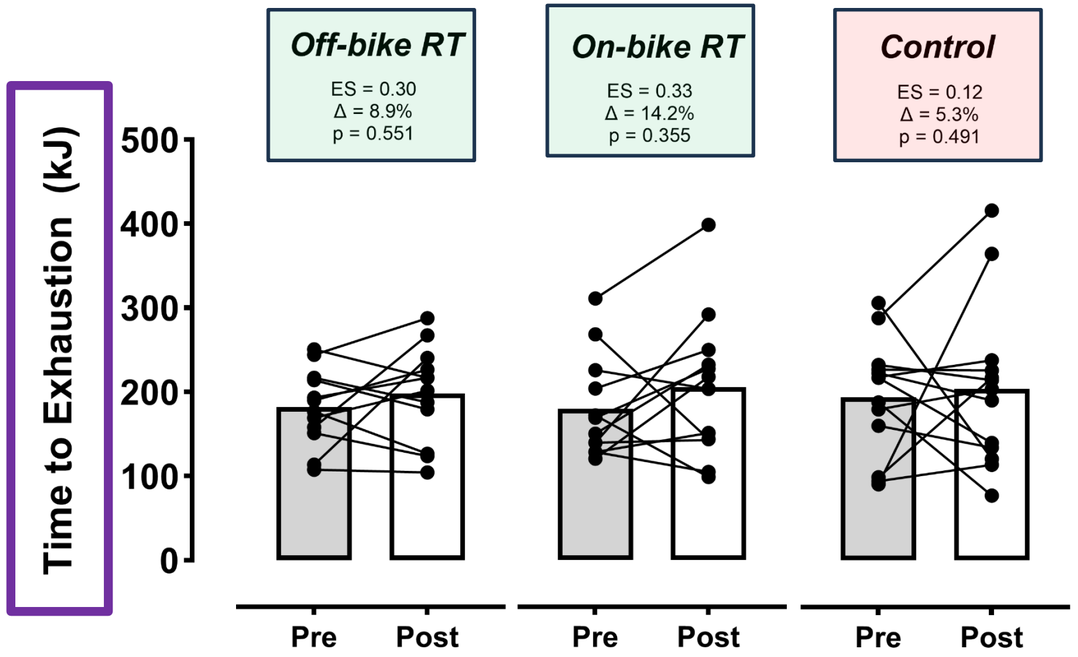

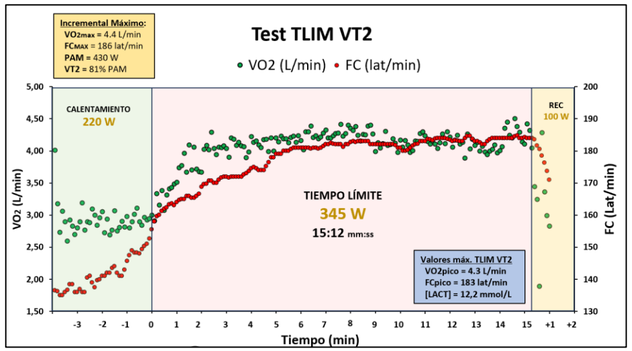

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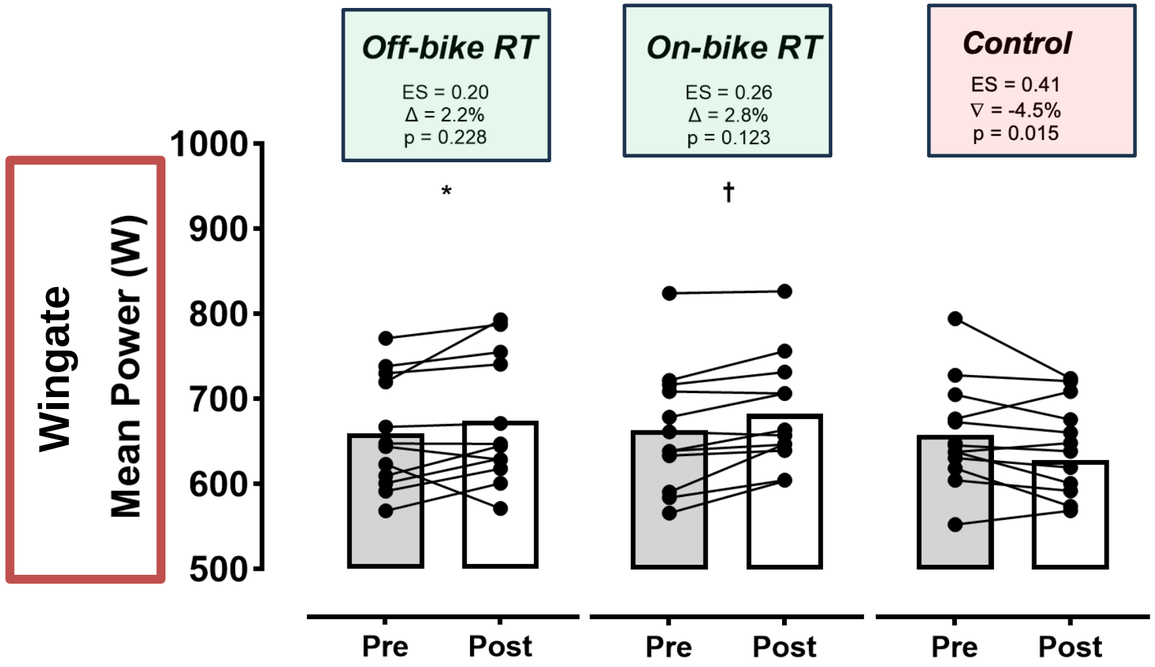

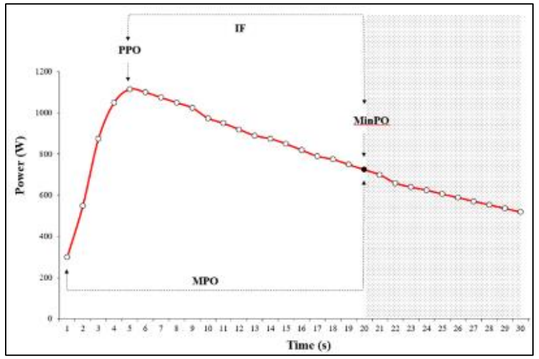

No differences between RT Interventions

Relevant Effect Sizes + Significant Differences respect Control Group

STUDY INTERVENTION

ON-bike vs. OFF-bike vs. CON

Resistance Training

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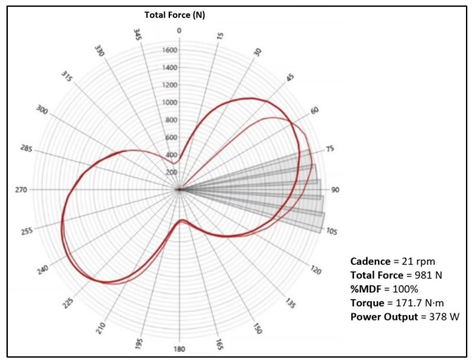

