# Comparison of two different **training interventions** on **laboratory parameters** and **race performance** in competitive young **XCO** athletes a randomized controlled trial.

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# Mountainbike Cross Country Olympic (MTB XCO)

- XCO is characterized by race durations of 1:00 to 1:45 hours
- Race profiles increasingly become more irregular and technical

| | World Championships, World Cup, Continental Championships, Hors Class Class 1 events. | |
|---|---|---|
| | Race time | Lap length |
| Men Juniors | 1:00 - 1:15 | 4km - 6km |
| Women Juniors | 1:00 - 1:15 | |
| Men under 23 | 1:15 - 1:30 | |
| Women under 23 | 1:15 - 1:30 | |
| Men Elite | 1:30 - 1:45 | |
| Women Elite | 1:30 - 1:45 | |

*under 23 compete with Elite

[UCI Cycling Regulations Part 4 Mountain Bike, version 4.04.14] | Theobald, Leistungssport 2015]

# Race Charateristics XCO

Bike Advisor

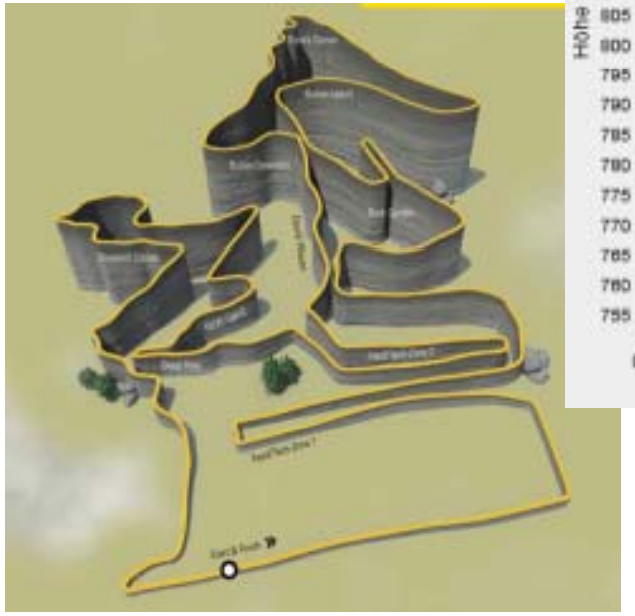

Reviews.mtbr.com

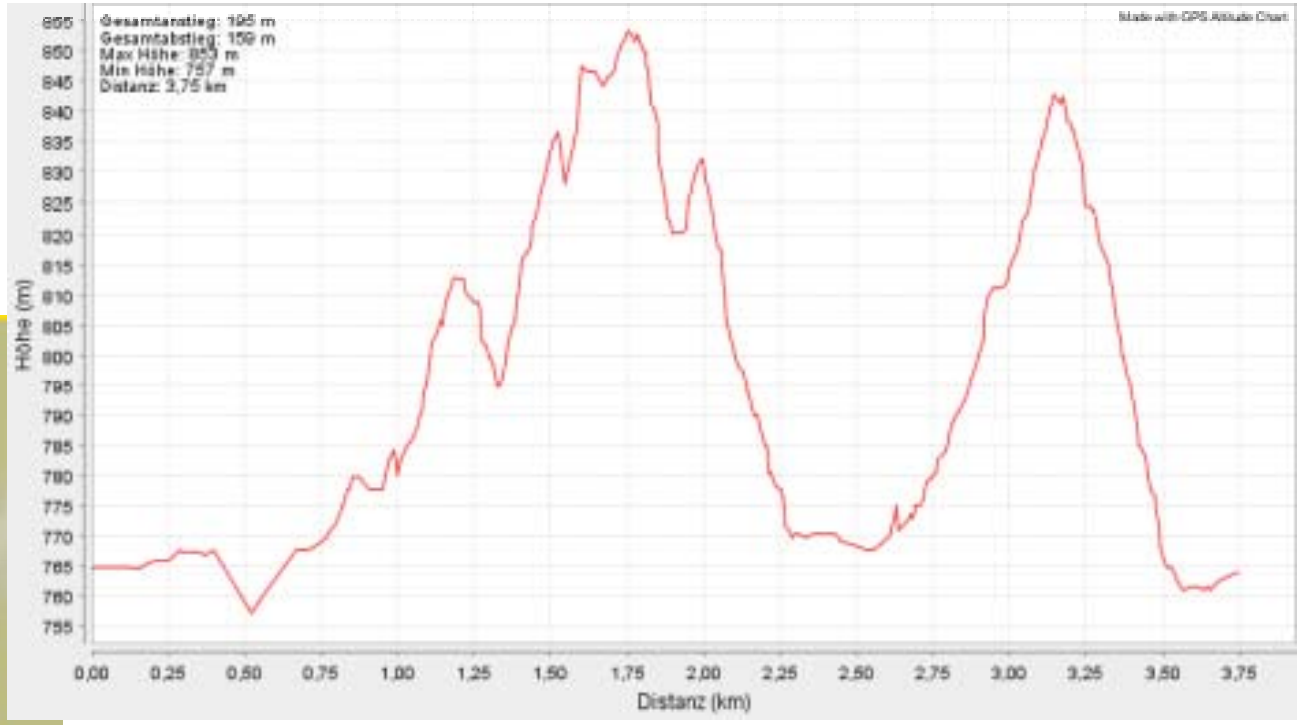

Freehub Magazine


Krauss


Krauss

# Race Charateristics XCO






[mtb-news.de]

