University of Verona

Dept of Neurological, Biomedical and Movement Sciences

MUSCLE ECCENTRIC TRAINING FOR ENDURANCE RUNNING PERFORMANCE

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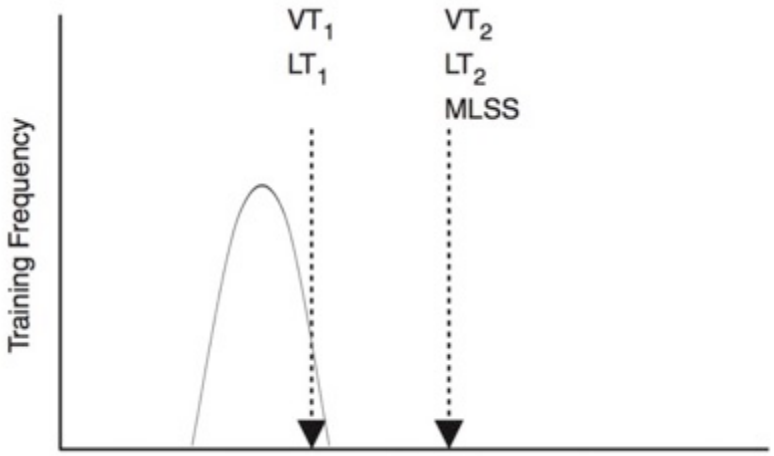
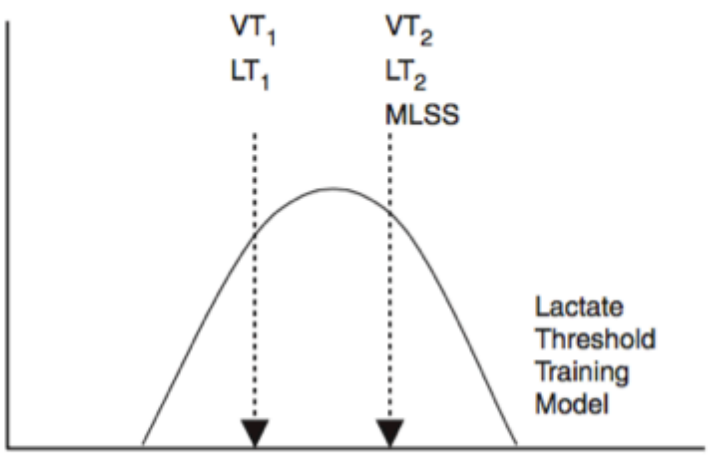
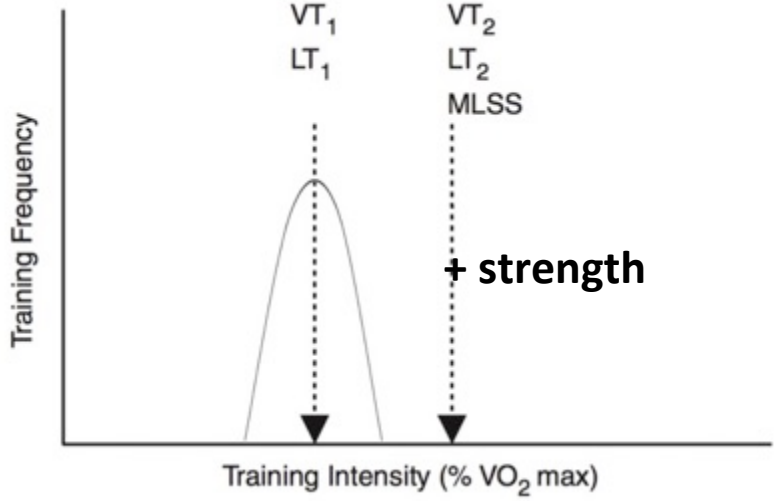
RECREATIONAL

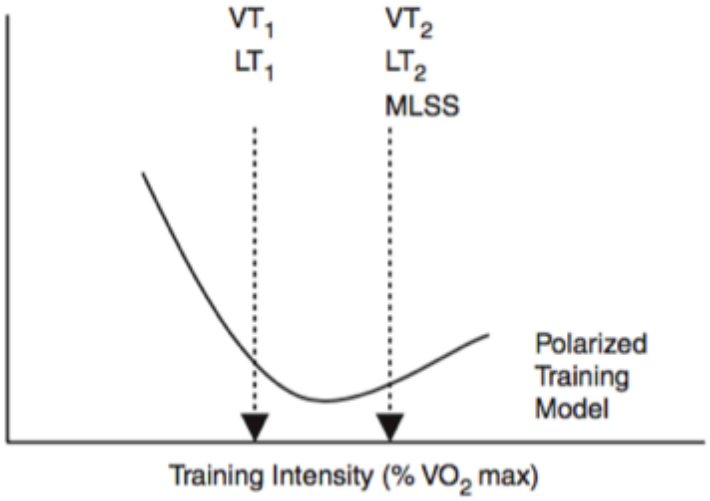
ELITE

Coyle et al. 1999





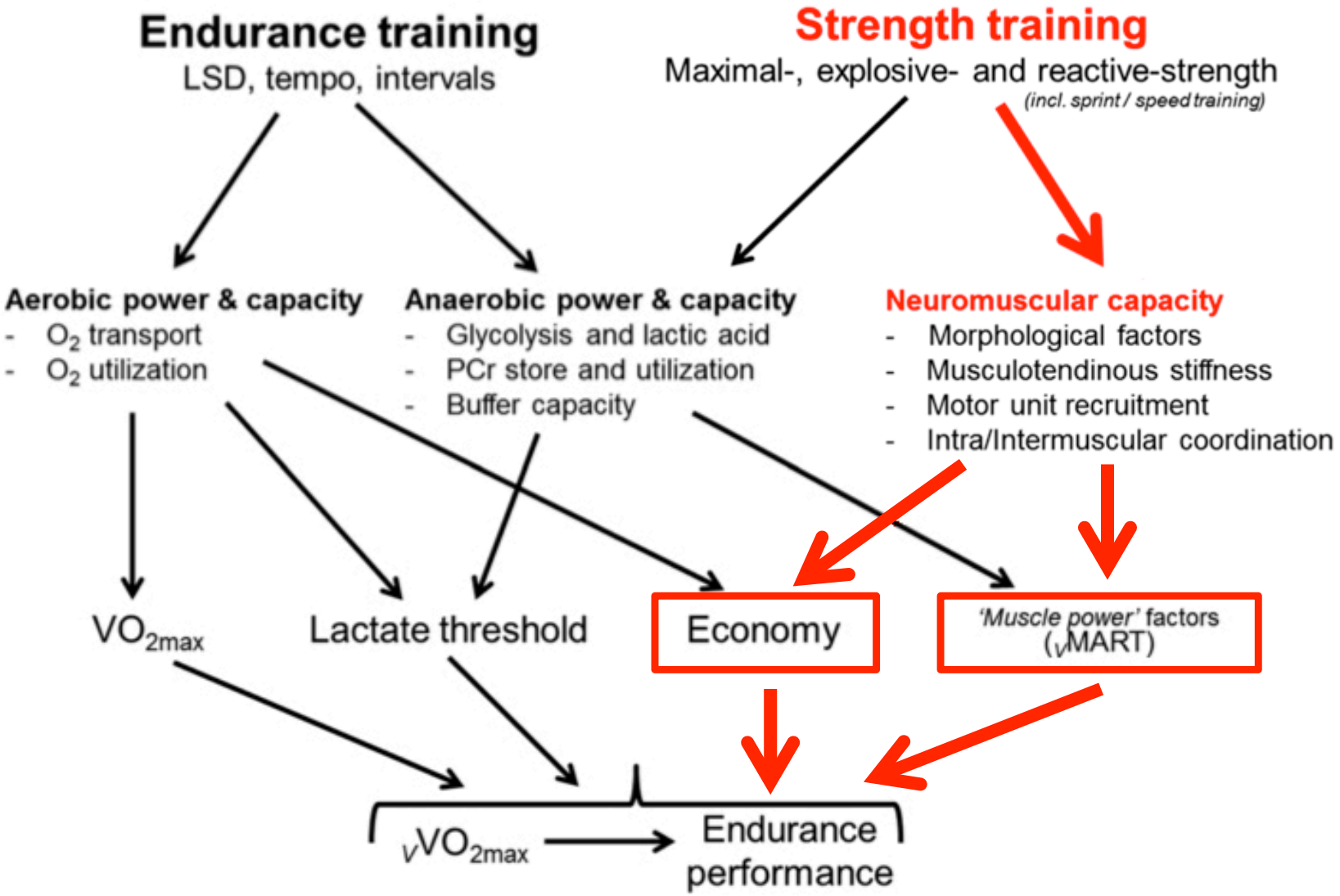




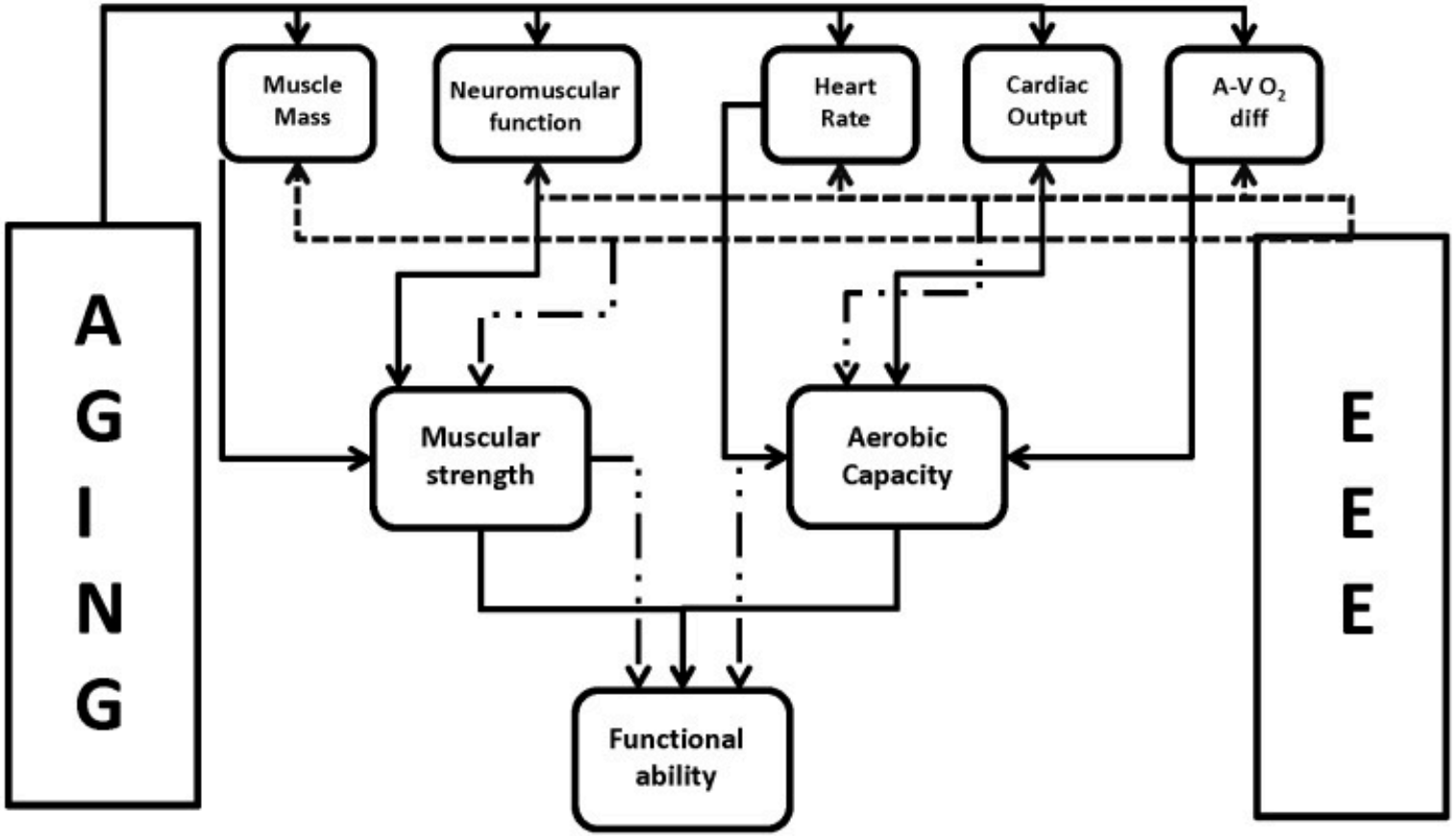
[SEILER et Al. Scand J Med Sci Sports 2006]

