

# FISIOLOGIA DELLO STRETCHING

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# INTRODUCTION

## Acute passive stretching:

- Increases joint range of motion
- Reduces risks of injuries
- Improves performance

# Stretching and anaerobic performance

- ✓ decreases maximum force and power
- ✓ reduces performance

Fowles, J Appl Physiol (2000)

Kokkonen, Res Q Exerc Sport (2001)

Nelson, J Sports Sci (2004)

Cè, J Sports Sci (2008)

Costa, Int J Sports Med (2009)

## Two main mechanisms:

### Neural changes:

Decreased moto-neuron excitability (pre- and post-synaptic mechanisms)

### Muscle-tendon unit changes:

Increased muscle-tendon unit compliance, reduction in passive tension, alteration of muscle elasticity and tension/length relationship

**Mainly type II motor units**

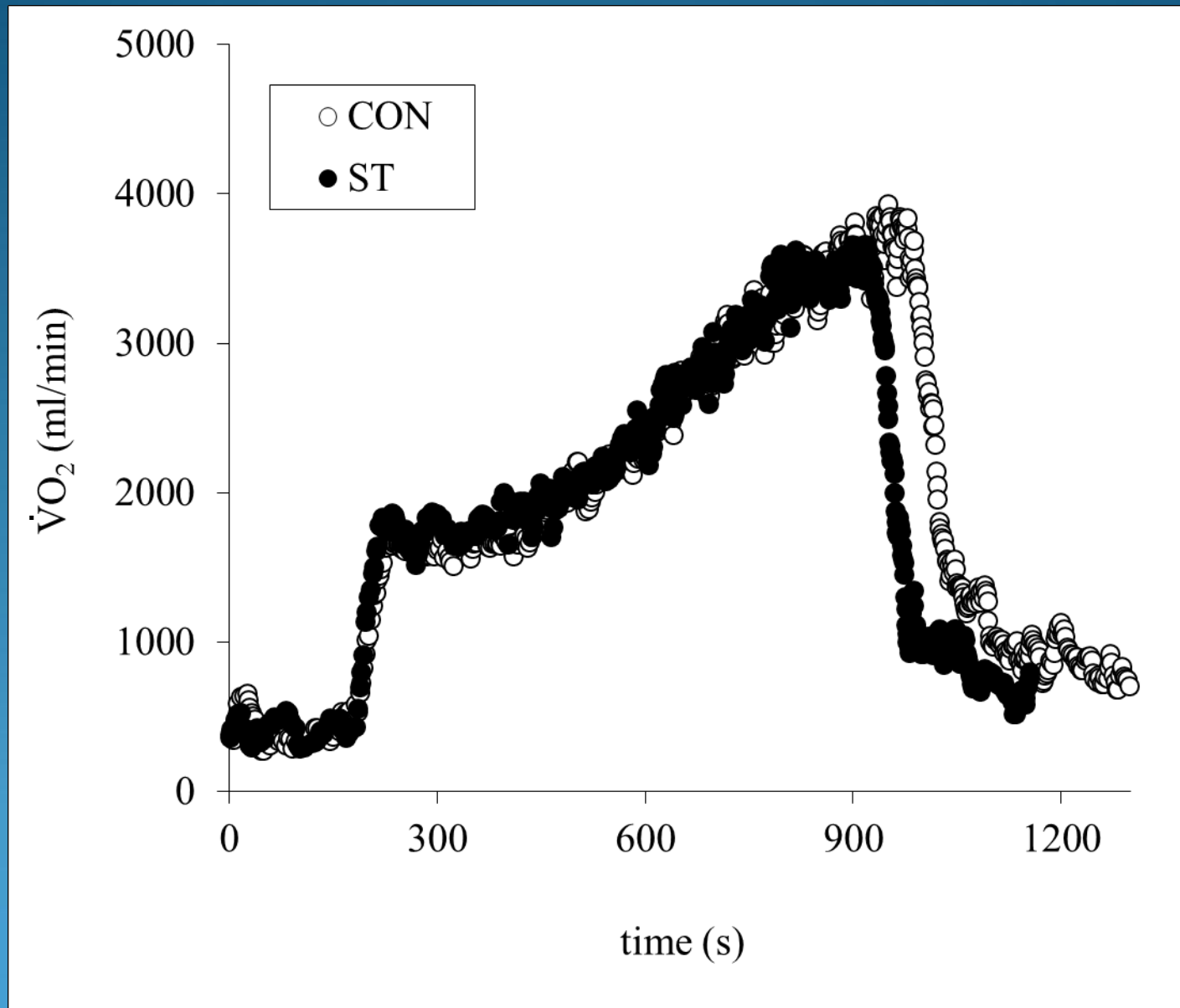
# AIM

To assess stretching-induced effects on maximum aerobic power and endurance

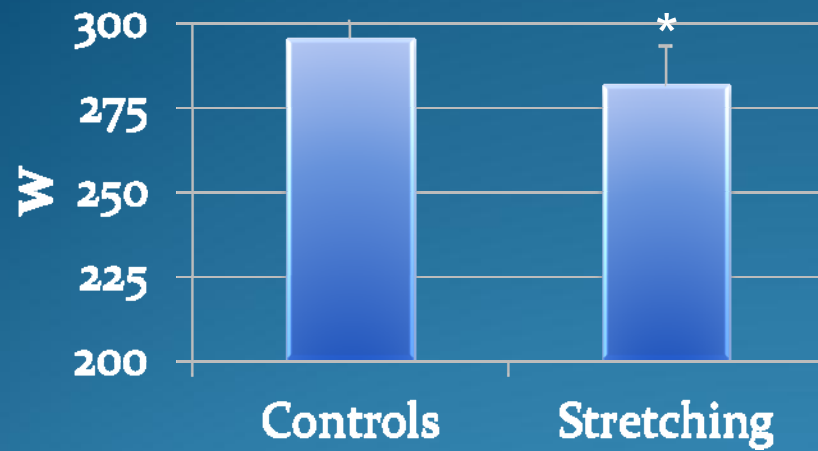
# METHODS

- Ten active males (age  $23 \pm 5$  yrs; body mass  $69 \pm 7$  kg; stature  $171 \pm 9$  cm; mean  $\pm$  SD)
- Ten tests (5 with and 5 without stretching) on a cycle ergometer ( $100 \pm 3$  rpm), in a random order
  - Two square-wave maximum incremental tests
  - Two ramp maximum incremental tests
  - Six tests at  $85\% \dot{V}O_{2 \max}$  ( $\dot{W}_{85}$ ), until exhaustion
- Stretching routine: 5 x (45 s on / 15 s off)
- Measurements: gas exchange, cardio-respiratory parameters, lactate concentration