# Physical requirements for race performance

- XCO is characterized by race durations of 1:00 to 1:45 hours
- Race profiles increasingly become more irregular and technical
- Short term high intensive intervals are predominant in MTB XCO

| Power Zone | % of FTP | Training Purpose |
|---|---|---|
| Zone 1 | <55% | Recovery |
| Zone 2 | 56-75% | Aerobic endurance |
| Zone 3 | 76-90% | Tempo |
| Zone 4 | 91-105% | Lactate threshold |
| Zone 5 | 106-120% | Aerobic capacity |
| Zone 6 | 121-150% | Anaerobic capacity |
| Zone 7 | >150% | Sprint power |

- 85% of the race duration in zone 5 & 6
- ~50% of the intervalls in zone 6

[Theobald, Leistungssport (2012)]| Allan & Coggan (2010/2012)]

# Testing XCO-Athletes

- Laboratory tests and field tests are used to determine important factors for race performance
  - Individual anearobic threshold (IAT)
  - Peak power output
  - VO2max
  - All-out-time-trials (AOTT): CP5, CP30, CP60, Wingate 5x30, FTP 20‘, FTP 60‘
  - …

[i.e. Ahrend et al. (2016) | Novak et al. (2017) | Impellizzeri et al. (2002), (2005), (2008) | Costa & Oliveri (2008) | Stapelfeld (2004)]

# Testing XCO-Athletes

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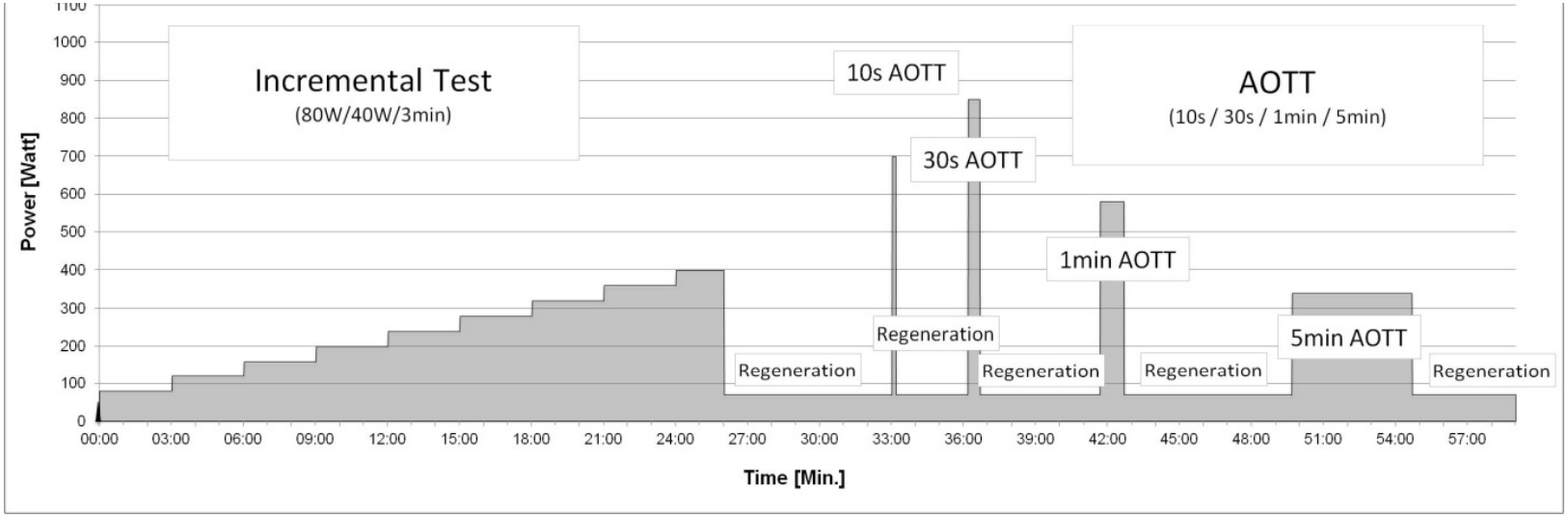



[i.e. Ahrend et al. (2016) | Novak et al. (2017) | Impellizzeri et al. (2002), (2005), (2008) | Costa & Oliveri (2008) | Stapelfeld (2004)]

# Training modalities

- HIT
  - Wingate Design (4-6 bouts of 30‘ „all out cycling effort“, 4‘ recovery) [Gibala et al . 2012}
  - Sprint Training (8-12x 30s all out intensity, 4‘ rest at 10-15 CR100) [Inoue et al . 2016]

- Endurance-like adaptations:
  - increased skeletal muscle oxidative capacity
  - reduced rate of glycogen utilization and lactate produktion during matched-work exercise
  - increased capacity for whole-body and skeletal muscle lipid oxidation
  - enhanced peripheral vascular structure and function
  - improved exercise performance
  - Increased maymimal oxygen uptake

[Gibala et al. J Physiol (2012) | Laursen ScandJMEdScieSports (2012) | Inoue et al PlosOne 2016]

# Polarized Training (PT)

- Polarized Training:
  - 85% of total training volume at low intensities
  - 15 % at supra-maximal intensities

⇒ may be the optimal training intensity distribution for elite athletes who compete in intense endurance events? [Laursen (2010)]

[Gibala et al. J Physiol (2012) | Laursen ScandJMEdScieSports (2012)]

# Aim of the study

Polarized Training

Aerobic Endurance Training

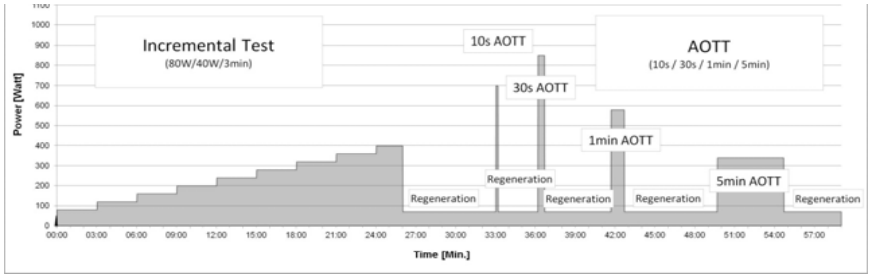
[Cycling News]

# Aim of the study

?

