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# Does speed influence time to exhaustion at maximal aerobic power in treadmill cycling?

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Copenhagen, 30.06.2022

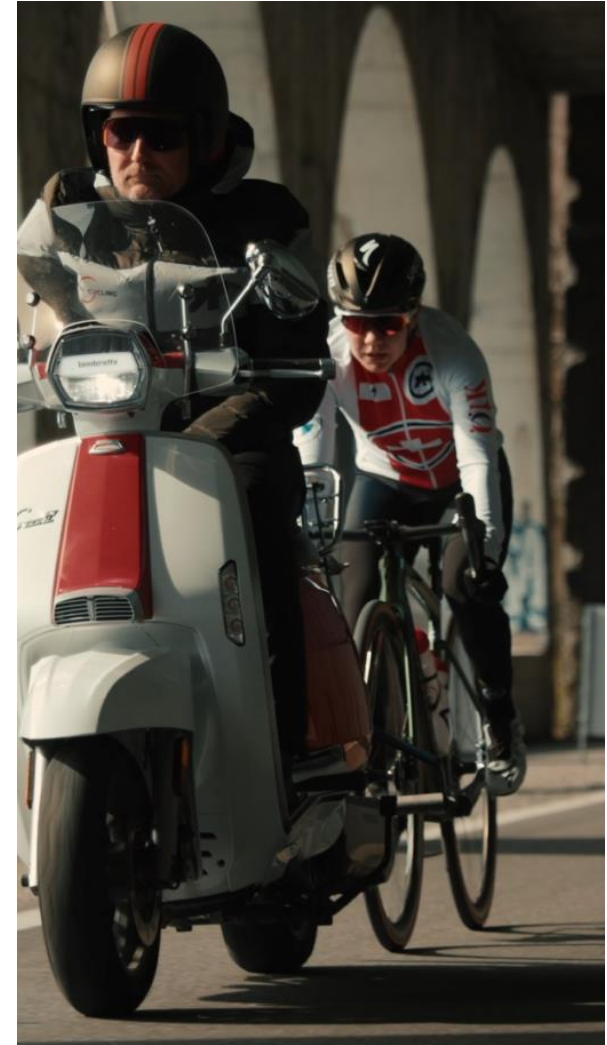


# Introduction Training



Assos

Variation in speed with and  
without motorpacing  
while producing the **same  
power output**