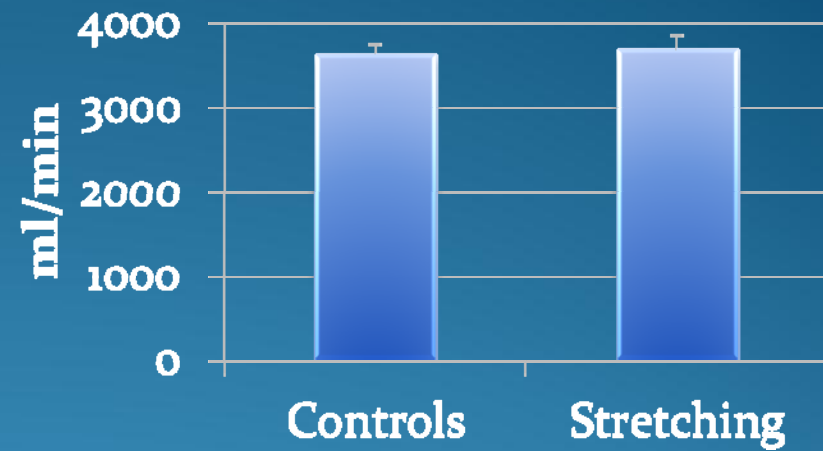
# RAMP MAXIMUM INCREMENTAL TEST



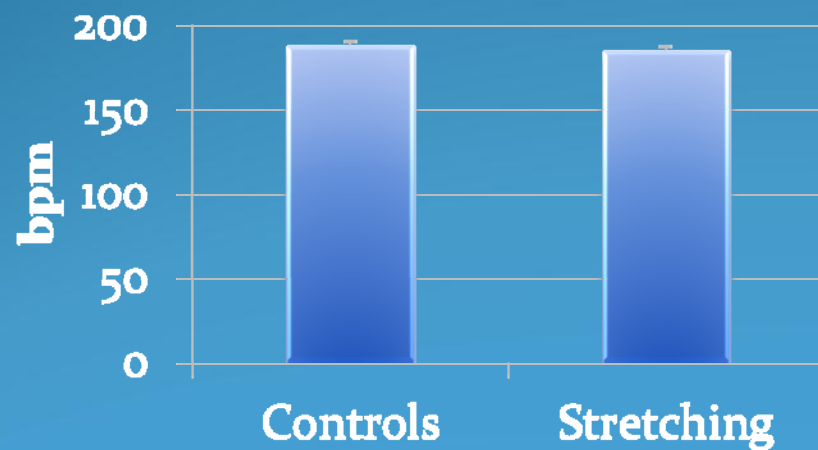