PT

AET





[Cycling News]

# Study Design

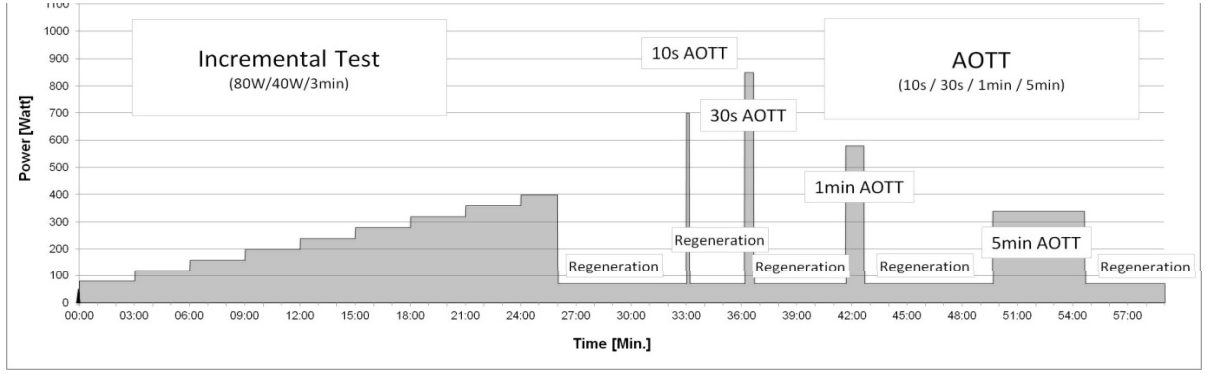
# t0

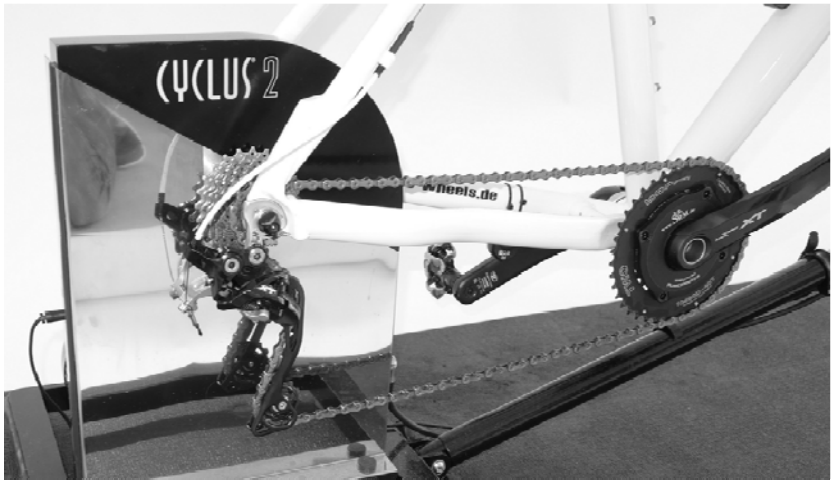
## Medical Assessment

**t0**

# Medical Assessment

## Performance Test

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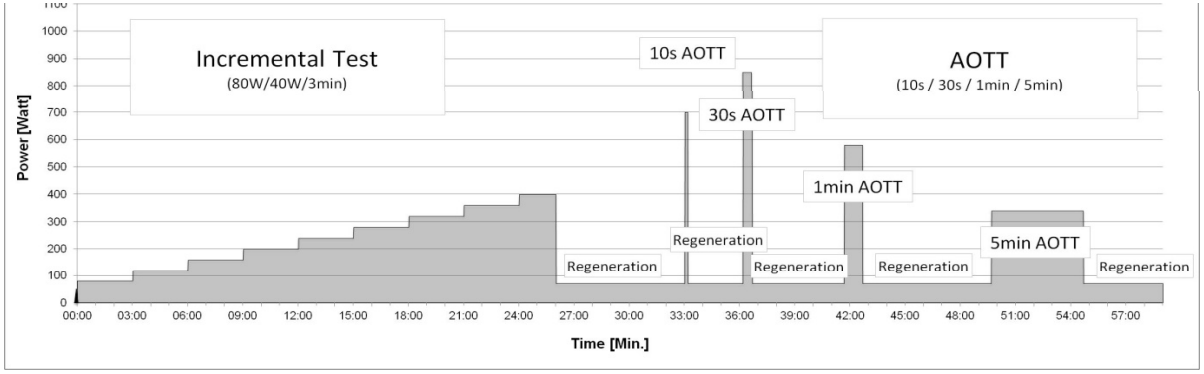
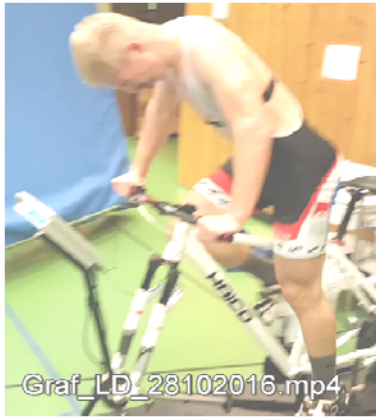
# t0