Strategies to Improve Running Economy

Kyle R. Barnes · Andrew E. Kilding

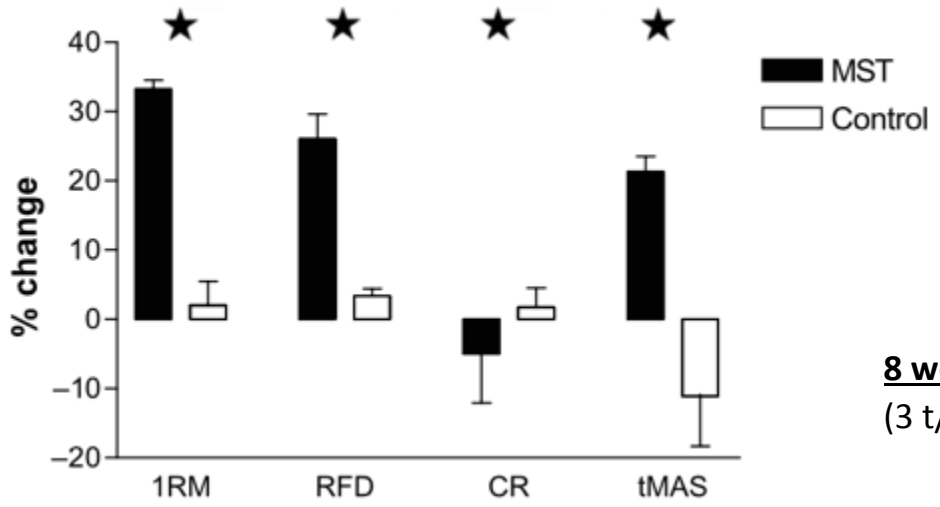


[Beattie K , Sports Med. 2014]



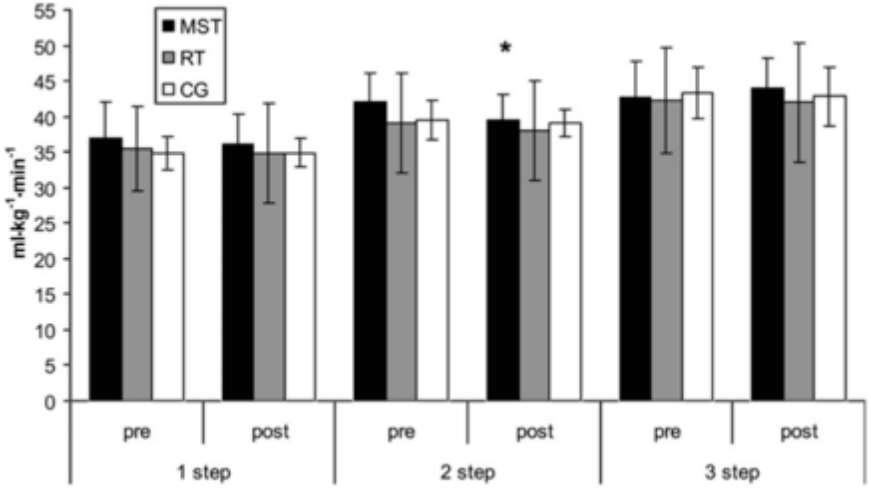
EEE, Eccentric Endurance Exercise; → negative impact of aging; —·→ positive effects of eccentric endurance exercise; - - - → effects of eccentric endurance exercise not known.

[Gault and Willems, Aging Dis. 2013]



8 weeks
(3 t/w: 4 sets-4 rep.) + endurance tr.

[Støren O et Al. Med Sci Sports Exerc. 2008]



6 weeks
MST: (2 t/w: 4 sets-4 rep.) + endurance tr.
RT: (2 t/w: 3sets-10 rep.) + endurance tr.
CTRL: only endurance tr.

[Piacentini MF et Al. J Strength Cond Res. 2013]

Table 1: Comparison of the effects of the resistance exercise on running economy.

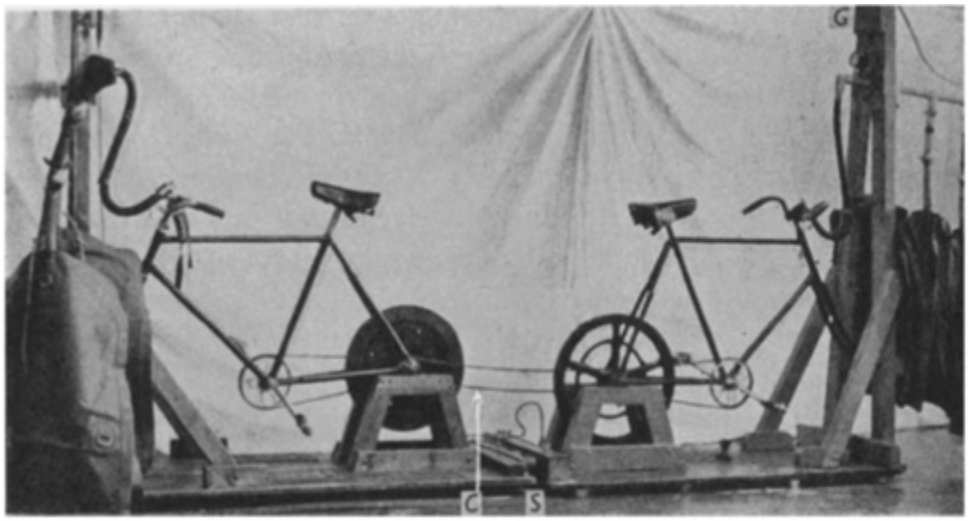
Study	Subjects	EIMD	Muscle damage	VO_2max (%)	RE (%)
Paschalis et al. [10]	10 healthy males	120 eccentric actions	↑ CK, ↑ DOMS, and ↓ ROM, and ↓ strength	55 and 75	√
Burt et al. [12]	9 healthy men	100 squats at 80% body mass	√ CK, ↑ DOMS, and ↓ strength	90	↓ 4-5
Vassilis et al. [87]	24 young healthy men	120 eccentric actions	↑ CK, ↑ DOMS, ↓ strength	70	√
Scott et al. [88]	8 active men and 8 active women	3-4 × 10 repetitions of squat, lunges, step up and step down, and stiff-legged deadlift	↑ DOMS	70	√

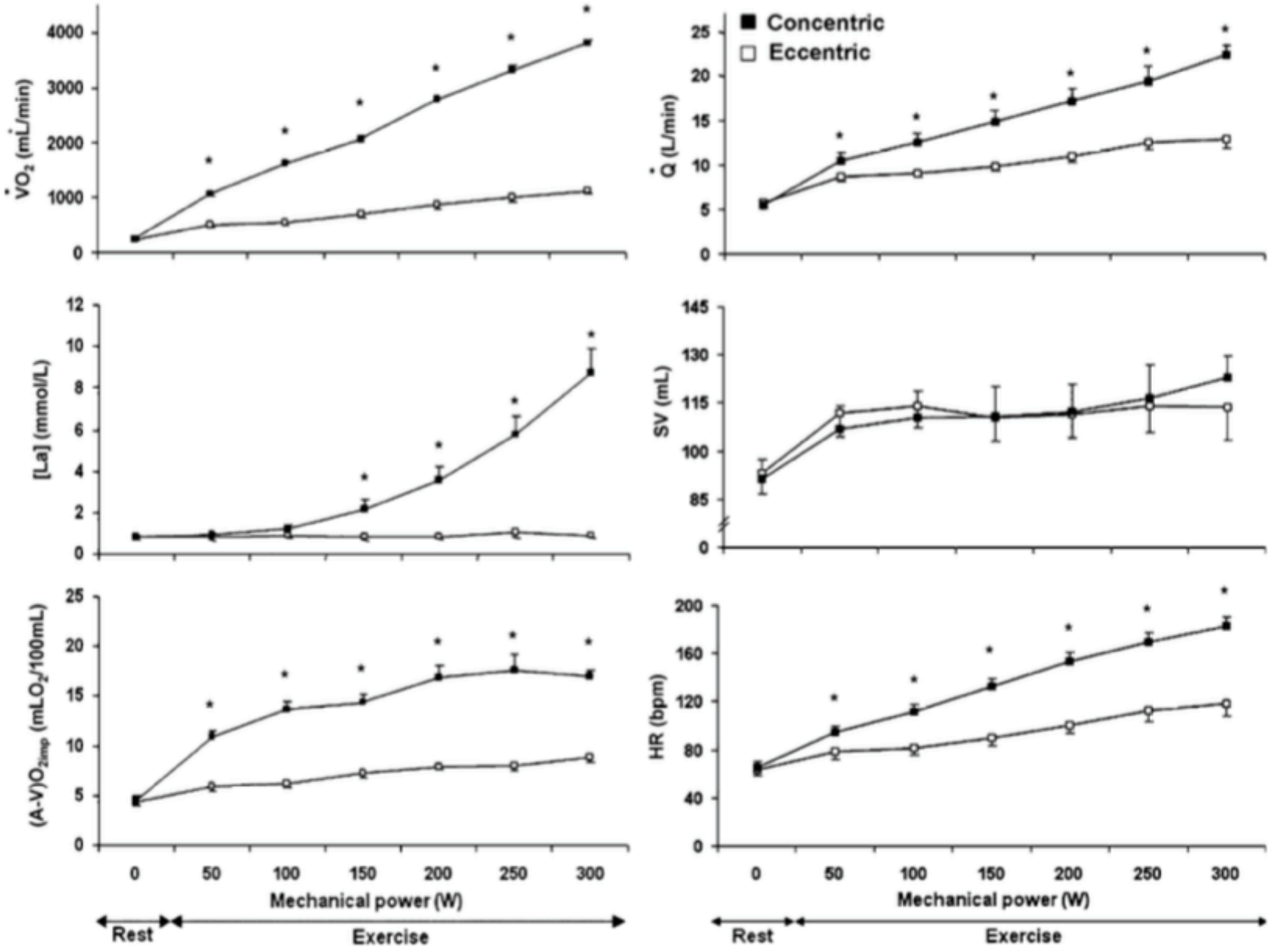
Table 2: Comparison of the effects of the downhill running on running economy.