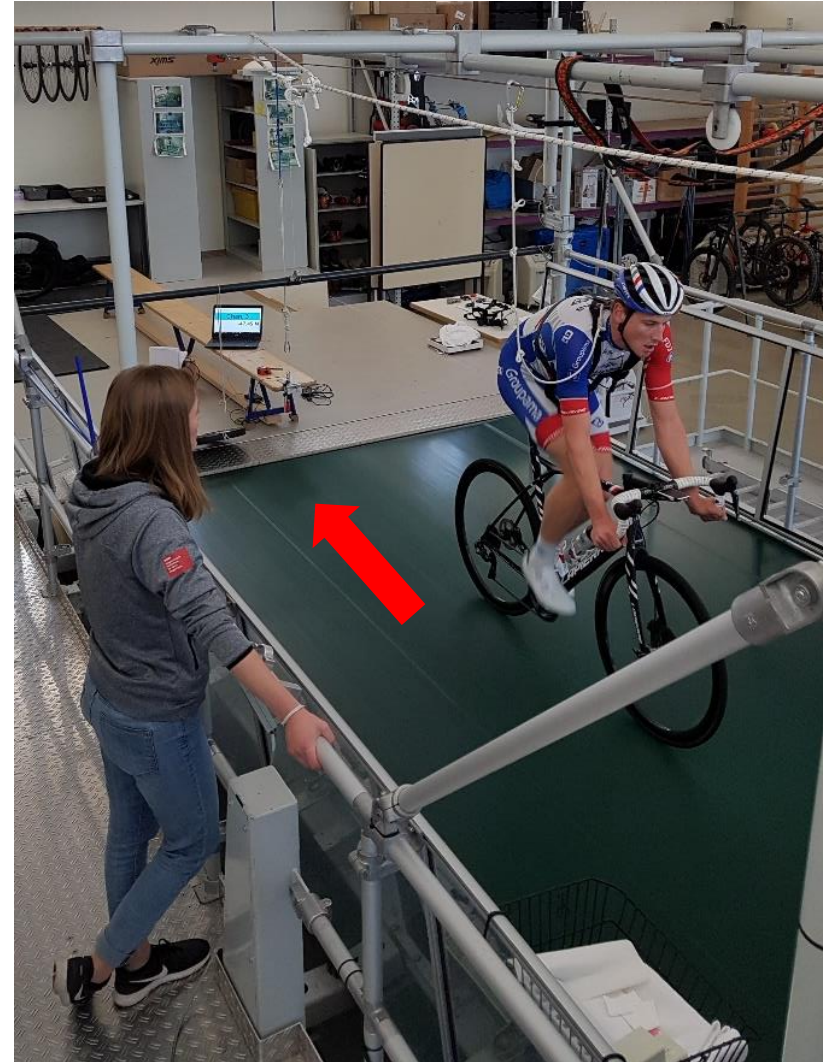
Assos



# Introduction Testing



Predefined speed via flywheel mass  
and treadmill speed





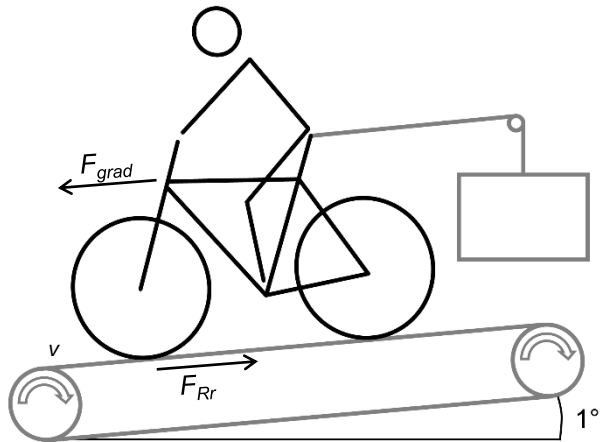
# Introduction

## Research Question

- Does the predefined speed in the lab influence performance?
  - **Effect of Speed on Time to Exhaustion (TTE) at Maximal Aerobic Power (MAP) in Treadmill Cycling**

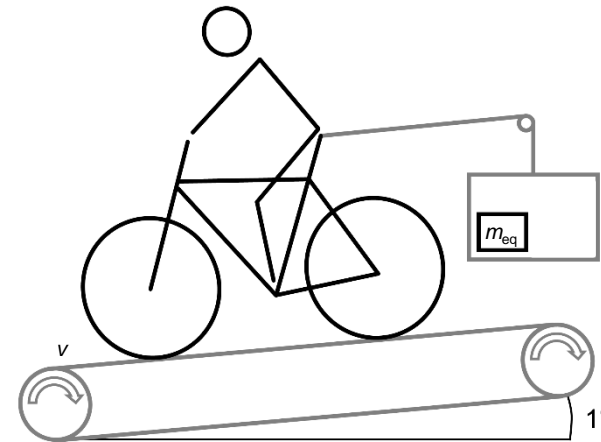


# Method Back Pulling System



Step 1: Adjust  $m_{eq}$  during coasting until equilibrium is achieved

$$\vec{F}_{eq} = \vec{F}_{grad} + \vec{F}_{Rr}$$



Step 2: Add  $m_2$  to generate desired power output (Watt)

$$P \eta = F_2 v$$

$\eta$  : Drive train efficiency

Maier, T., Schmid, L., Müller, B., Steiner, T., & Wehrin, J. P. (2017). Accuracy of Cycling Power Meters against a Mathematical Model of Treadmill Cycling. *International journal of sports medicine*, 38(6), 456–461. <https://doi.org/10.1055/s-0043-102945>