## Medical Assessment

## Performance Test




**t0**

## Medical Assessment

## Performance Test (t0)

## XCO-Race (t0)




**t0**

## Medical Assessment

## Performance Test (t0)

## XCO-Race (t0)

## **Intervention** (3 weeks + 1 week tapering)

| Testdatum | 26.09.2016 | ID |
|---|---|---|
| Name | | |
| $LT_4$ [W]* | 273 | |
| CP5' [W]** | 331 | |

| Trainingsbereich | Trainingszone | % $LT_4$ | Trainingsleistung [W] |
|---|---|---|---|
| KB | Z1 | ≤ 55% | 150 |
| GA1 | Z2 | ± 60% | 164 |
| GA2 | Z3 | ± 76% | 207 |
| EB*** | Z5*** | ± 115% | 381 |

** Leistung bei Laktatschwelle 4mmol/l*
*** Leistung im 5min All-Out-Time-Trial*
**** % CP5'*

**AET**

**PT**

# Training intervention

Table: Exemplary training schedule for men U19, U23, Elite

| | | week 1 | s/w | week 2 | s/w | week 3 | s/w | week 4 | s/w | t1 |
|---|---|---|---|---|---|---|---|---|---|---|
| **PT** | test & race | Z5 (2*10*30s) | 3 | Z5 (3*10*30s) | 3 | Z5 (3*10*30s) | 2 | Z5 | 0 | race & test |
| | | Z2 (2h) | 1 | Z2 (2h) | 2 | Z2 (2h) | 3 | Z2 (2h) | 1 | |
| **AET** | test & race | Z5 | 0 | Z5 | 0 | Z5 | 0 | Z5 | 0 | race & test |
| | | Z2 (2-3h) | 4 | Z2 (2-3.5h) | 4 | Z2 (1.5-5h) | 5 | Z2 (2h) | 1 | |

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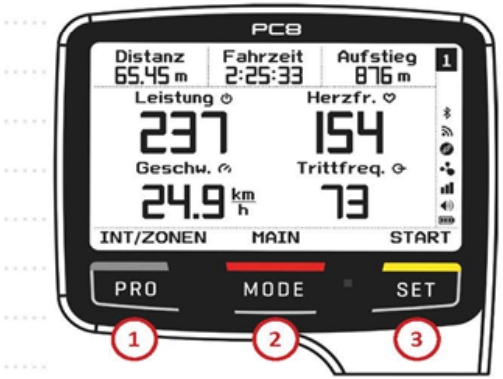
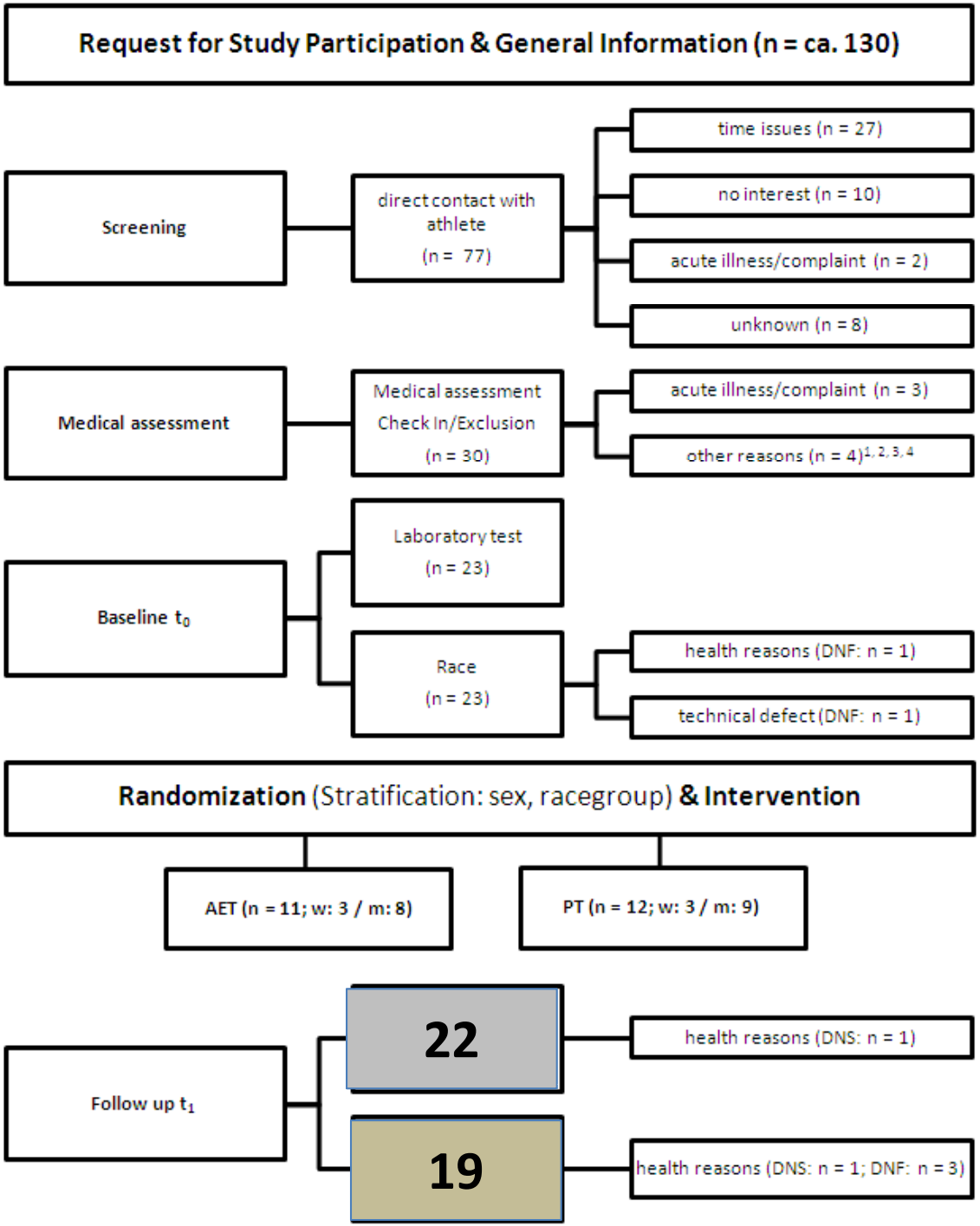



| | |
|---|---|
| t0 | **Medical Assessment** |
| | **Performance Test** |
| | **XCO-Race** |
| | **Intervention** (3 weeks + 1 week tapering) |
| t1 | **XCO-Race** |
| | **Performance Test** |