Study	Subjects	EIMD	Muscle damage	VO_2max (%)	RE (%)
Chen et al. [11]	50 male students	30 min DHR at −15%	↑ CK, ↑ DOMS, ↓ strength, and ↑ LDH	70, 80, and 90	↓ 5
Hamill et al. [92]	10 recreational female runners	30 min DHR at −15%	↑ CK, ↑ DOMS	80	√
Braun and Dutto [93]	9 endurance trained men	30 min DHR at −10%	↑ DOMS	65, 75, and 85	↓ 3
Chen et al. [94]	10 soccer trained men	30 min DHR at −15%	↑ CK, ↑ DOMS, ↓ strength, and ↑ MB	65, 75, and 85	↓ 4–7

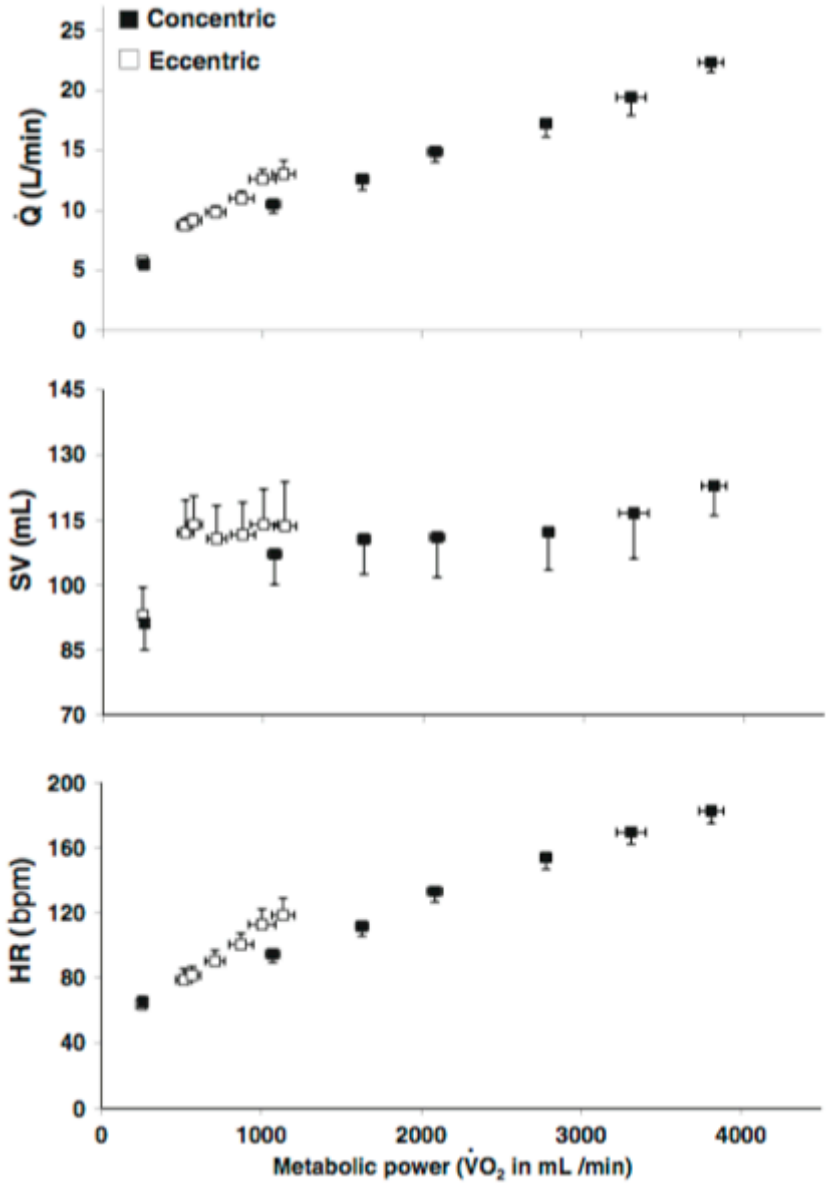
[Assumpção et al. ScientificWorldJournal. 2013]

ECCENTRIC EXERCISES



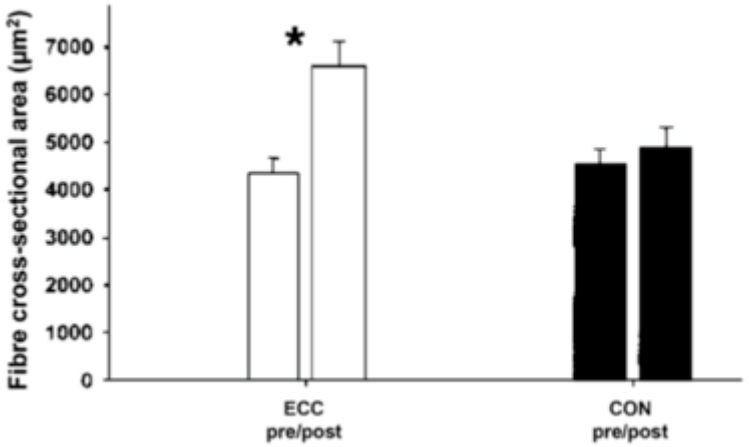


[Dufour et al. Med Sci Sports Exerc. 2004]



[Dufour et al. Med Sci Sports Exerc. 2004]

12 weeks 3 t/w



[LaStayo et al. Am J Physiol 2000]

Compare the RE variation pre-post a regular endurance training program added to a **specific eccentric muscle efforts (**Yo-Yo Leg Press),

versus an **low** or **high intensity** training programs

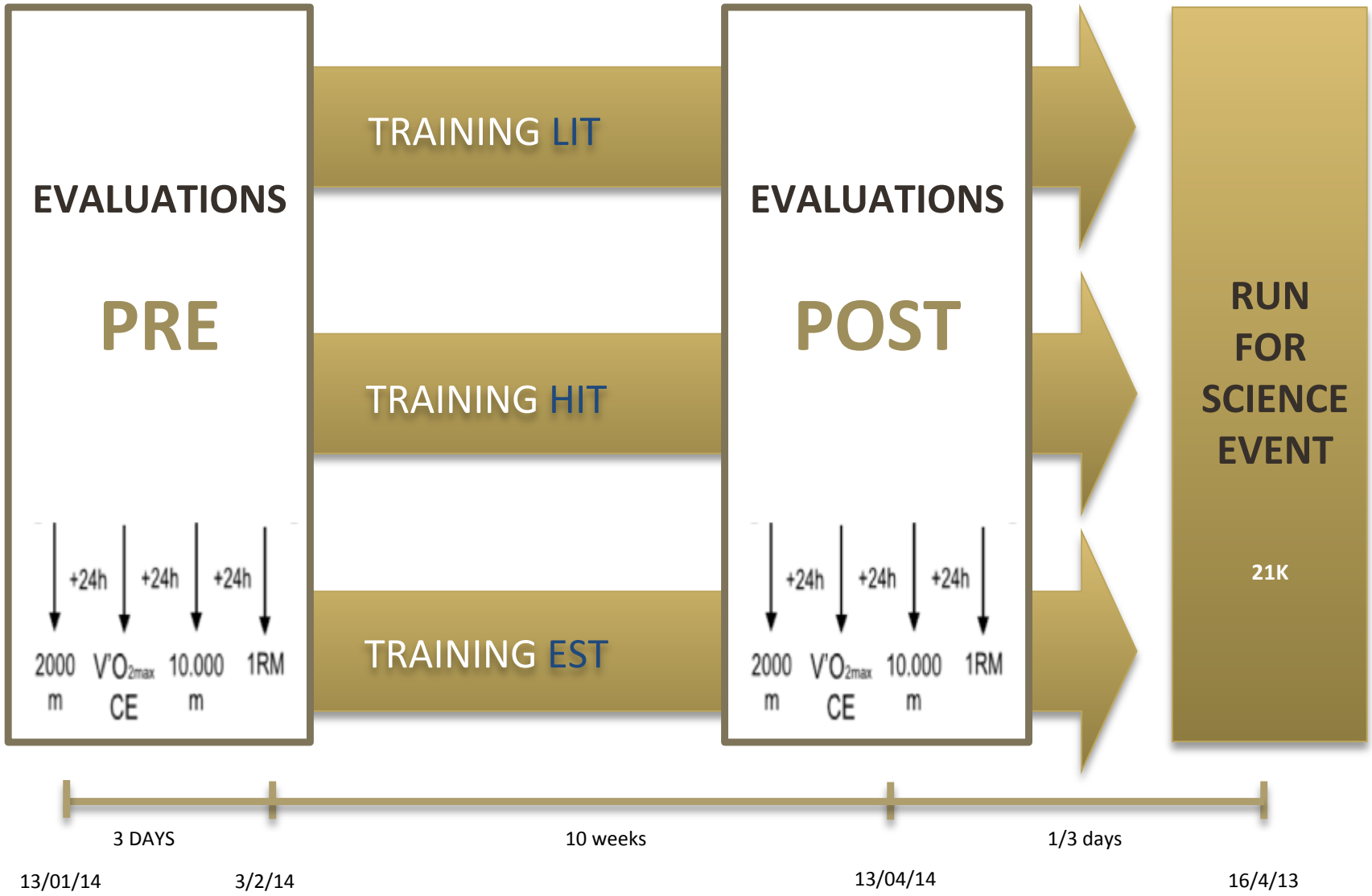
Hypothesis:
in recreational runners, the eccentric strength program, added to a regular endurance training, could lead neuromuscular adaptations allowing benefits in RE

40-50 yy
previous experiences for half marathon in last year

no pathologies
no other sport

		n	Age	Height	Weight	$V'O_{2max}$
Eccentric Strength Training	EST	9	44.5± 6.0	169.0±9.1	71.3±9.4	48.8±5.1
High Intensity Training	HIT	9	42.2±8.6	171.2±6.8	70.9±11.9	50.3±3.7
Low Intensity Training	LIT	11	45.4±8.0	171.8±9.6	66.1±11.7	50.2±6.7