## Power<sub>max</sub>



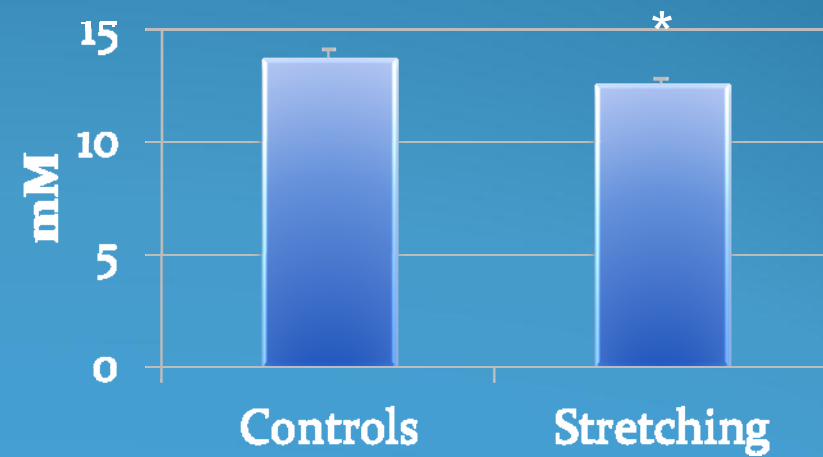
## Peak O<sub>2</sub> uptake



## Heart Rate<sub>max</sub>