# Study Flow Chart


Request for Study Participation & General Information (n = ca. 130)
Screening
direct contact with athlete (n = 77)
time issues (n = 27)
no interest (n = 10)
acute illness/complaint (n = 2)
unknown (n = 8)
Medical assessment
Medical assessment Check In/Exclusion (n = 30)
acute illness/complaint (n = 3)
other reasons (n = 4)[1, 2, 3, 4]
Baseline $t_0$
Laboratory test (n = 23)
Race (n = 23)
health reasons (DNF: n = 1)
technical defect (DNF: n = 1)
Randomization (Stratification: sex, racegroup) & Intervention
AET (n = 11; w: 3 / m: 8)
PT (n = 12; w: 3 / m: 9)
Follow up $t_1$
22
19
health reasons (DNS: n = 1)
health reasons (DNS: n = 1; DNF: n = 3)

# Results

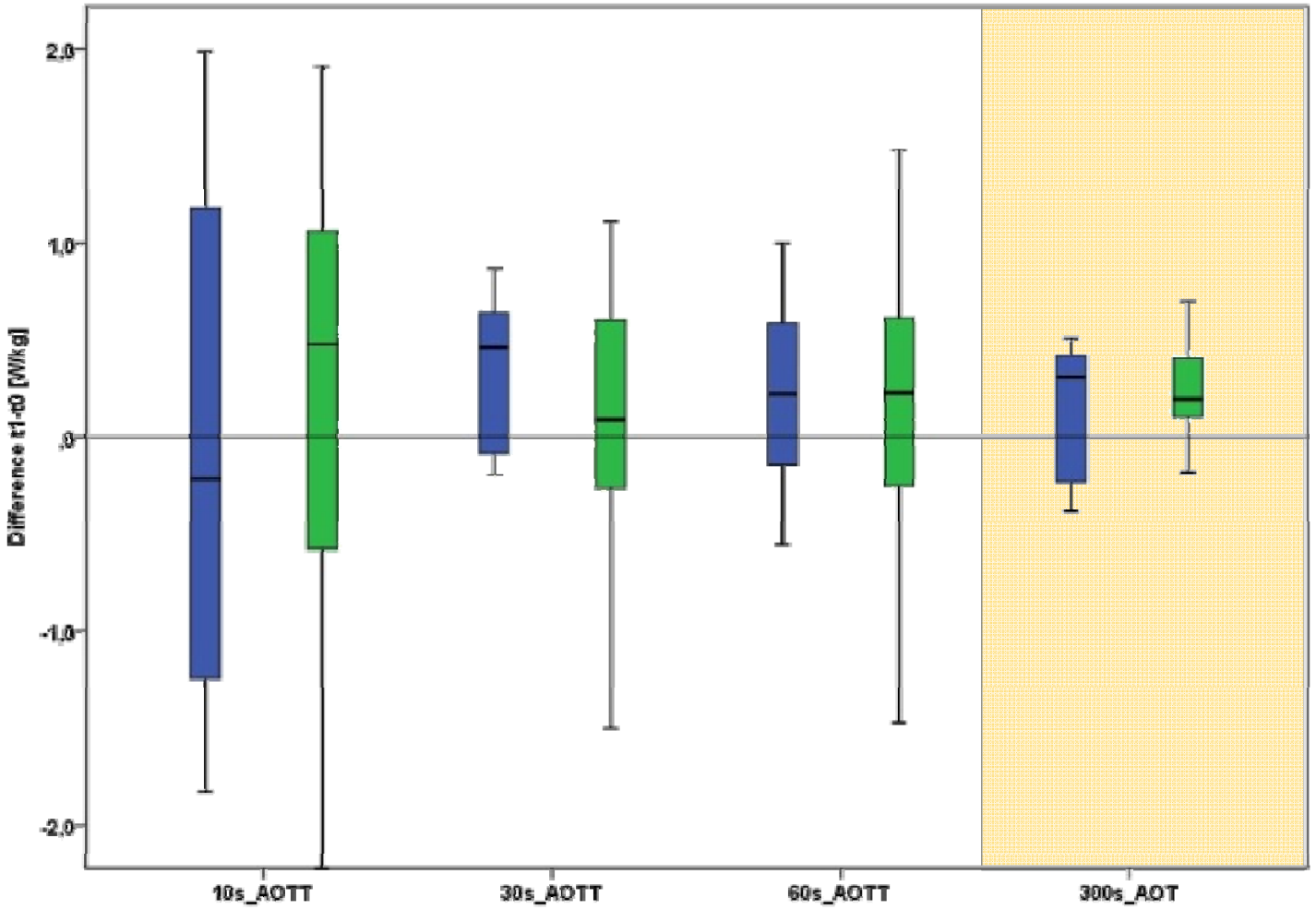
**t0**

**Medical Assessment**

**Performance Test**

| Median (Min, Max) | Men | Women |
|---|---|---|
| **Age** | 17 (15, 30) | 17 (15, 20) |
| **BMI** | 21 (18, 24) | 21 (19, 22) |
| **4mmol IT [W/kg]** | 4.2 (3.4, 4.4) | 3.3 (2.8, 4.3) |
| **PPO IT [W/kg]** | 5.2 (4.7, 5.6) | 4.5 (3.8, 4.9) |
| **n U17** | 5 | 2 |
| **n U19, U23, Elite** | 11 | 4 |