EXPERIMENTAL DESIGN



Bioenergetics & muscle

Gas exchange data analyser, Quarkb2, Cosmed IT

- $V'O_{2max}$; $vV'O_{2max;}$ VT_1; VT_2; CE

Isocinetic LegPress, Technogym IT

- 1RM

Metabolic lab

Body composition

DEXA, QDR Explorer W, Hologic, MA USA

- Fat Free Mass, (FFM, %FFM)
- Fat Mass, (FM, %FM)
- total body and arm/leg

Anthropometry lab

Field performance

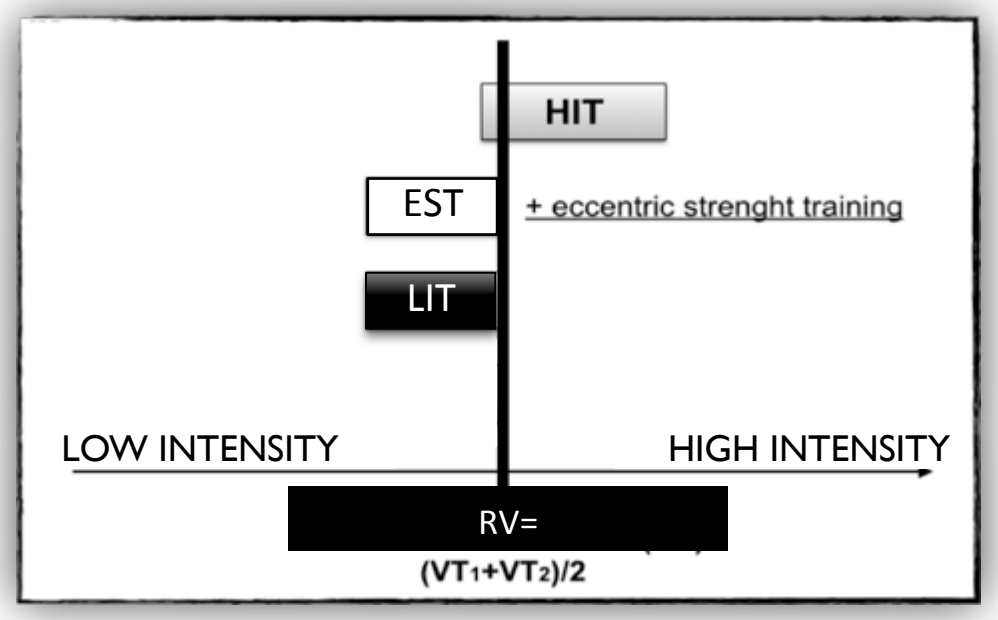
- Vmax 2 – 10 – 21 km

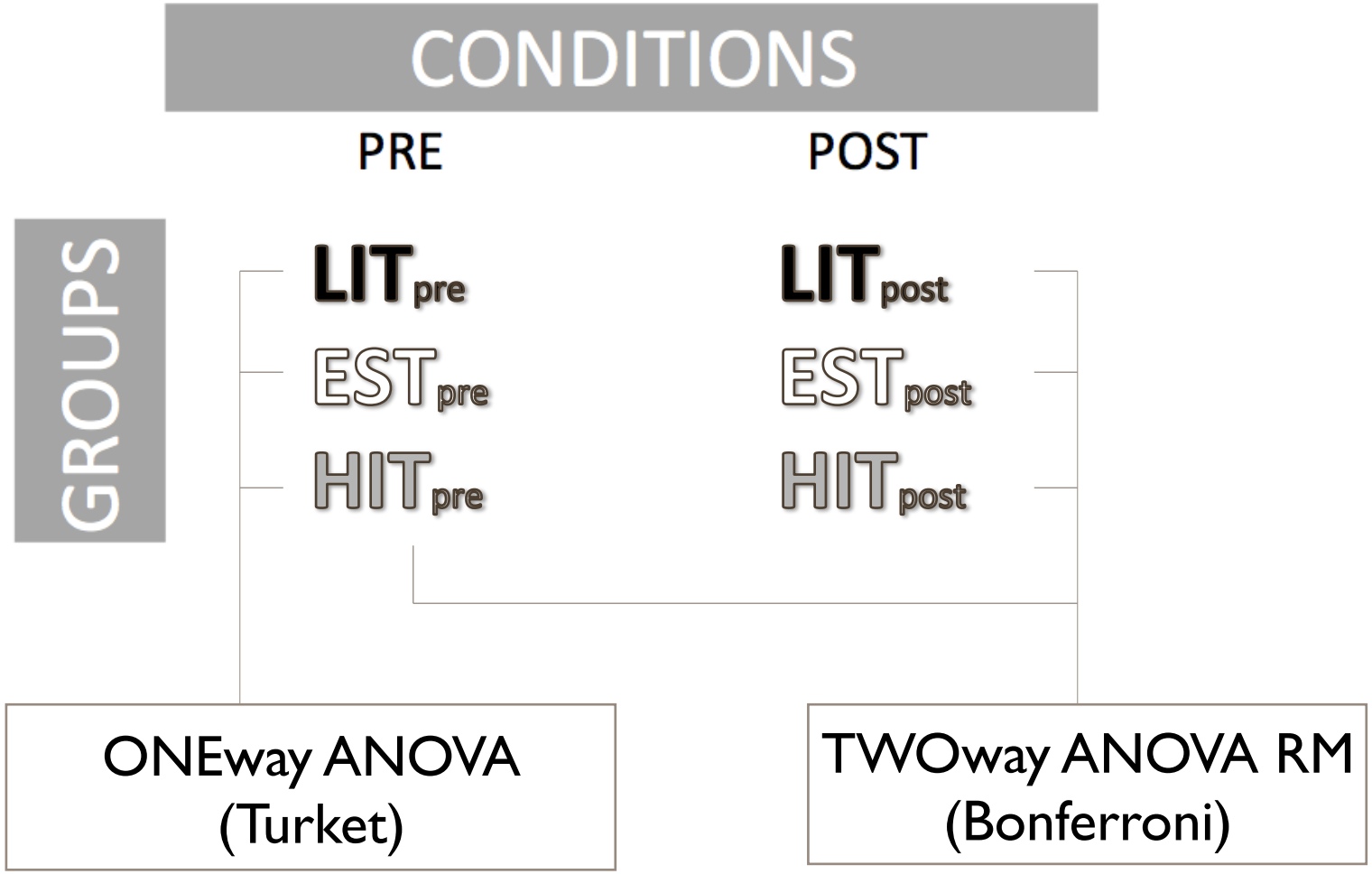
Centro Maratona

HIT: 3 t/w sessions, running @ 95-140% of RV

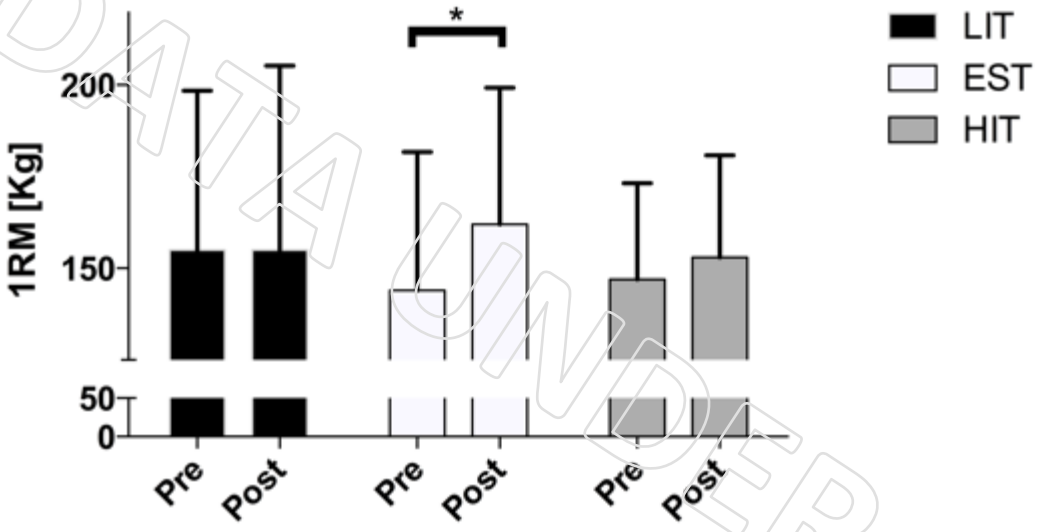
EST: training characterized by 1 t/w 4set 7rep. on Yo-Yo Leg Press at maximal power + 3 t /w sessions, running @ 70-105% of RV

LIT: 3 t /w sessions, running @ 70-105% of RV



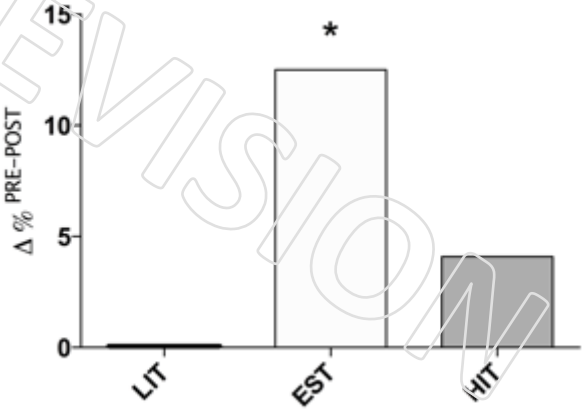

CONDITIONS
PRE
POST
GROUPS
LIT pre
EST pre
HIT pre
LIT post
EST post
HIT post
ONEway ANOVA
(Turket)
TWOway ANOVA RM
(Bonferroni)

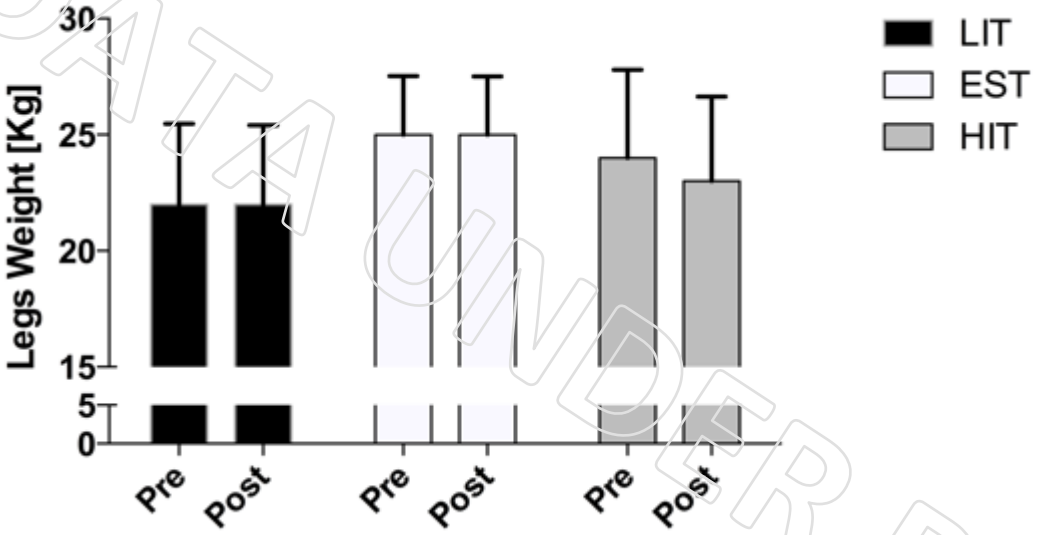
* $p<0.05$



P value ≤ 0.05

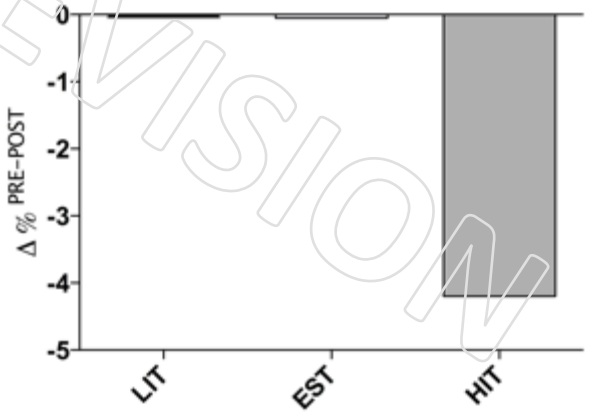
1RM shown a significant increase from 144 to 162 kg for the group EST