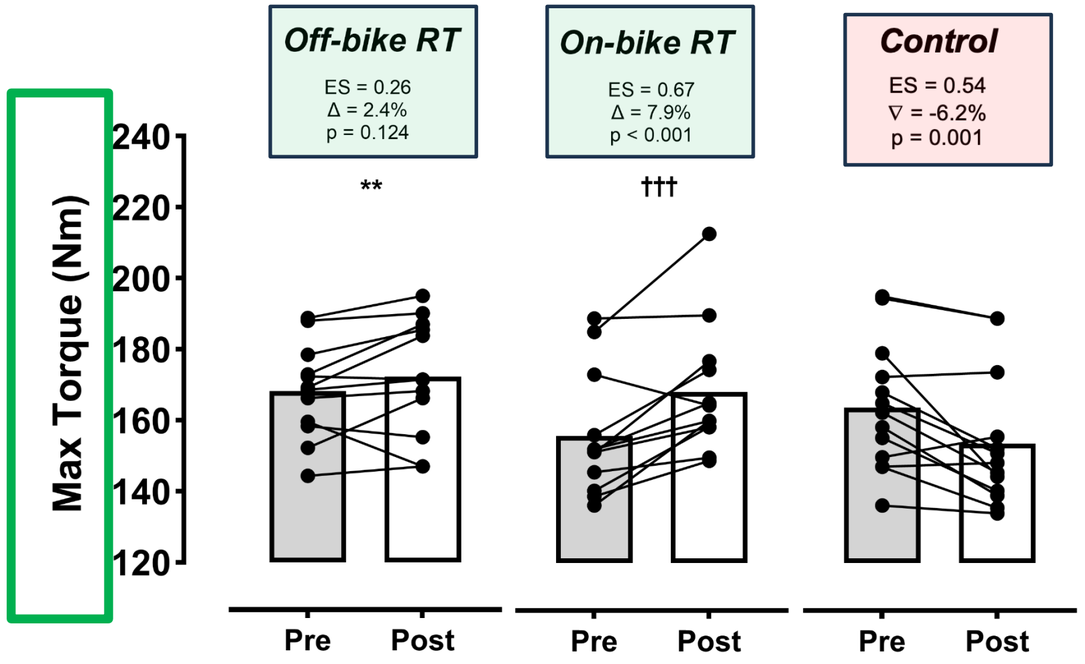

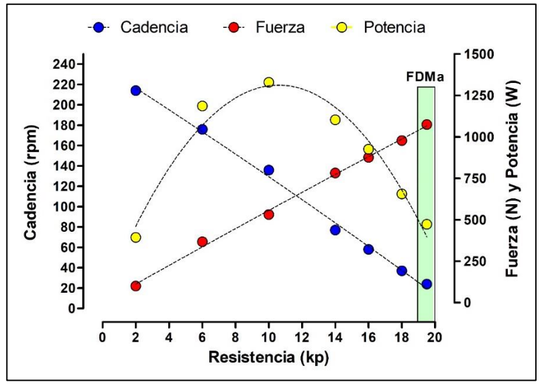

No differences between RT Interventions

Relevant Effect Sizes + Significant Differences PRE-POST

STUDY INTERVENTION

ON-bike vs. OFF-bike vs. CON

Resistance Training

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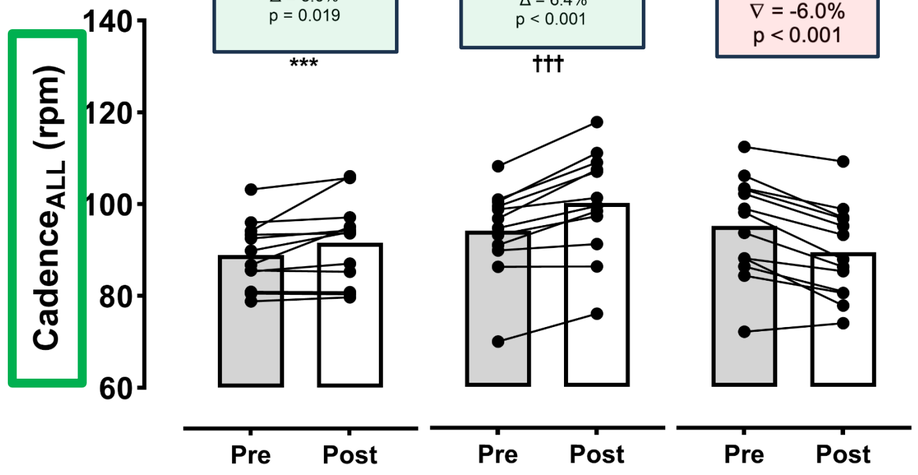