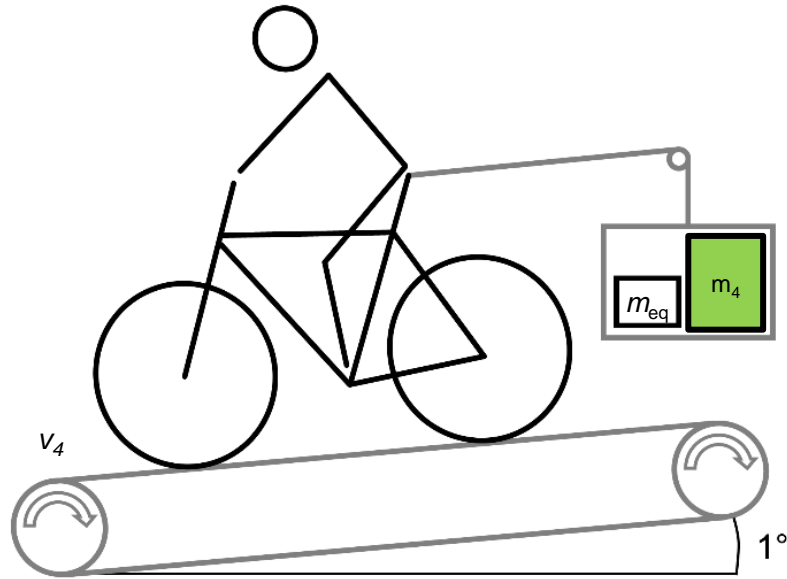


# Method

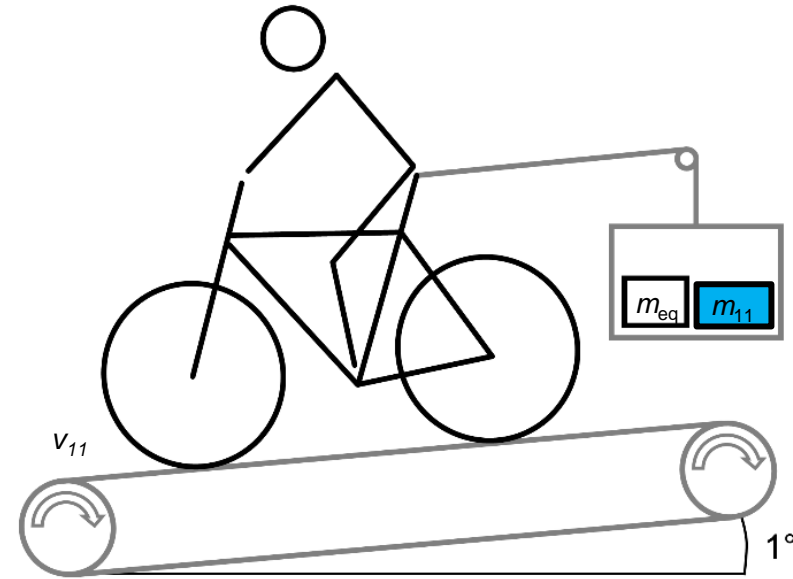
How to achieve the same power output with two different treadmill speeds

Low Speed (4 m/s)

High Speed (11 m/s)



$$\text{MAP } \eta = v_4 m_4 g$$



$$\text{MAP } \eta = v_{11} m_{11} g$$



# Method

## Study Design

- 20 subjects
- 2 conditions: low (4 m/s) and high (11 m/s) speed
- 2 TTE tests at individual MAP
- Randomized order
- Within 2 weeks, at least 24h rest between trials
- Own bikes and self-selected cadence



# Method

Subjects n = 20 (f = 5, m = 15)

Variable	mean $\pm$ SD	min - max
Age [y]	22.4 $\pm$ 7.3	15.1 - 37.9
Height [cm]	173.7 $\pm$ 7.4	159.5 - 188.9
Body Weight [kg]	64.8 $\pm$ 9.0	50.3 - 86.9
MAP [W]	349 $\pm$ 56	250 - 450
VO <sub>2</sub> max <sup>1</sup> [mL min <sup>-1</sup> kg <sup>-1</sup> ]	64.5 $\pm$ 5.4	57.1 - 74.6