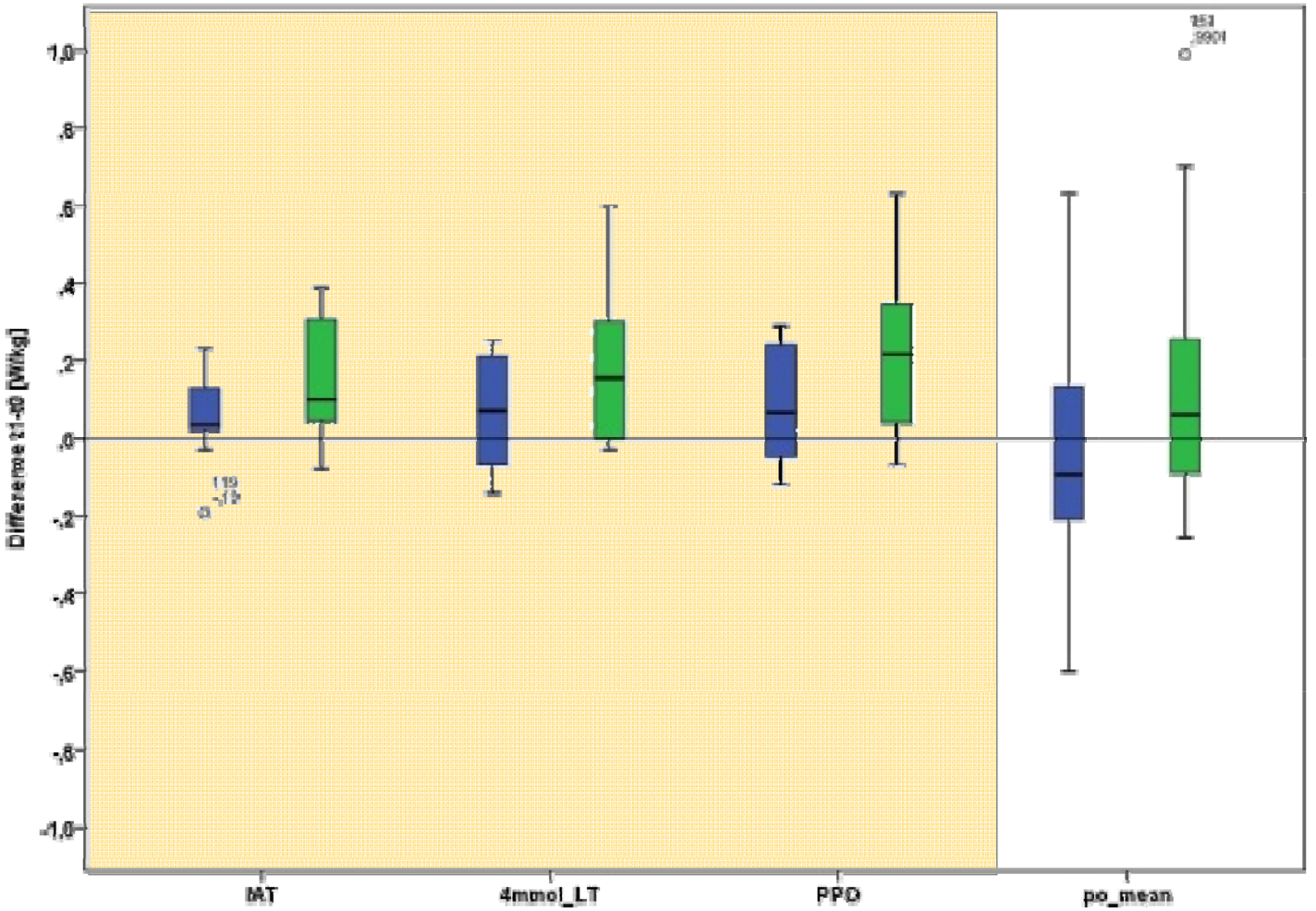
# Results All Out Time Trials (AOTT)