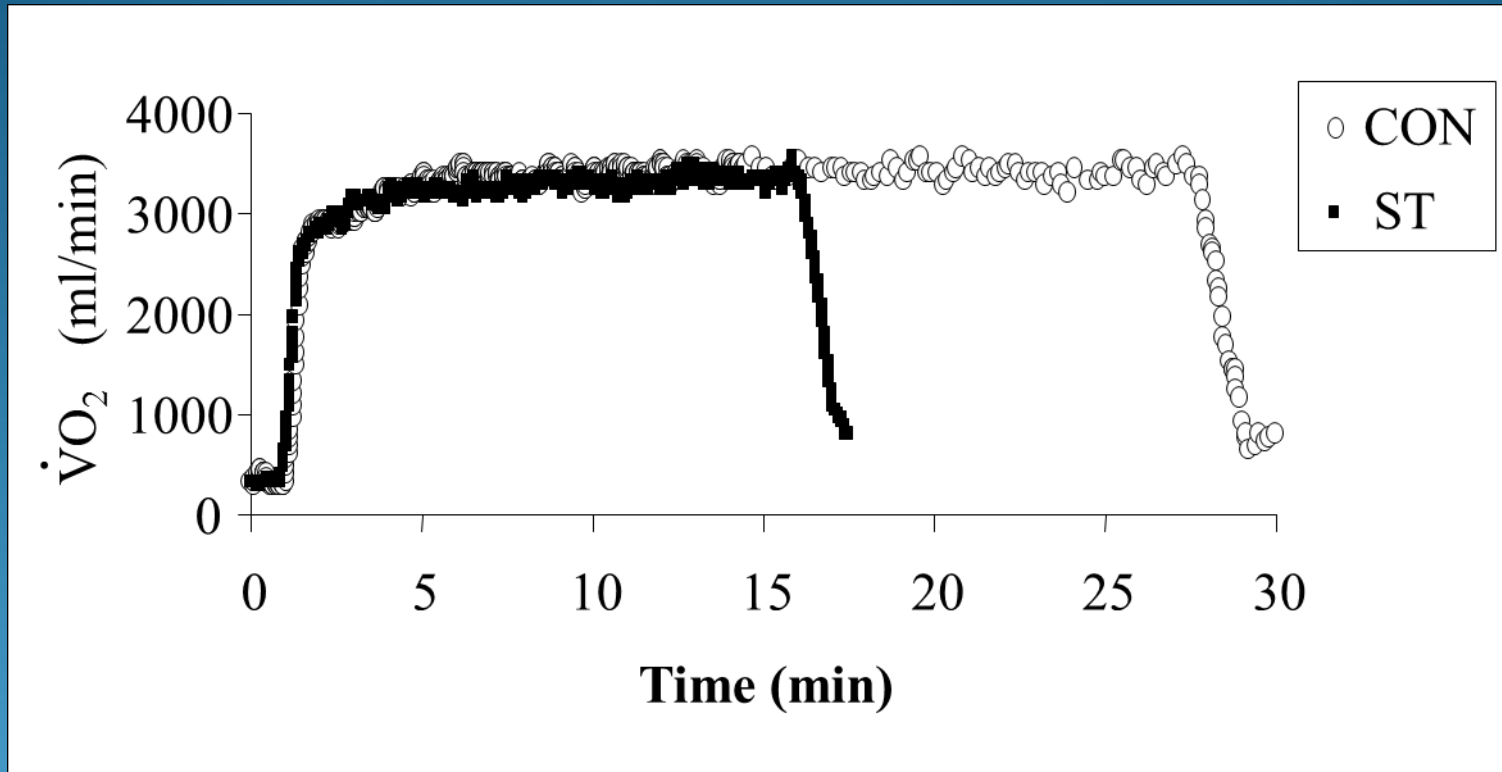


## Peak [La]

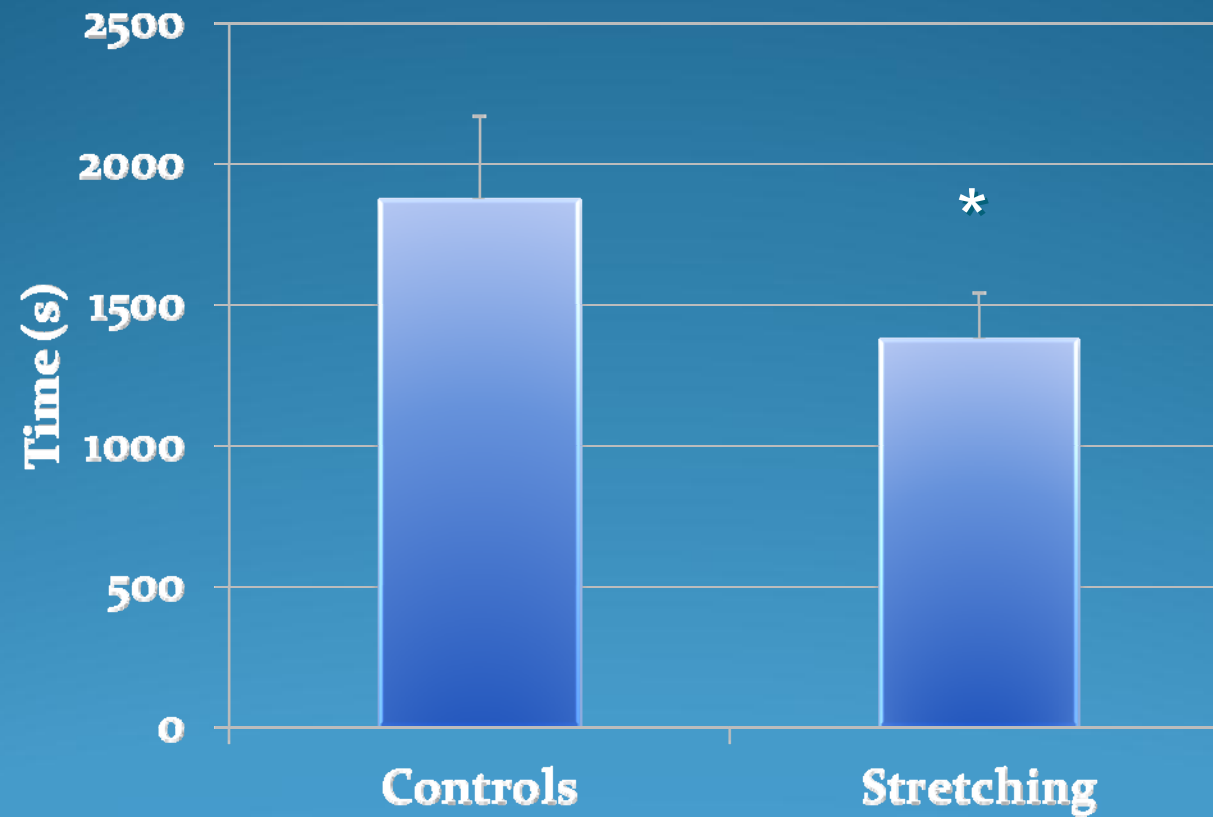




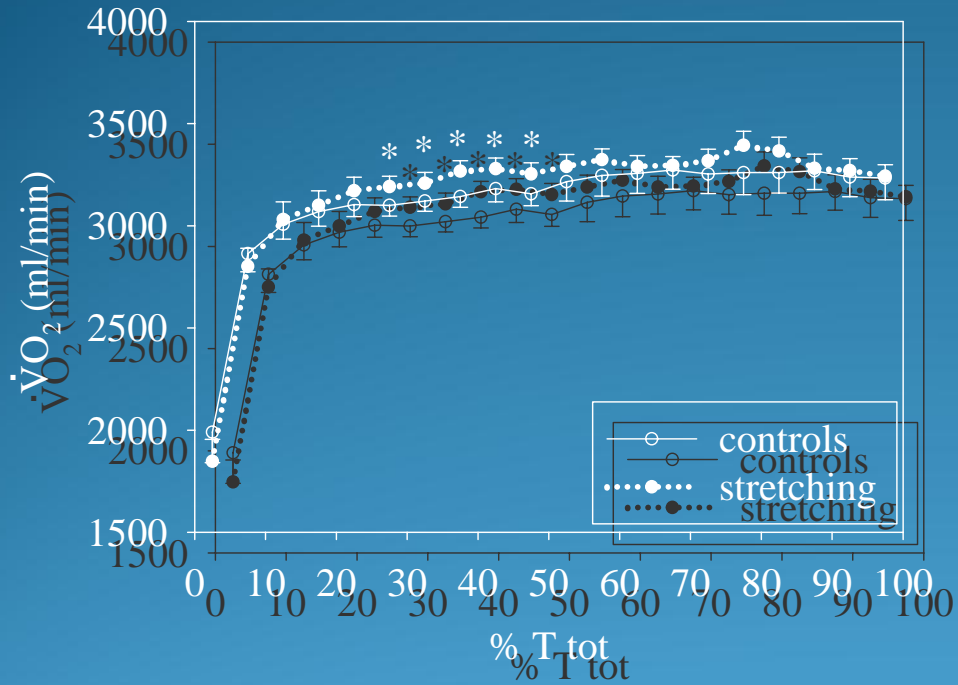