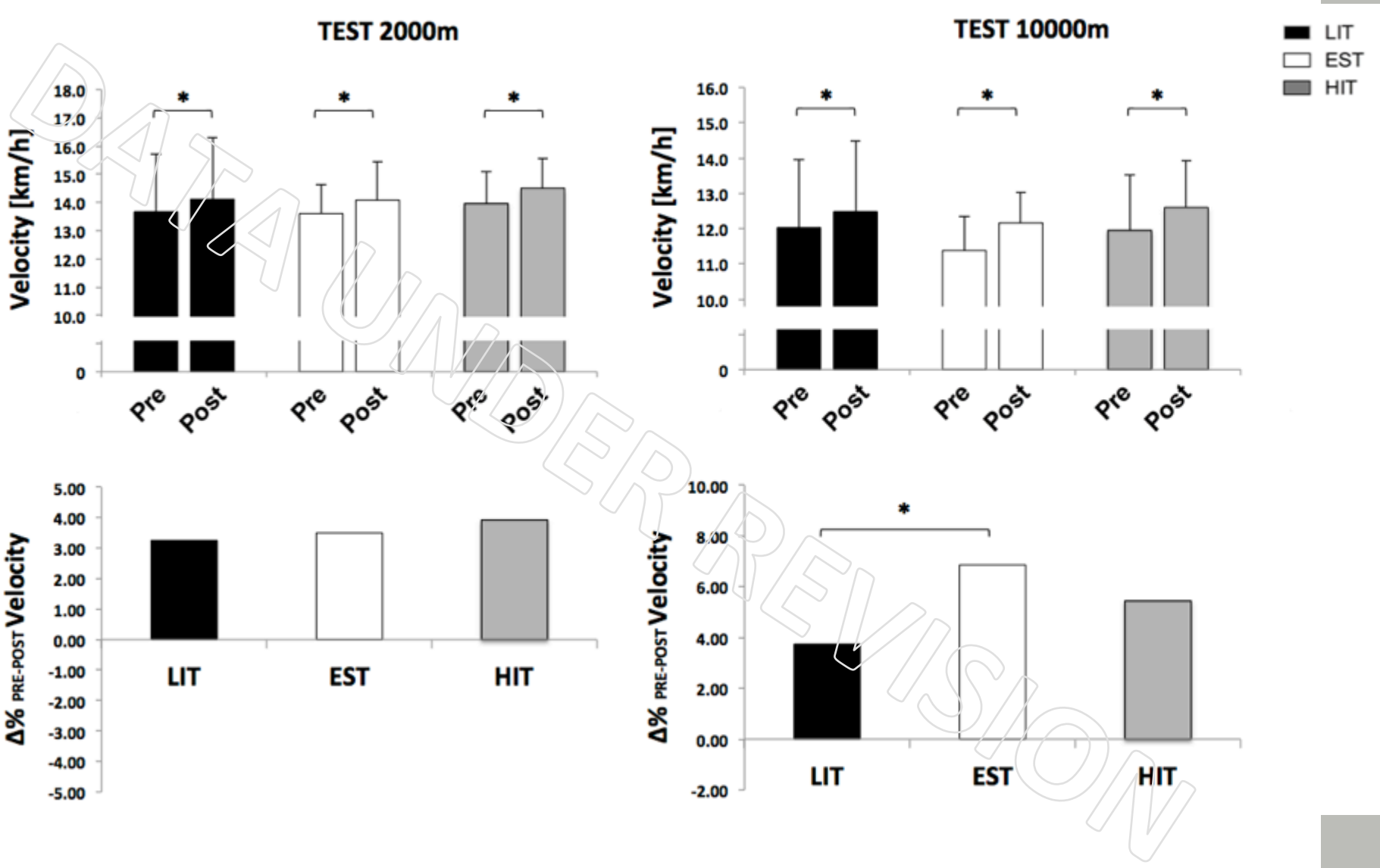


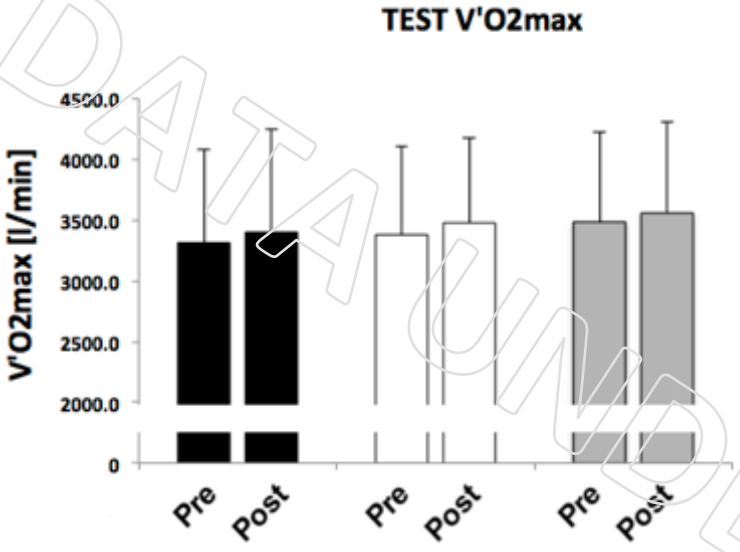


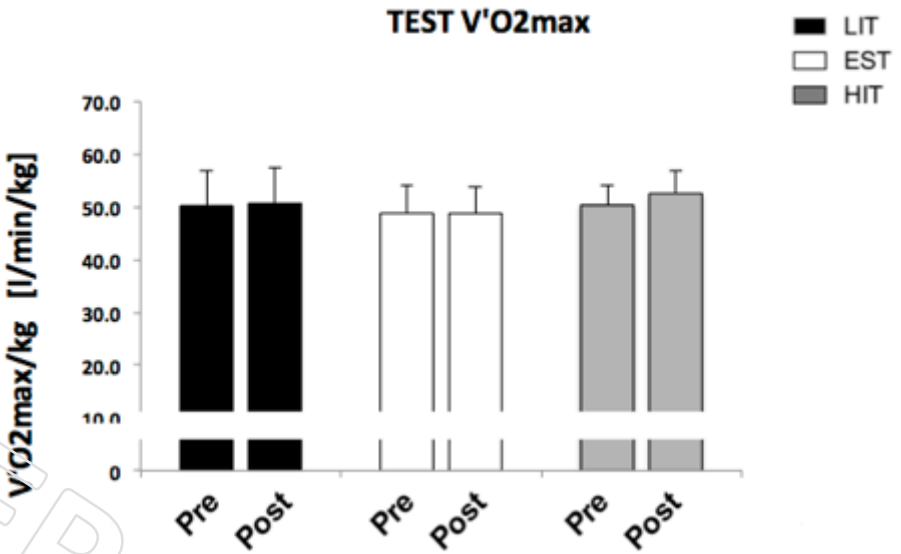
P value ≤ 0.05

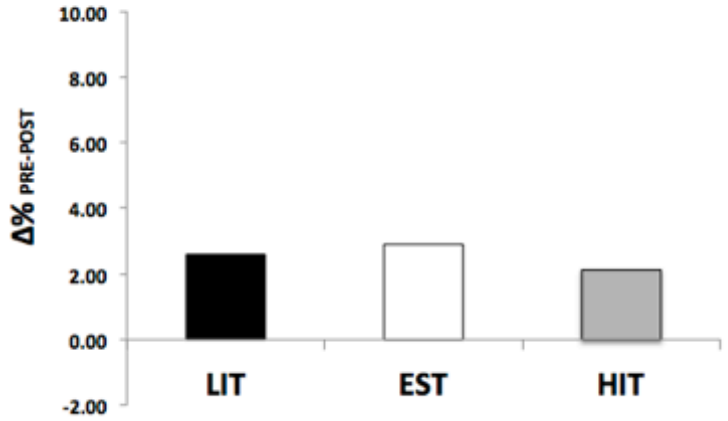
There was no significant change in Fat Free Mass of Legs in any groups