PT

AET

# Results Incremental Test and Race




PT

AET

# Discussion All Out Time Trials (AOTT)

PT

AET

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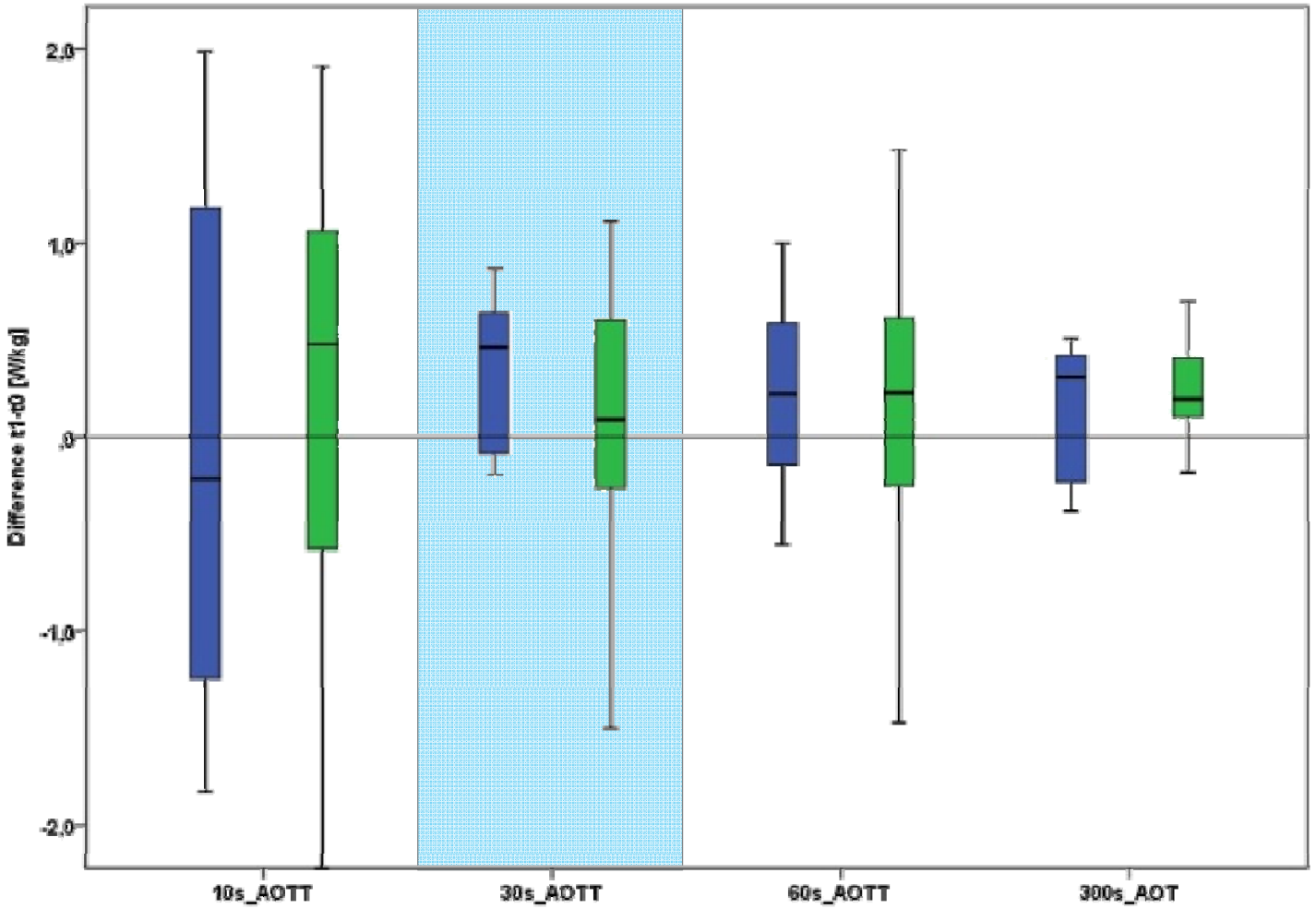