$\dot{V}W_{85}$



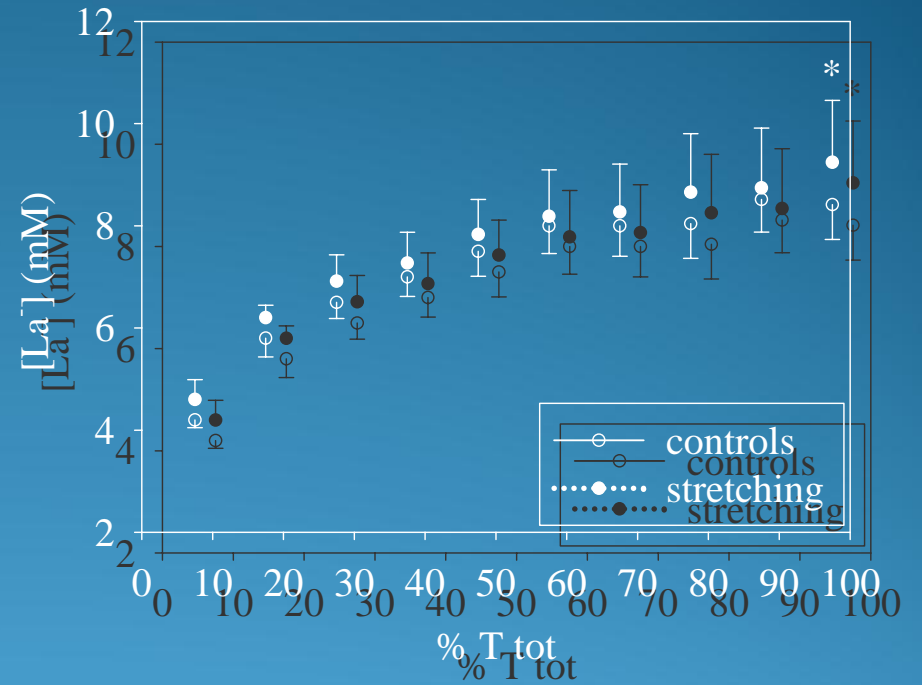
# Exercise duration

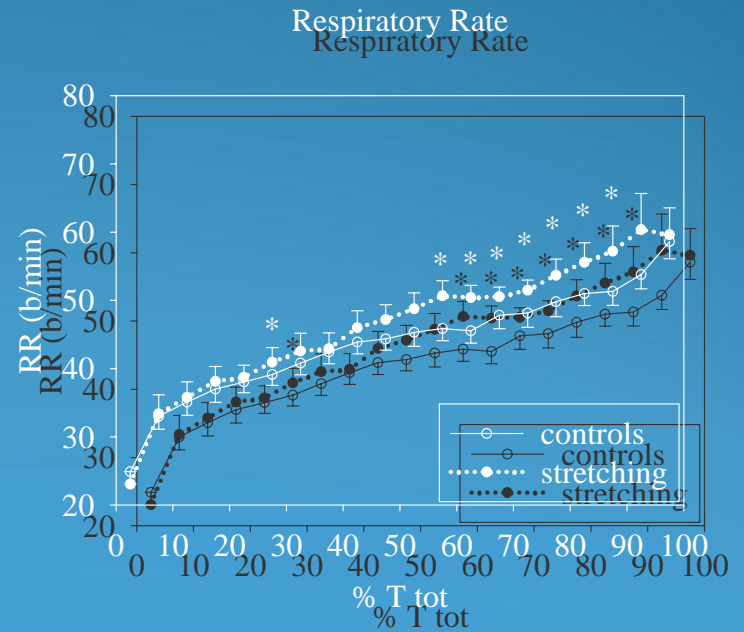