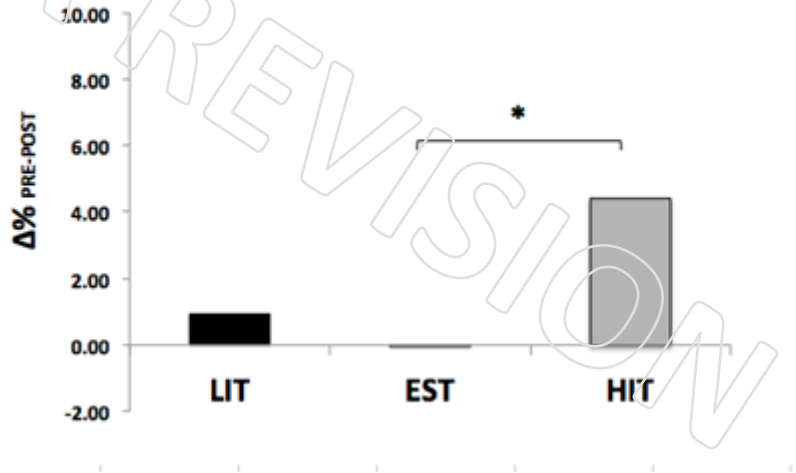


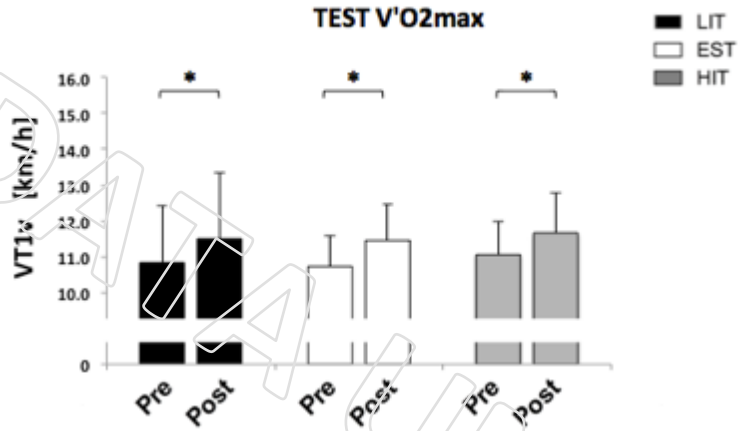


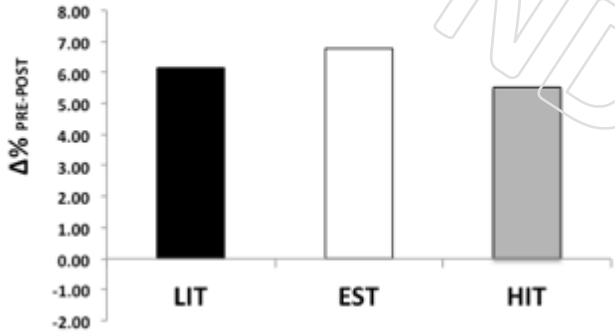


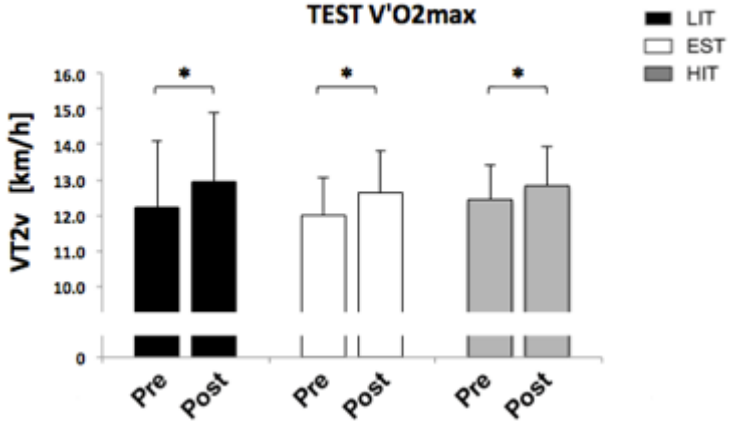


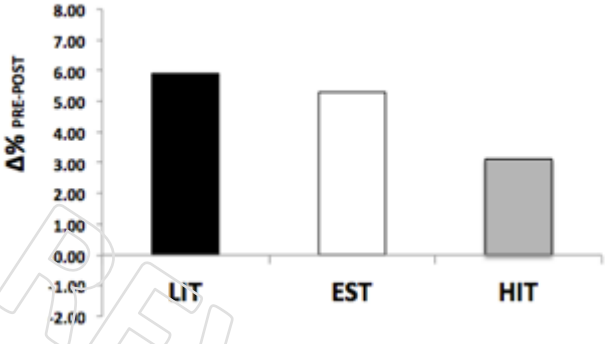


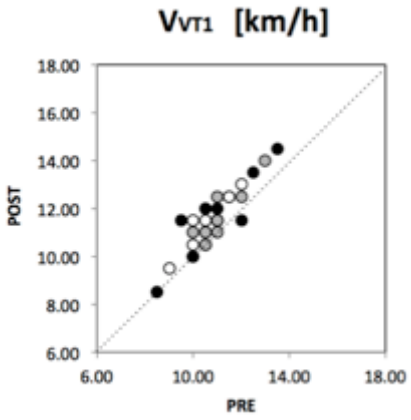


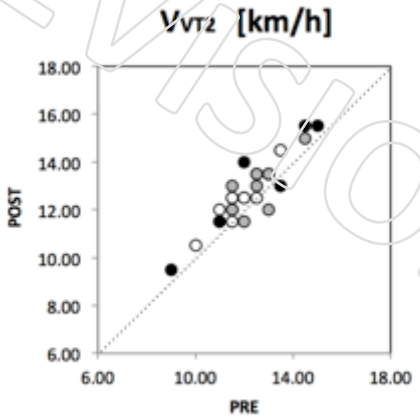


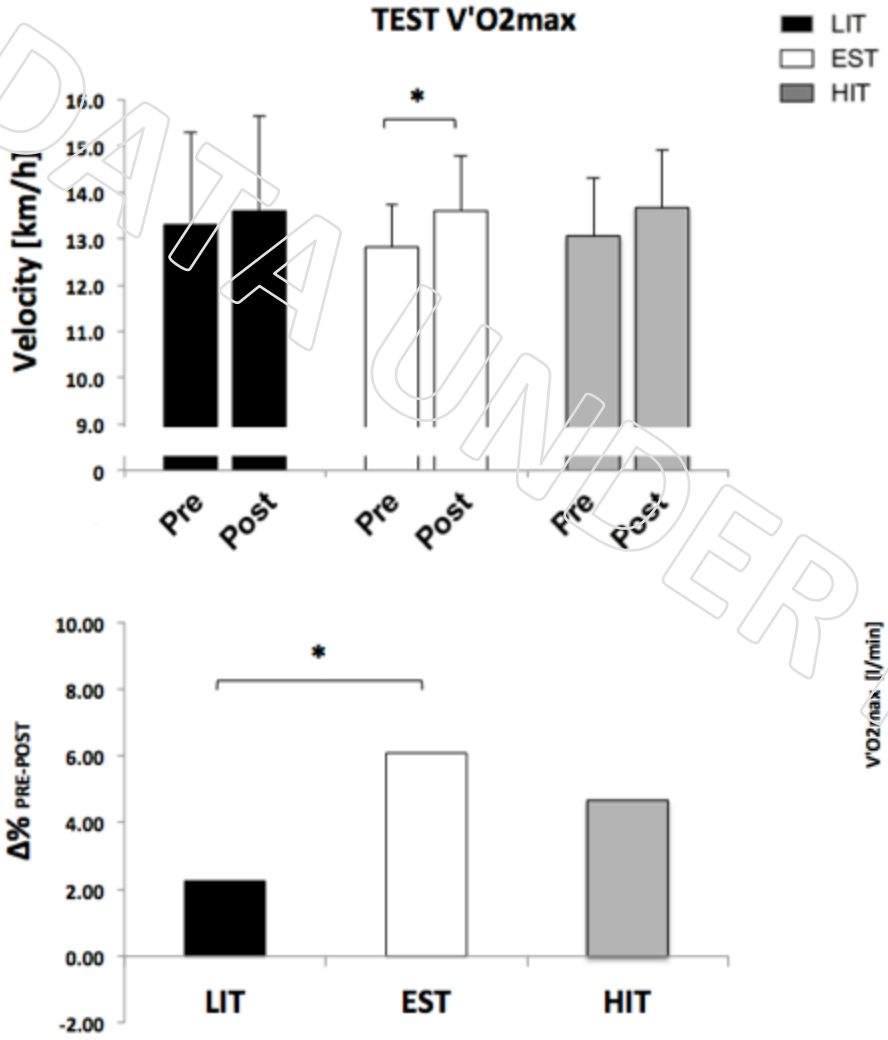




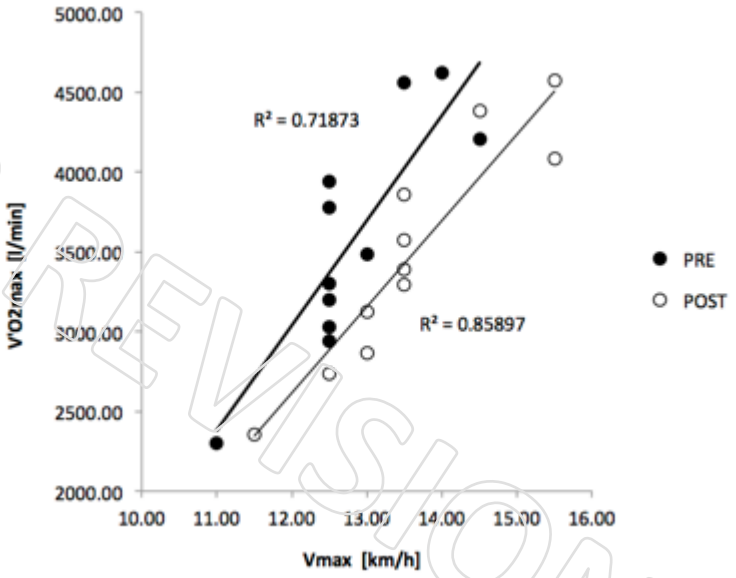