PT

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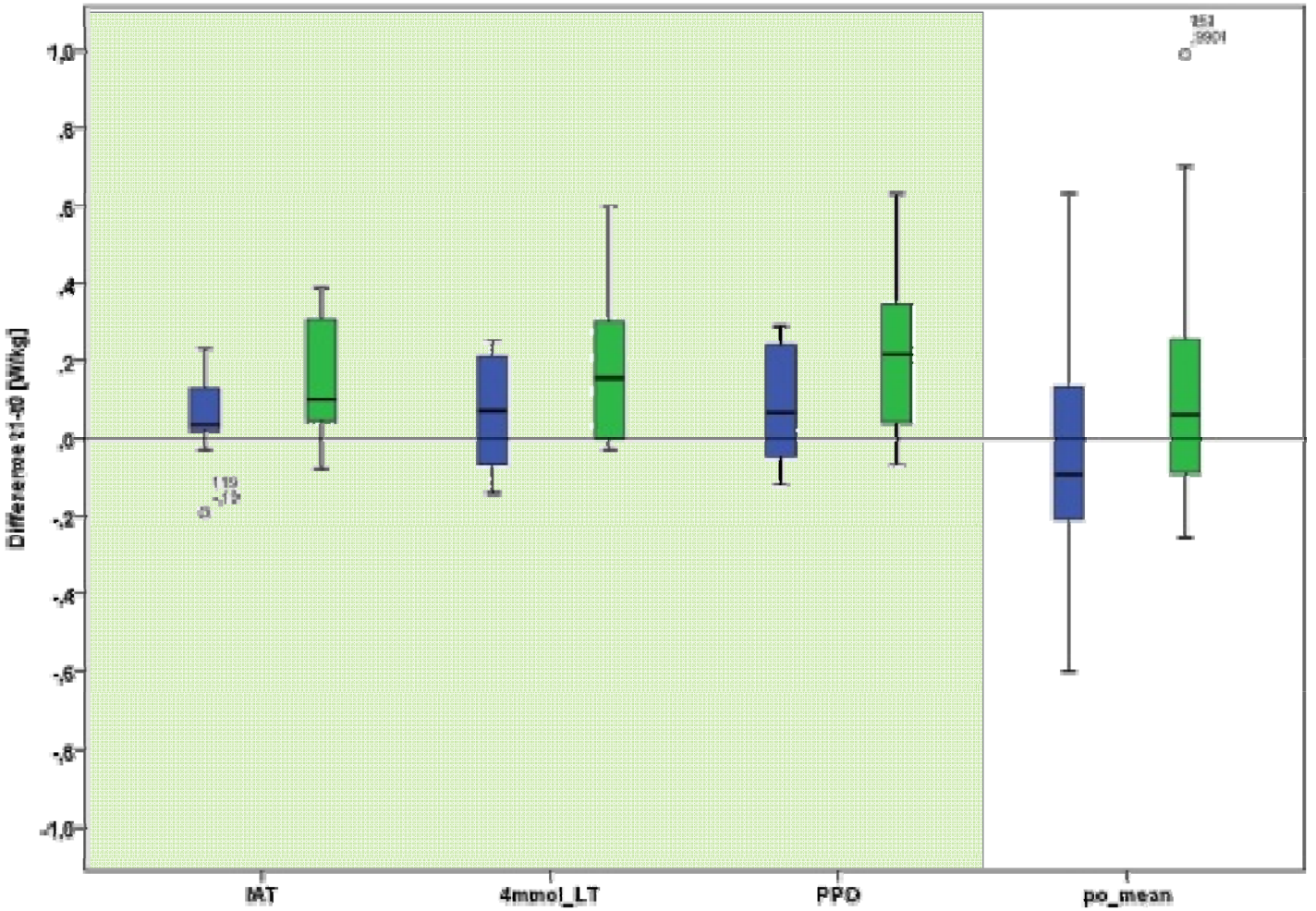
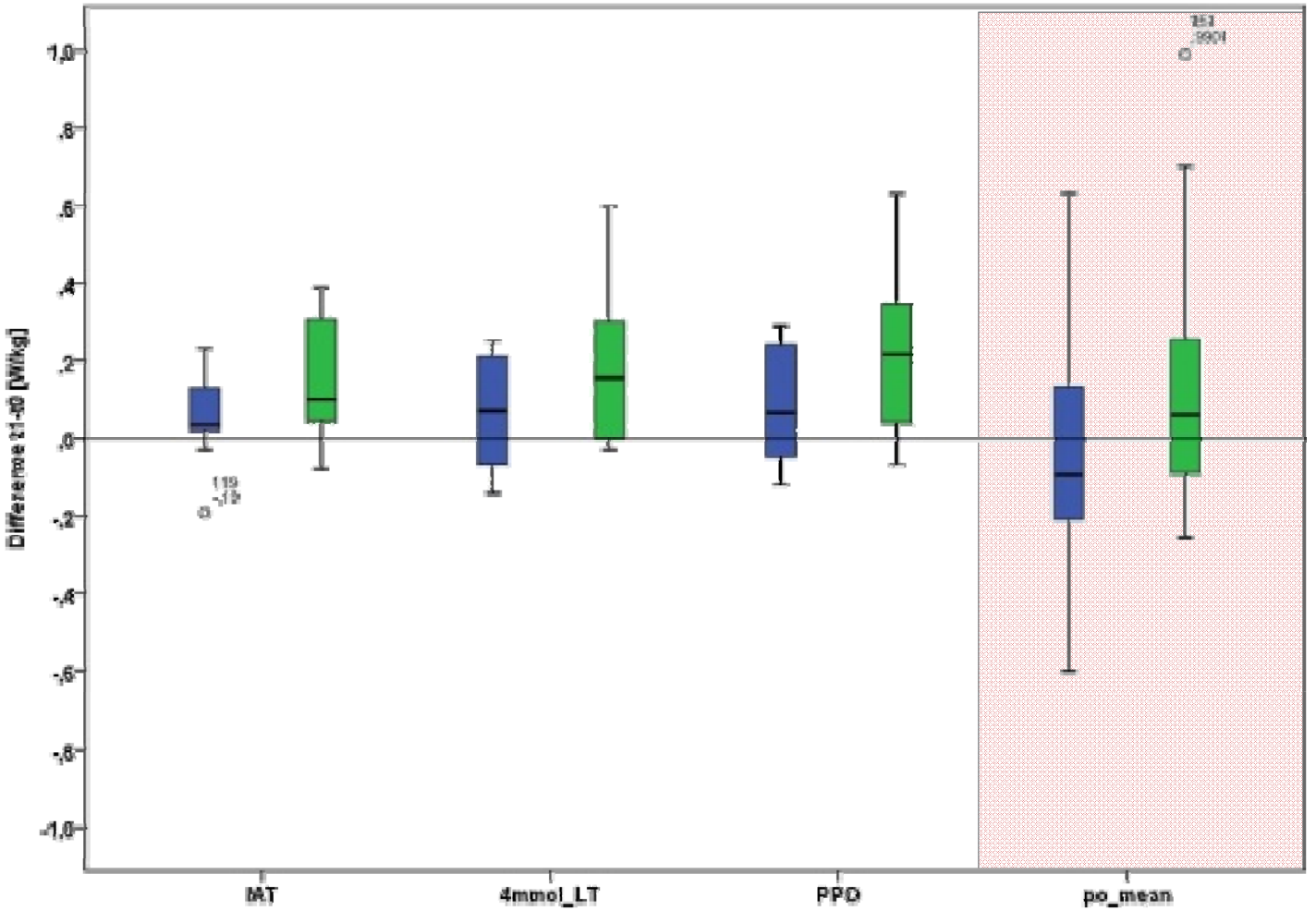
# Discussion Incremental Test and Race




PT

AET

# Discussion Race




PT

AET

# Comparison to other MTB-studies

- Inoue et al. (PLOSone, 2016),
  - Sprint Training (n=9): 8-12 30s supramaximal bouts vs. Hit Training (n=7): 7-10x 4-6’
  - 6 weeks
  - Both interventions enhanced MTB performance (Race time, PPO, OBLA, LT)
    - MTB simulation performance time (HIT:-5% ST: -3%)
    - PPO (HIT: 8% ST: 5%)
  - HIT more effective for mean PO in the race (7.8% vs. 5%)

[Gibala et al. J Physiol (2012) | Laursen ScandJMEdScieSports (2012)]

## Practical Relevance

- Overall training effect  even in well-trained young athletes within 3+1 week
- Feasibility of powerbased training in young XCO-athletes
- Better compliance with training protocols by use of powermeters, especially at low intensities

## Prospects

- Race prediction of laboratory parameters for XCO race performance in young athletes
- Differentiated exploratory subgroup-analysis (individual, sex, age group)
- Further studies with longer intervention periods and more subjects

# Thank you

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