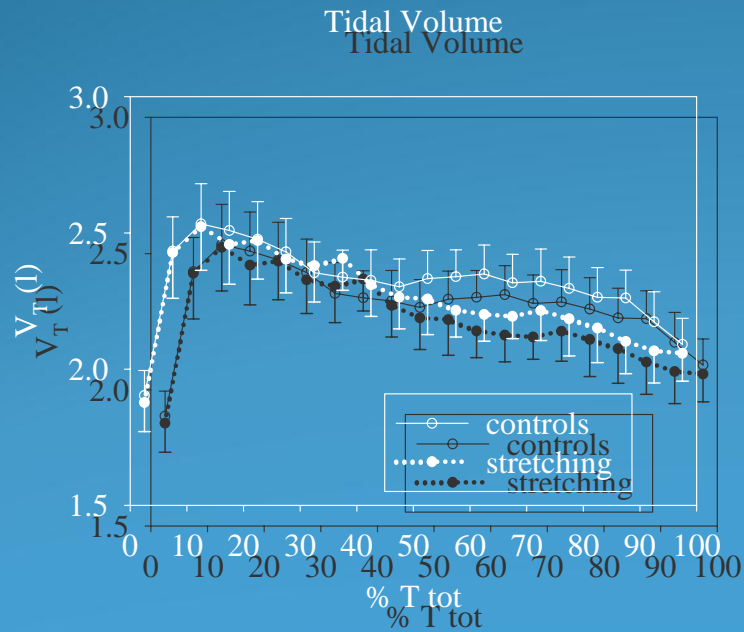
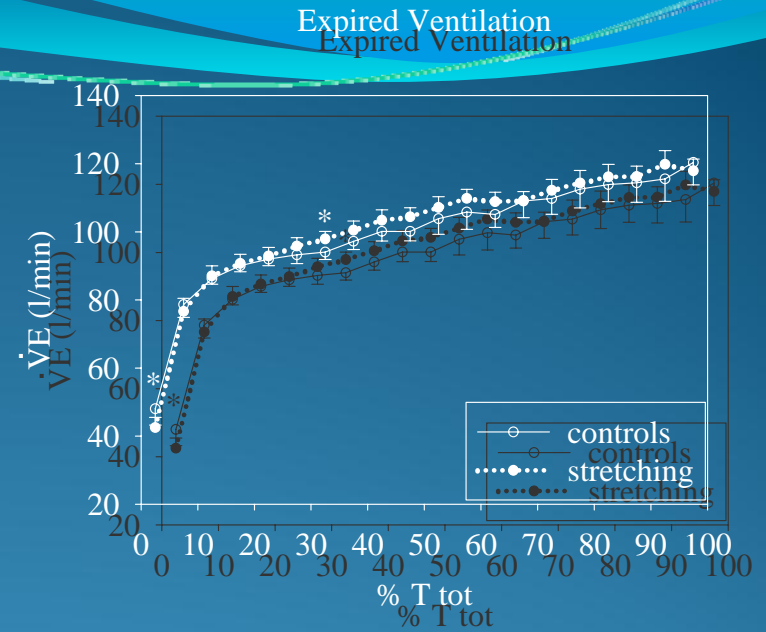
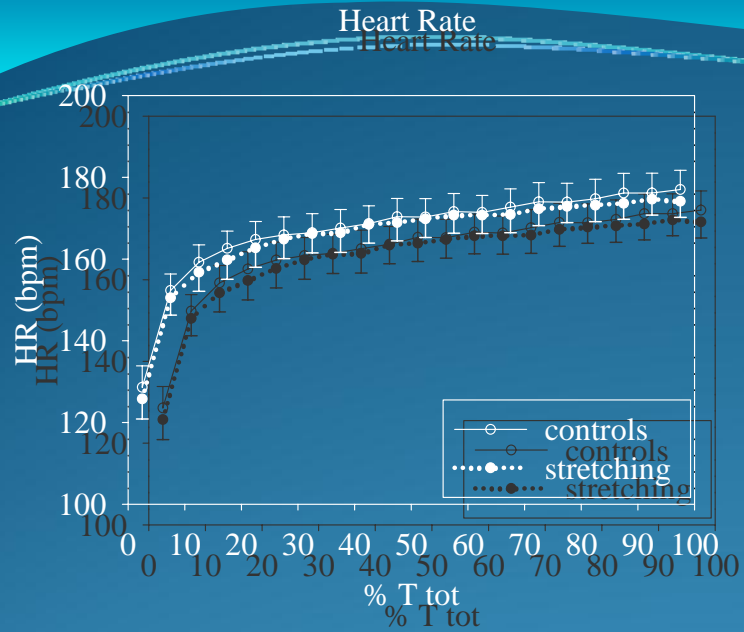