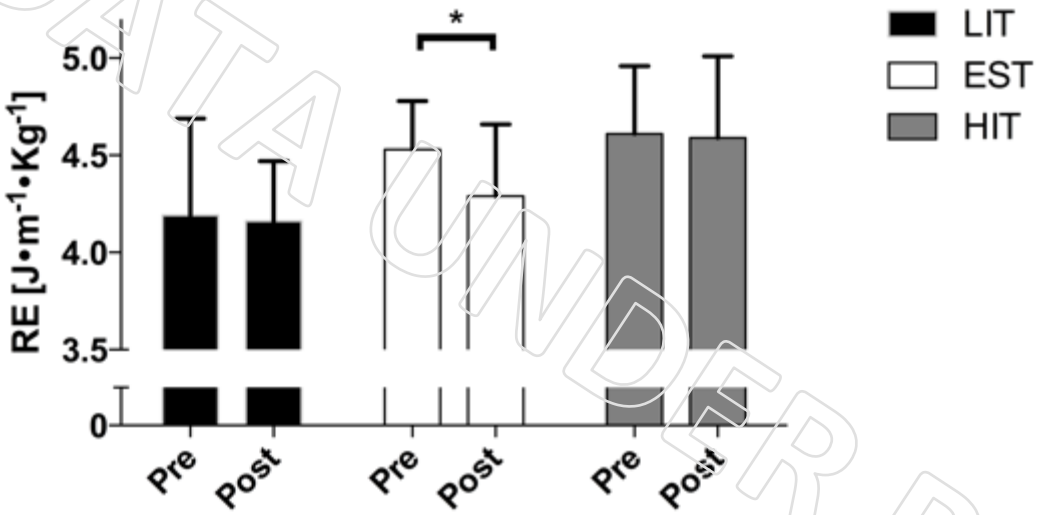




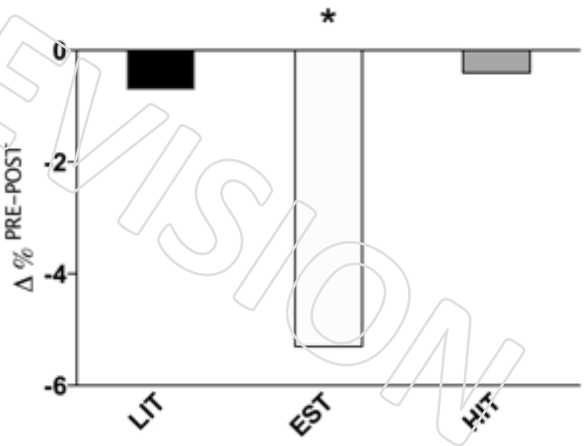


IMPROVED EFFICIENCY IN EST



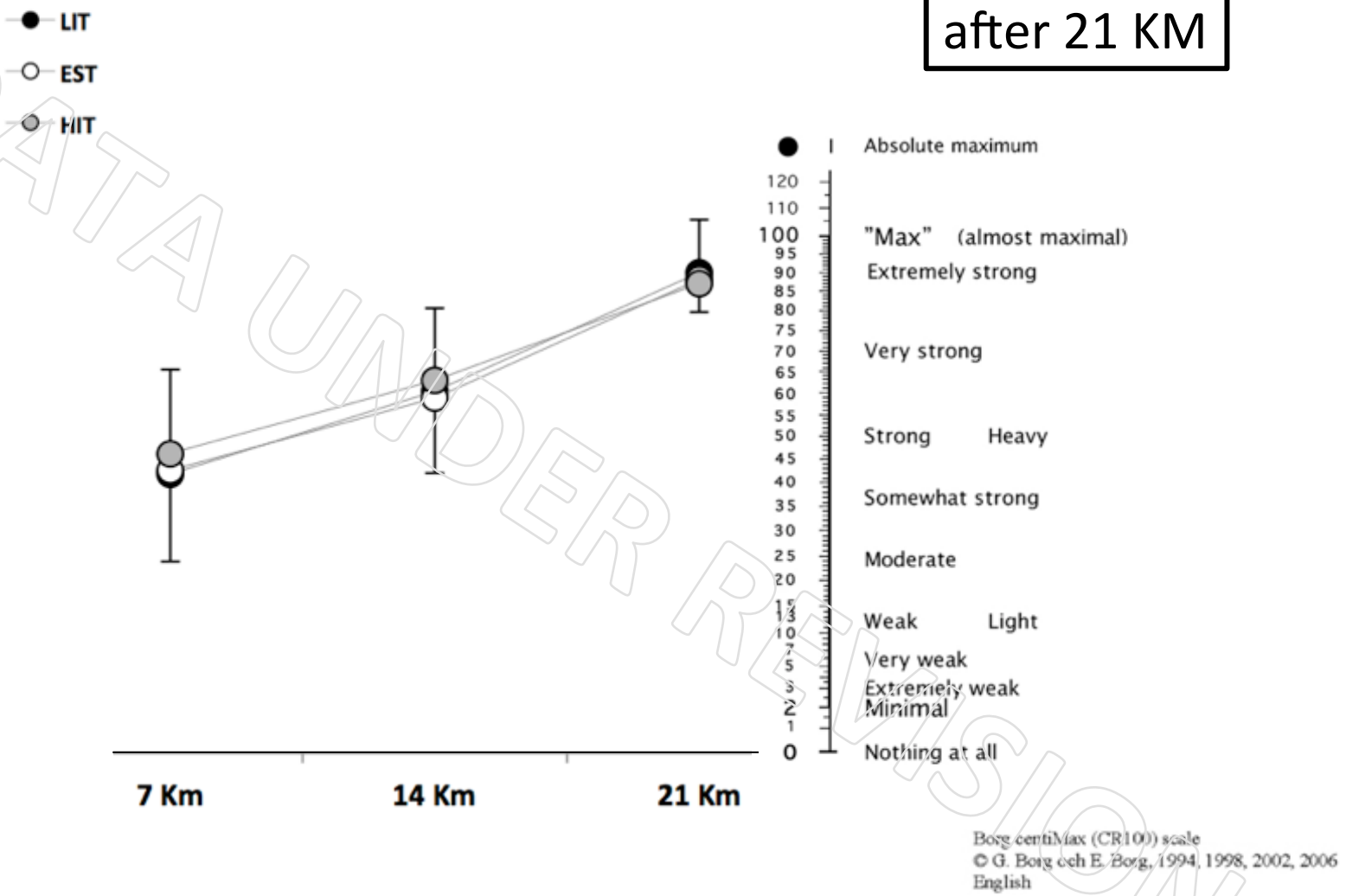


P value ≤ 0.05

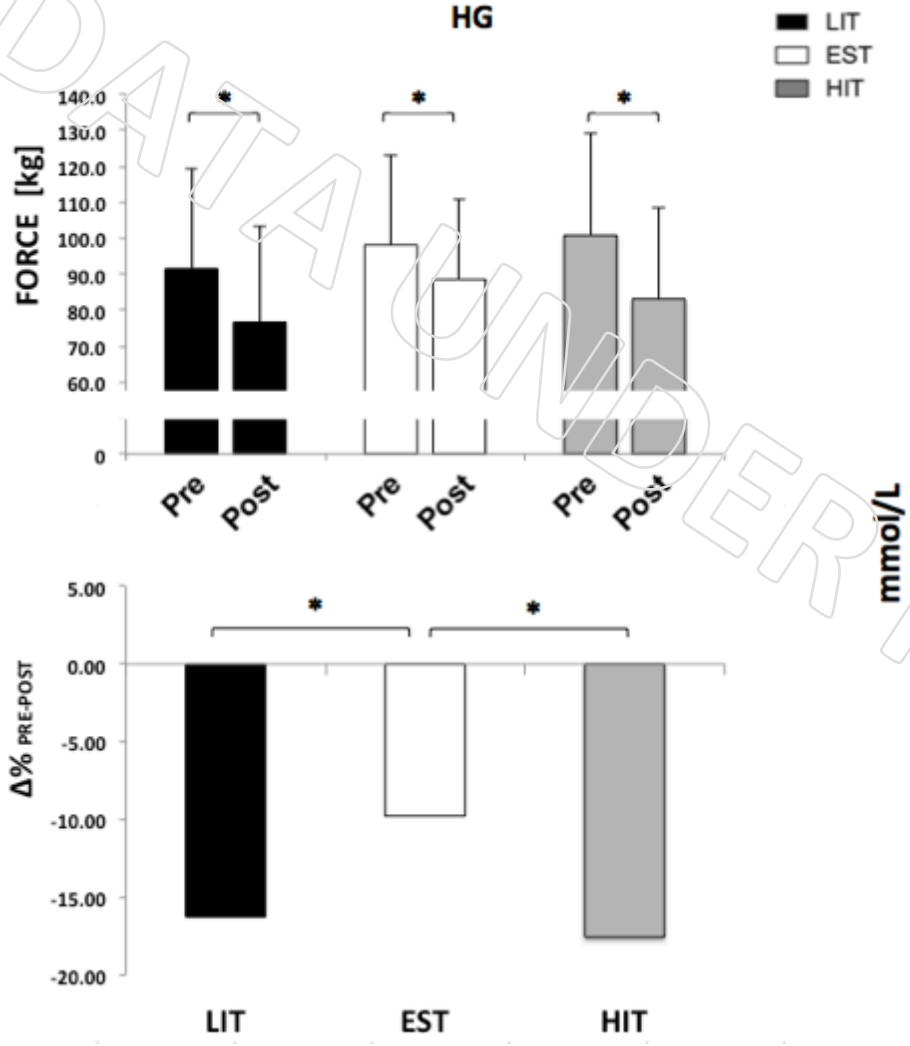


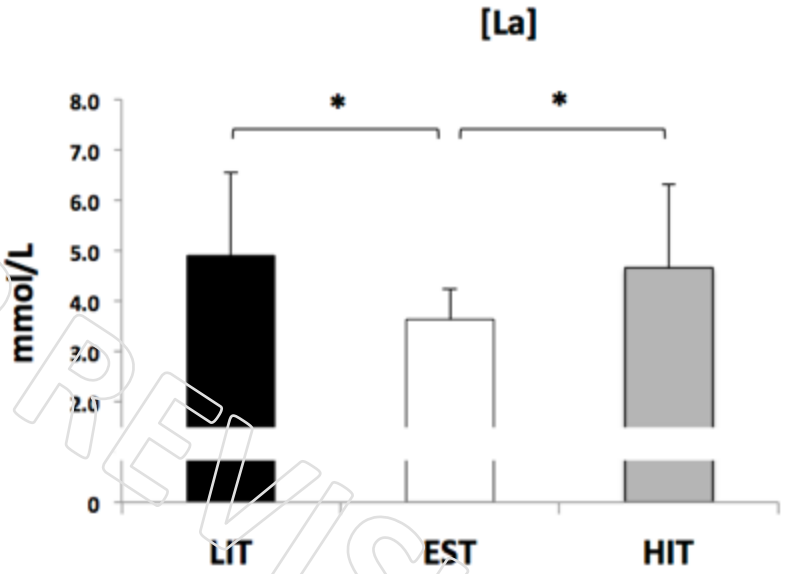
RE shown a significant reduction from 4.5 to 4.3 $J \cdot m^{-1} \cdot kg^{-1}$ for the EST group