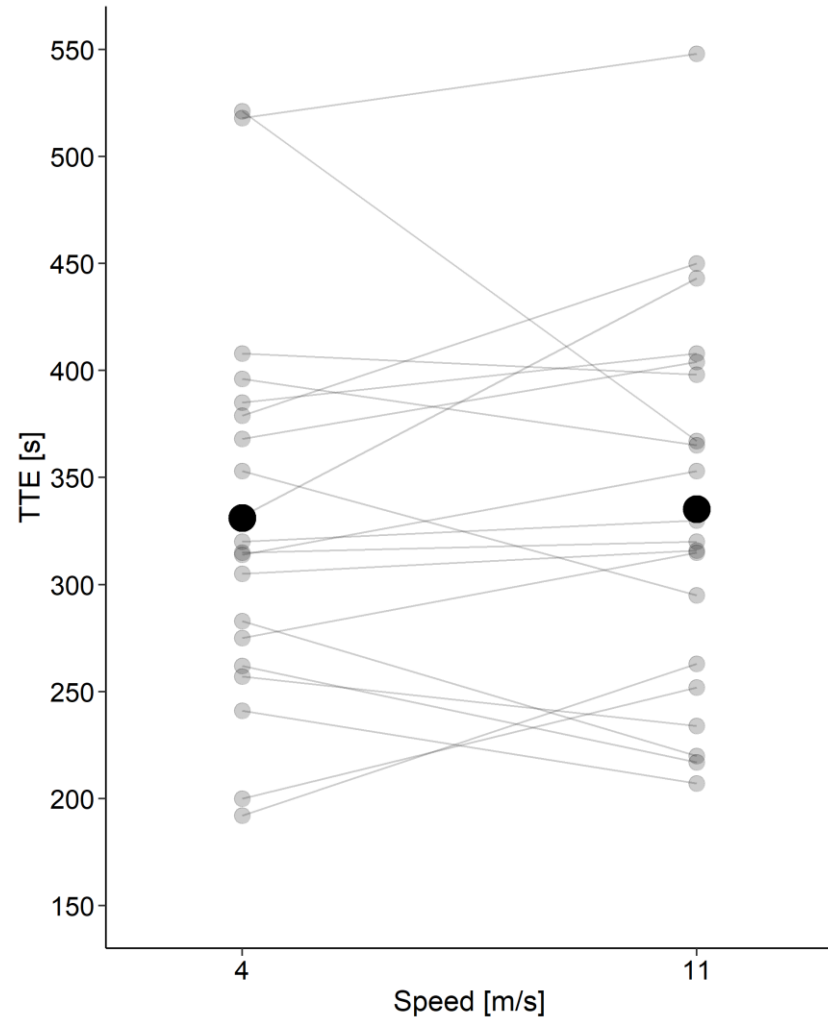
*Abbreviations:* MAP, maximal aerobic power; VO<sub>2</sub>max, maximal oxygen consumption.

<sup>1</sup> Sitko, S., Cirer-Sastre, R., Corbi, F., & López-Laval, I. (2022). Five-Minute Power-Based Test to Predict Maximal Oxygen Consumption in Road Cycling. *International journal of sports physiology and performance*, 17(1), 9–15. <https://doi.org/10.1123/ijsp.2020-0923>





# Results



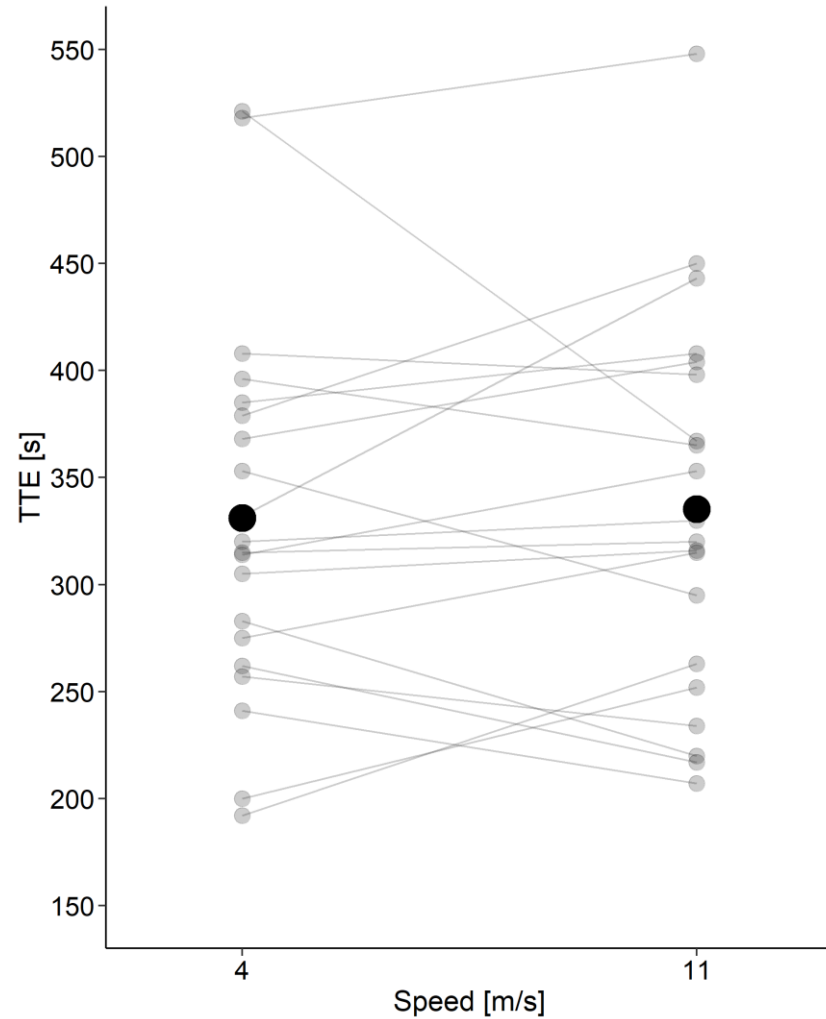
Note: Individual measurements shown as transparent points, mean values shown as black points