Oxygen uptake  
Oxygen uptake

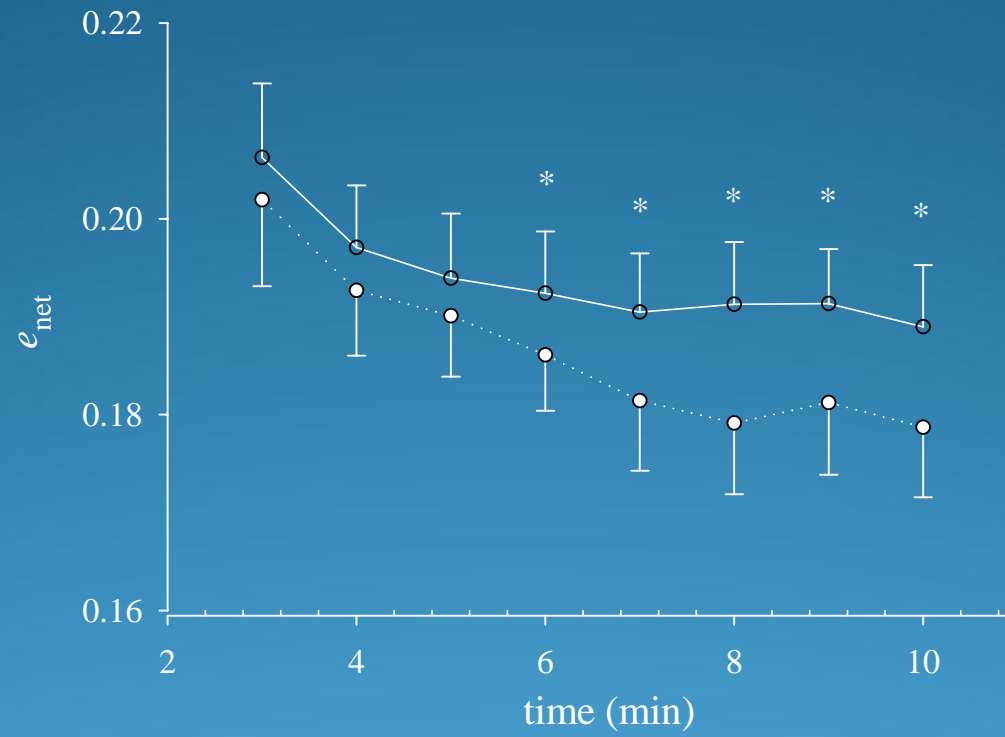


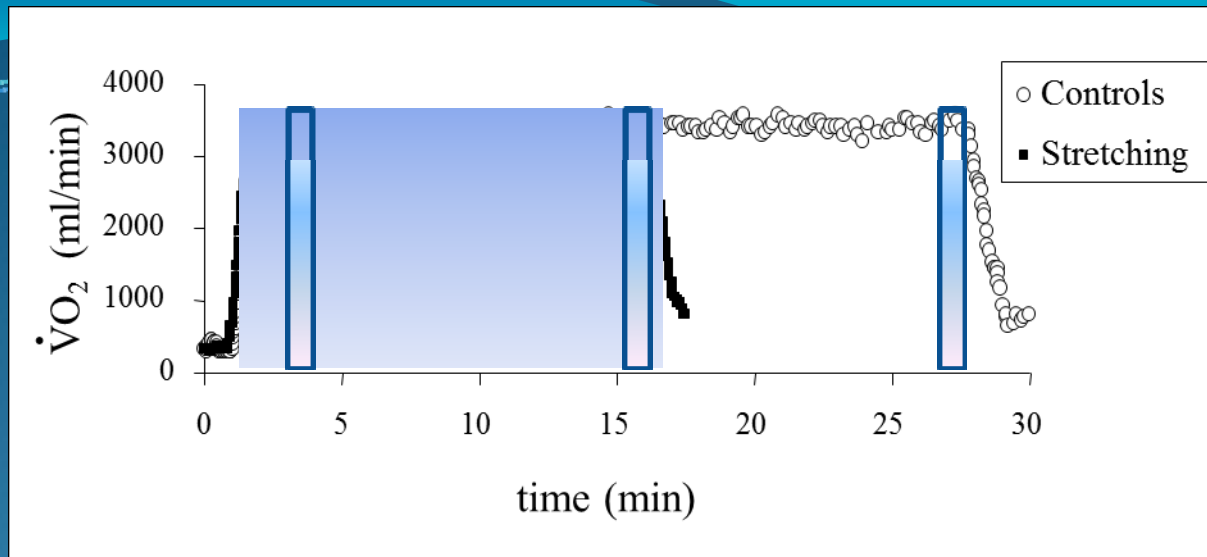
Blood Lactate  
Blood Lactate





# Net efficiency





	Controls			Stretching		
	min 3	last min	mean	min 3	last min	mean
VO <sub>2</sub> (ml/min)	2831 ± 73	3175 ± 87 #	3088 ± 48	2985 ± 87 *	3298 ± 79 #	3244 ± 62 *
VE (l/min)	83 ± 2	119 ± 5 #	96 ± 2	88 ± 2 *	120 ± 5 #	106 ± 3 *
V <sub>T</sub> (l)	2.46 ± 0.15	1.97 ± 0.10 #	2.28 ± 0.12	2.51 ± 0.14	2.15 ± 0.08 #	2.31 ± 0.09
RR (b/min)	34.7 ± 1.5	62.3 ± 4.1 #	43.1 ± 2.0	36.7 ± 2.4	56.7 ± 2.2 #	47.2 ± 1.6 *
HR (bpm)	155 ± 4	176 ± 5 #	165 ± 4	157 ± 5	175 ± 4 #	169 ± 4
[La <sup>-</sup> ] (mM)	4.80 ± 0.25	8.81 ± 0.67 #	7.17 ± 0.43	5.46 ± 0.59 *	9.26 ± 1.21 #	7.83 ± 0.90 *

# CONCLUSIONS

## With acute passive stretching:

- ✓ Maximum aerobic power is not affected
- ✓ Endurance time of a high-intensity exercise is significantly reduced
- ✓ Exercise efficiency is decreased
- ✓ Type II motor units are impaired



# ACKNOWLEDGEMENTS

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