after 21 KM

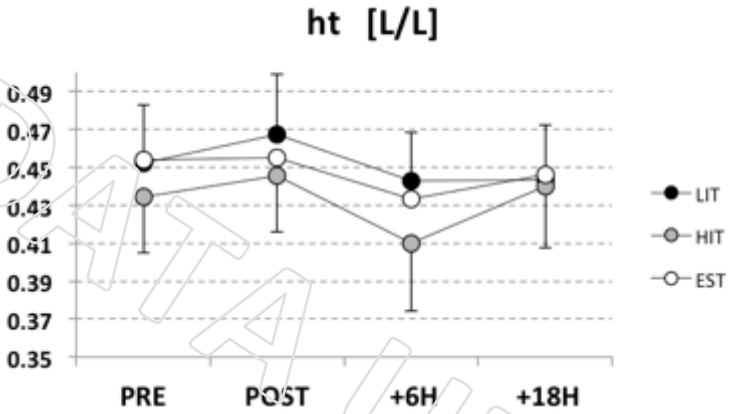


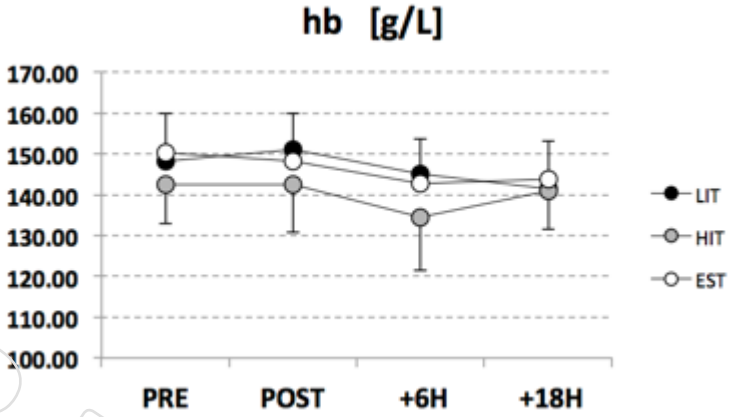
after 21 KM

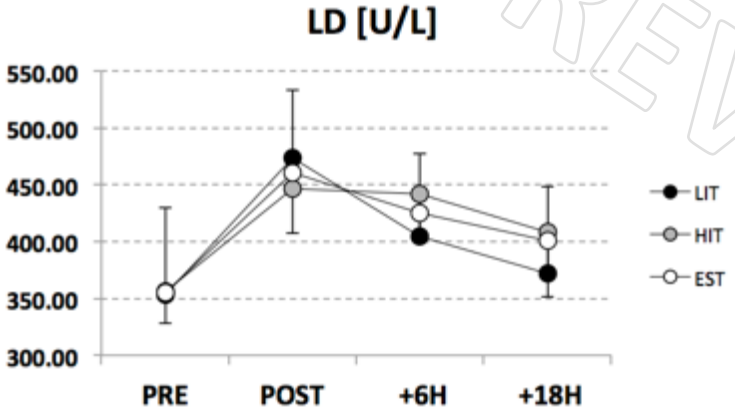




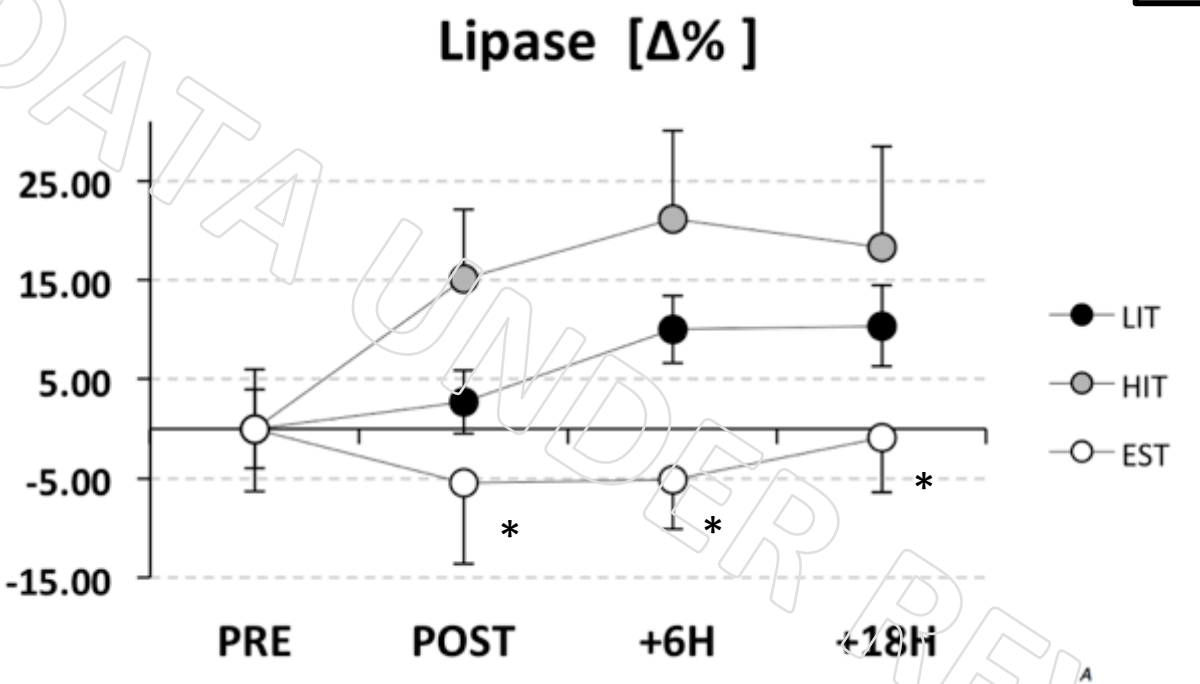
after 21 KM

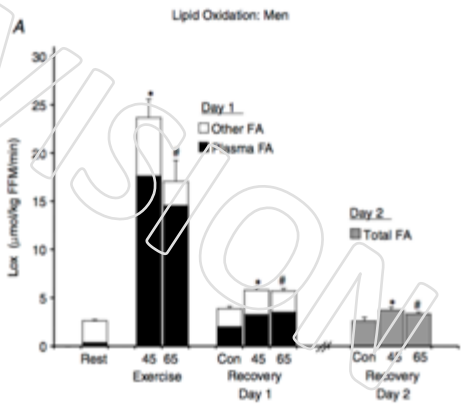




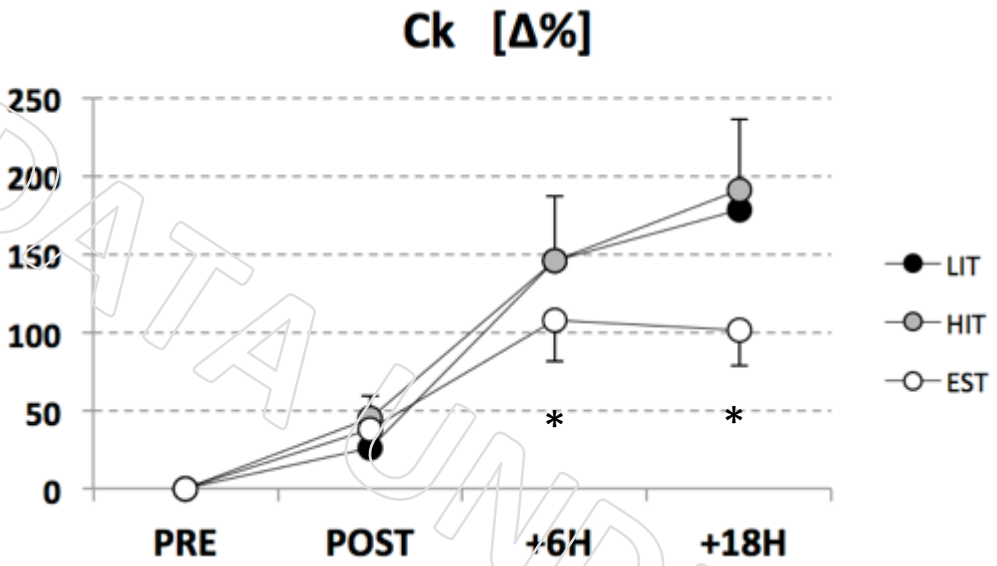


after 21 KM

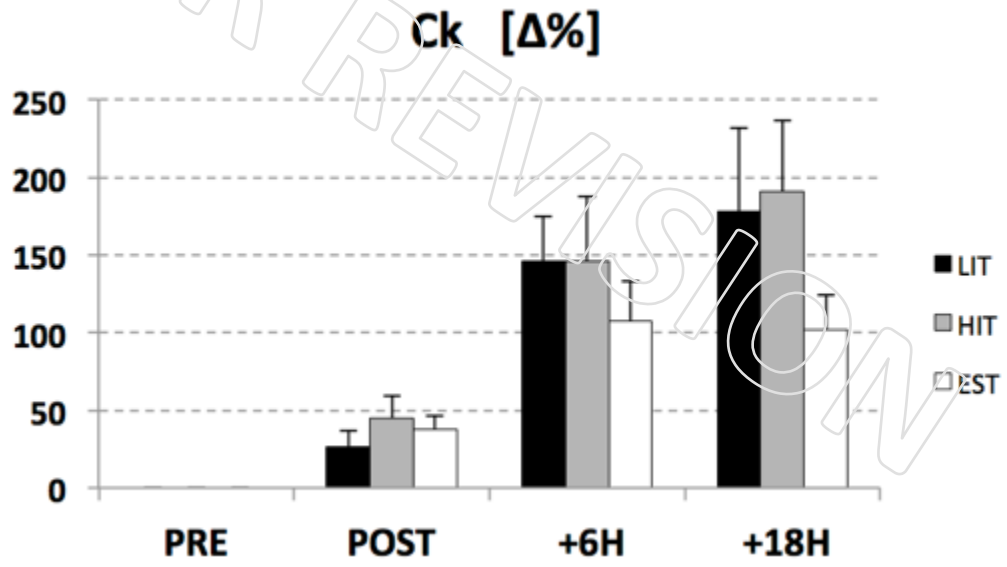




Henderson et al. J Physion 2007



after 21 KM



- -5.3% in RE is in agreement with the previous studies
- +12.5% in 1RM without hypertrophy is slightly lower than the results existing in literature
- a reduced cK at +6hh and +18hh after the effort

This results could be explain by neural adaptation such as:

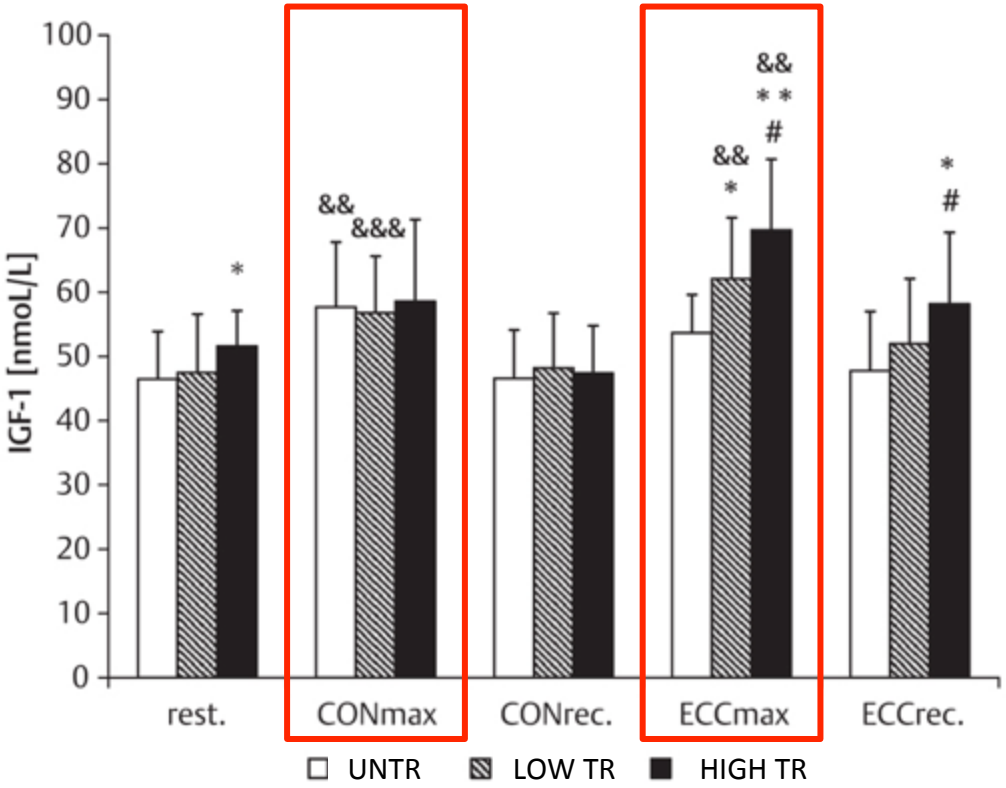
An increased muscle activation

A better sinchronization of motor units recruitment
(A greater efficiency in coordination intra/intermuscolar)

An increased α - motor neurons threshold

A decreased inhibition of Golgi's apparatus
(Paavolainen 1999, Taipale 2013)

And perhaps an implication of IGF-1 factor…



[Żebrowska A et Al. INT J SPORTS MED. 2013]

1 t/w of 4 sets of 7 rep. of ECCENTRIC EXERCISE
is sufficient to improve RE and 1RM
without muscle hypertrophy (and without injuries)

This training method, therefore, appears good
for recreational runners in terms of:

- ✓ Facility of execution
- ✓ Safety
- ✓ Saved time

Acknowledgements

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Dr. Kristina Skroce

CentroMaratona staff

Prof. Lippi Giuseppe
Prof. Salvagno Gian Luca
Clinical Biochemistry staff

Dr. Chiara Milanese
Dr.MF Piacentini