Variable	mean $\Delta \pm$ SD	p
TTE [%]	-0.4 $\pm$ 11.9	0.88
HRmax [bpm]	-1.2 $\pm$ 5.1	0.31
Borg	0.2 $\pm$ 0.5	0.19
Cadence [rpm]	-13.5 $\pm$ 9.5	<0.001

Abbreviations:  $\Delta$  = slow trial – fast trial; TTE, time to exhaustion; HRmax, maximal heart rate.



# Discussion

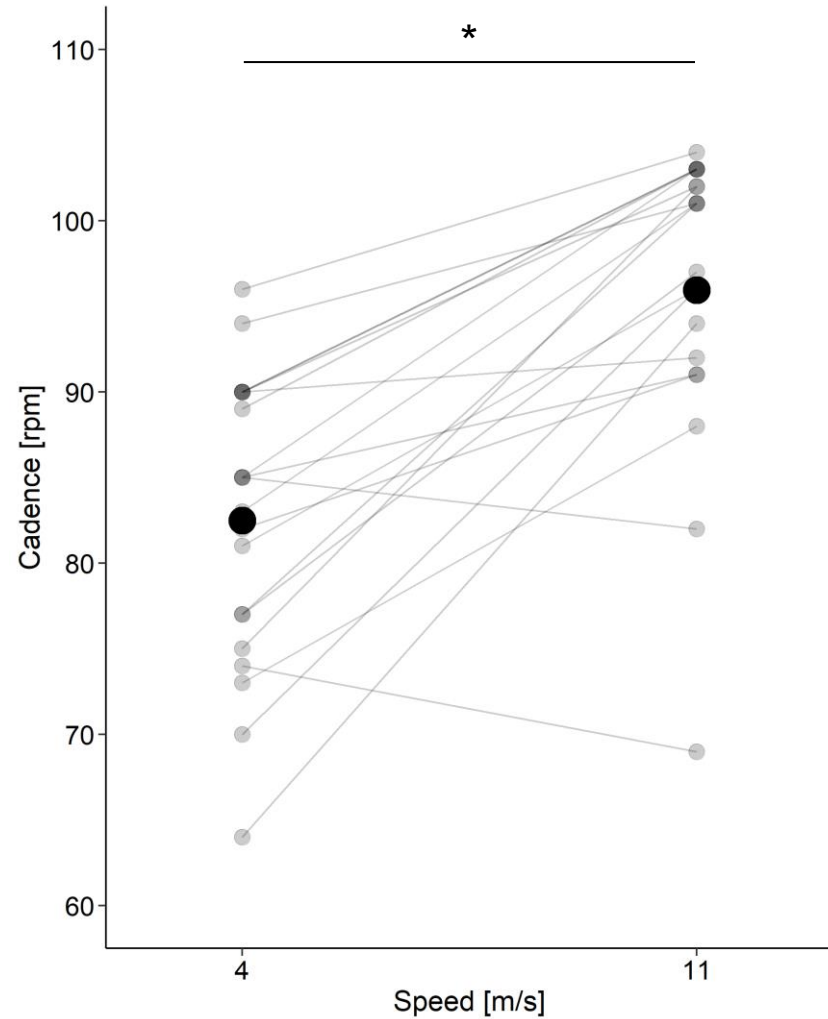


Note: Individual measurements shown as transparent points, mean values shown as black points

- On average no difference
- Large individual differences



# Discussion



Note: Individual measurements shown as transparent points, mean values shown as black points