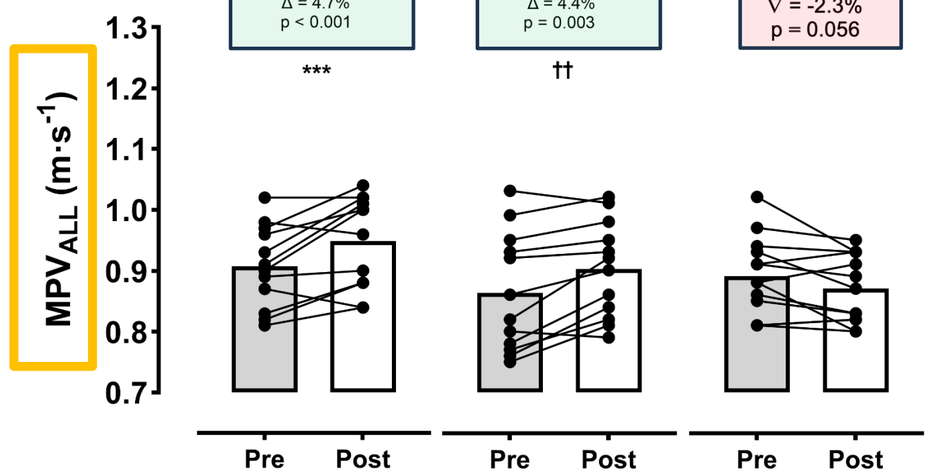

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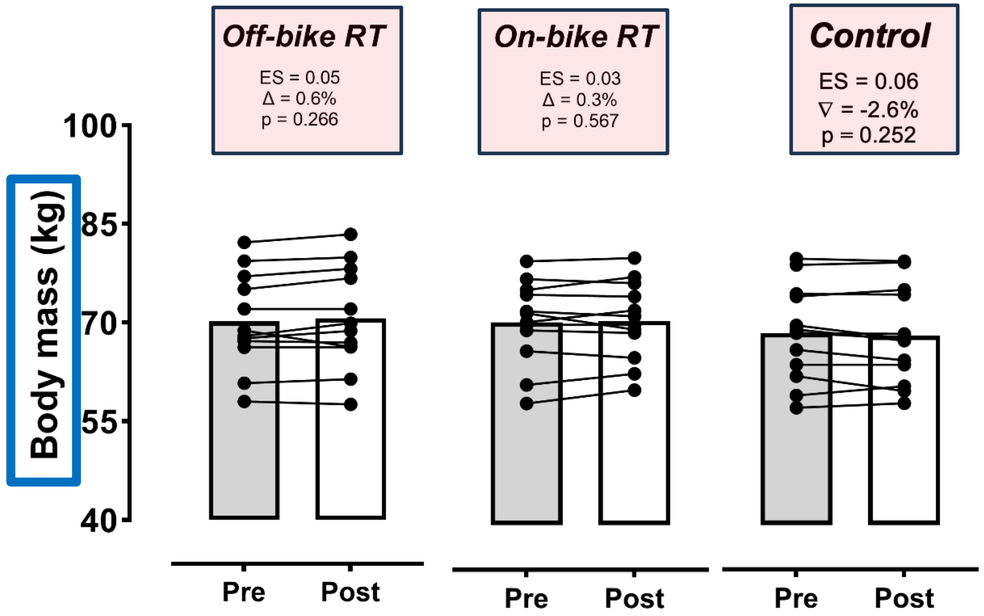

STUDY INTERVENTION

ON-bike vs. OFF-bike vs. CON

Resistance Training

CONCLUSIONS:

1. **Strength Training** with moderate-high loads produces improvements in cycling-specific performance (MAP, VT_2, TLIM, WGT), most likely as a consequence of neuromuscular and morphofunctional improvement.

2. The **cession of strength training** with medium-high loads produces a clear **detraining** in well-trained cyclists.

3. When **moderate - high load magnitudes (70% MDF)** are reached and **all load components (V, I, D, Rec) are balanced**, there are no adaptive differences on cyclist performance depending on whether the strength exercise is performed on the bike itself ("Starts"*; **On-bike***), or in general exercises (Full Squat; ***Off-bike***).

THANK YOU VERY MUCH FOR YOUR ATTENTION