- Significant difference in self-selected cadence



# Conclusion

- Effect of Speed on ...
  - TTE
    - On average no effect
    - Large individual differences – why?
  - Cadence
    - On average significant difference in self-selected cadence
    - Lower cadence for low speed condition
      - more force per pedalstroke at low speed trial
  
- Choose flywheel mass / speed with consideration

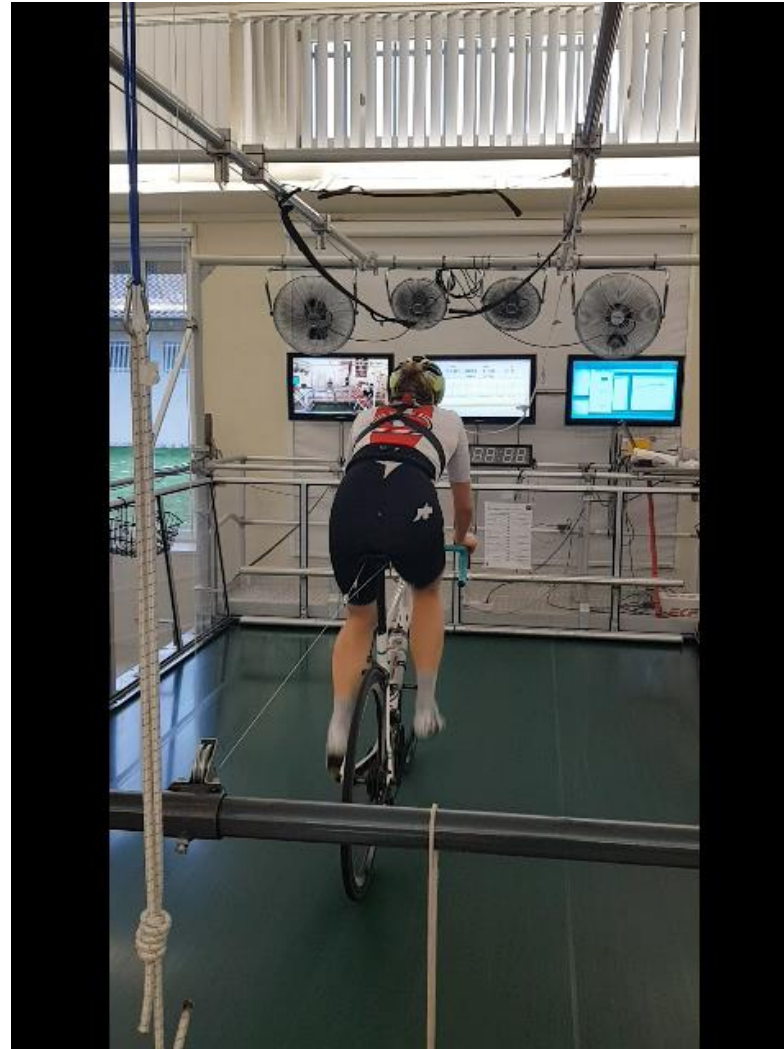


**Thank you for your attention!**



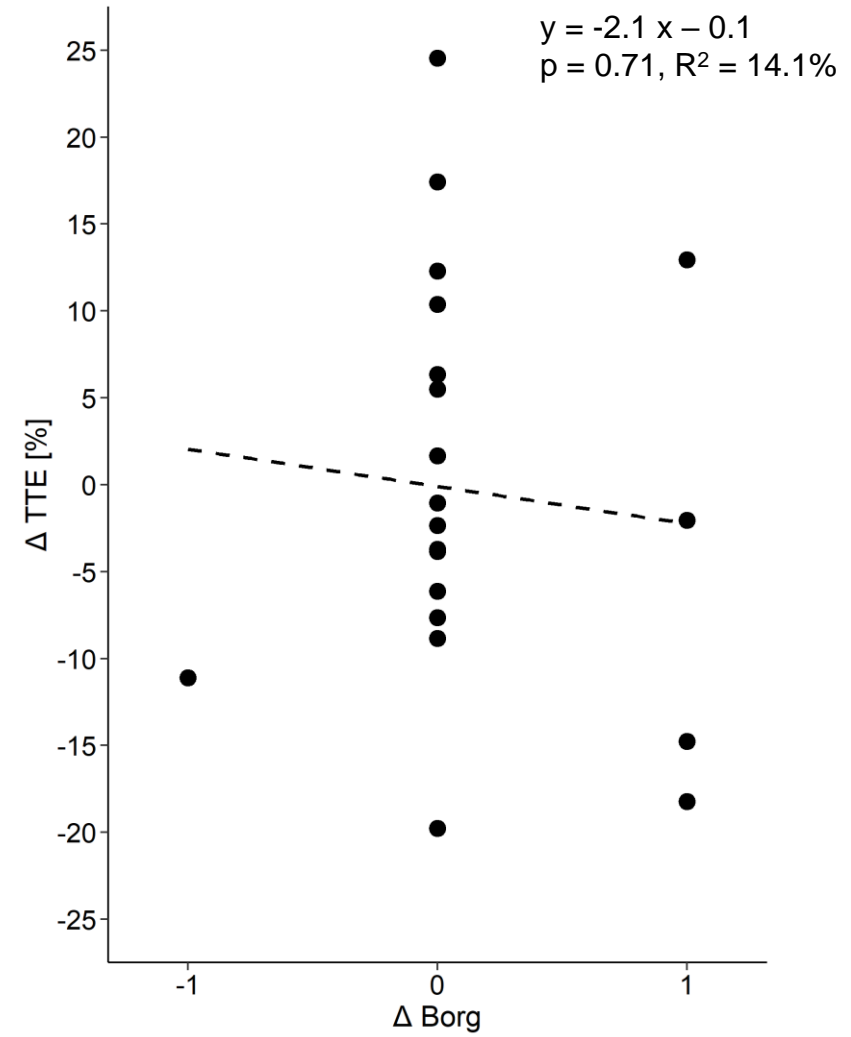
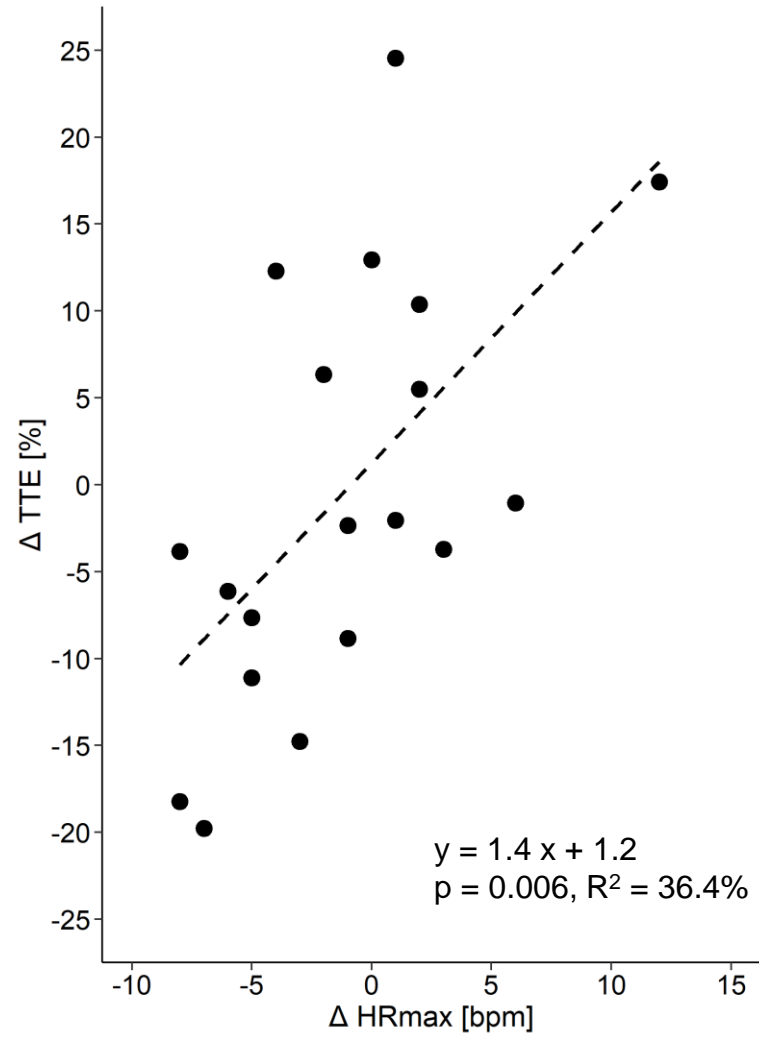


# Mögliche fotos





# Discussion







# Discussion

