

# Effects of aerobic exercise on inhibitory control in young adults aged 16-19 years

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# Executive functions

- Important for school readiness (above IQ) (Blair et al. 2007)
- Predict math and reading competence throughout all school years (Gathercole et al. 2004)
- Processes involved in Goal-directed behaviour
- Executive functions can be divided into 3 core functions
  - Inhibitory control
  - Working memory
  - Cognitive flexibility

# Physical activity and cognitive function

## - what we know

- Fitness and cognitive function are associated in young adults (Åberg et al. 2009)
- A single bout of aerobic exercise may improve executive functions in children and young adults (Hillman et al. 2009, Pontifex et al. 2009)
- Chronic aerobic exercise may improve executive function in young and old adults (Masley et al 2009, Eriksen et al. 2010)

# Physical activity and cognitive function

## - what we need to know

- Randomized controlled trials are needed in this age group.
- The influence of exercise intensity, duration and volume on the effects of aerobic exercise on executive function are still unclear.

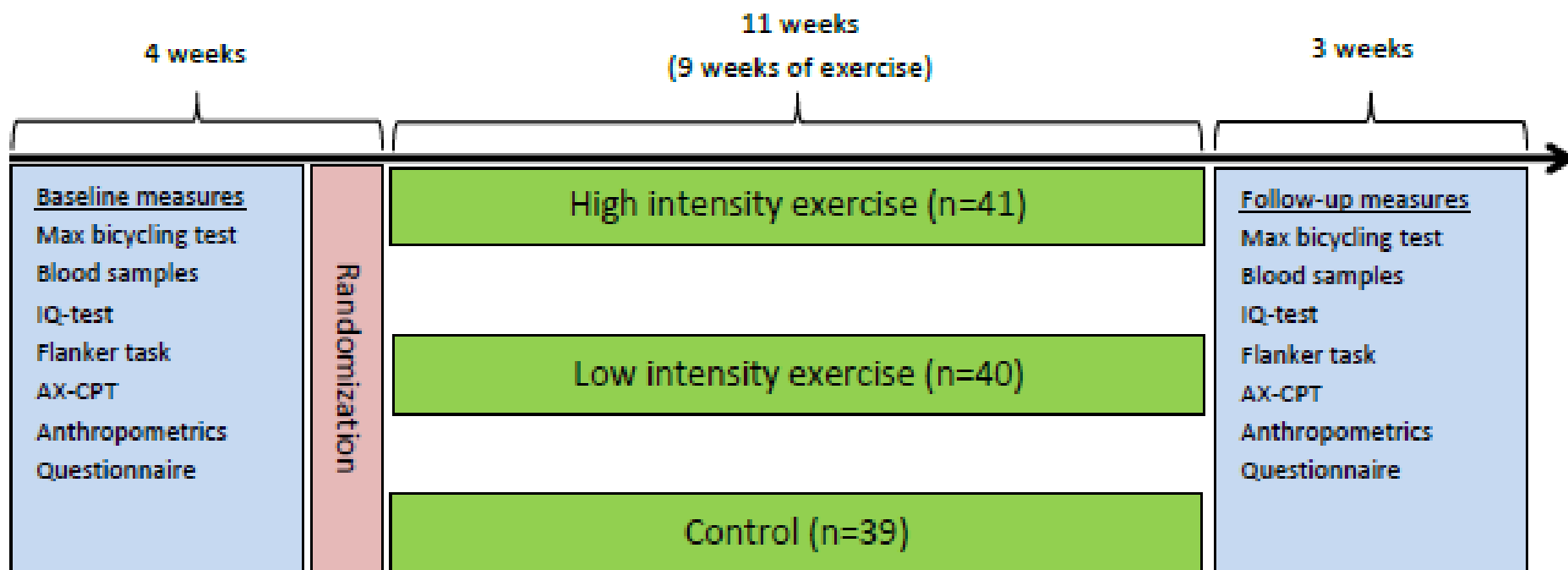
# Purpose

To investigate the effects of 9 weeks aerobic exercise on executive functions in young adults aged 16-19 years.

## Hypothesis

1. Exercise is selectively beneficial to task conditions requiring greater amount of inhibitory control.
2. Exercise intensity influence the effects on executive functions since aerobic fitness and cognitive function are found positively correlated.

# Methods



# The intervention

- Bicycling or running 30 minutes 3 times/week for 9 weeks
  1. Moderate intensity  
60-70% of HRmax
  2. High intensity
    - Progressive exercise program
    - 80-90% of Hrmax ("warm-up")
      - Week 1: 16 minutes
      - Week 9: 4 minutes
    - 95-100% of Hrmax (intervals)
      - Week 1: 5 \* 2+1 minute
      - Week 9: 9 \* 2+1 minute

# The intervention

- 20 classes during each week
- 6 instructors
- Registration at each session
- Cancellation should be done by SMS
- Heart rate monitor
- Few self training sessions (Easter and study trip)
- SMS, Facebook and doodle (for self registration)

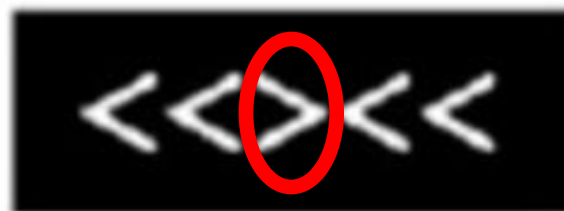
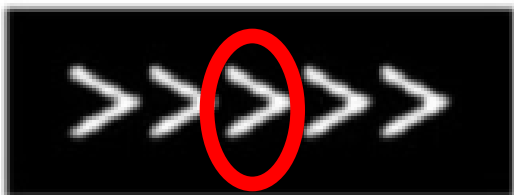
# Outcome

- Primary outcomes: a modified Flanker task (and AX-CPT)
  - Reaction time (RT) and accuracy (%correct)
  - Interference score measures – difference in RT and accuracy between congruent and incongruent stimuli
  
- Flanker design
  - Practise: 20 trials
  - 2 blocks of 100 trials (200 trials in total)
  - Break between trials: 45 sec.
  - Stimuli duration: 100 ms
  - Response window: 1000 ms
  - Inter-stimuli interval (ISI): 1250, 1350, 1450 or 1550 (random)

# Outcomes

## The Flanker task

Congruent



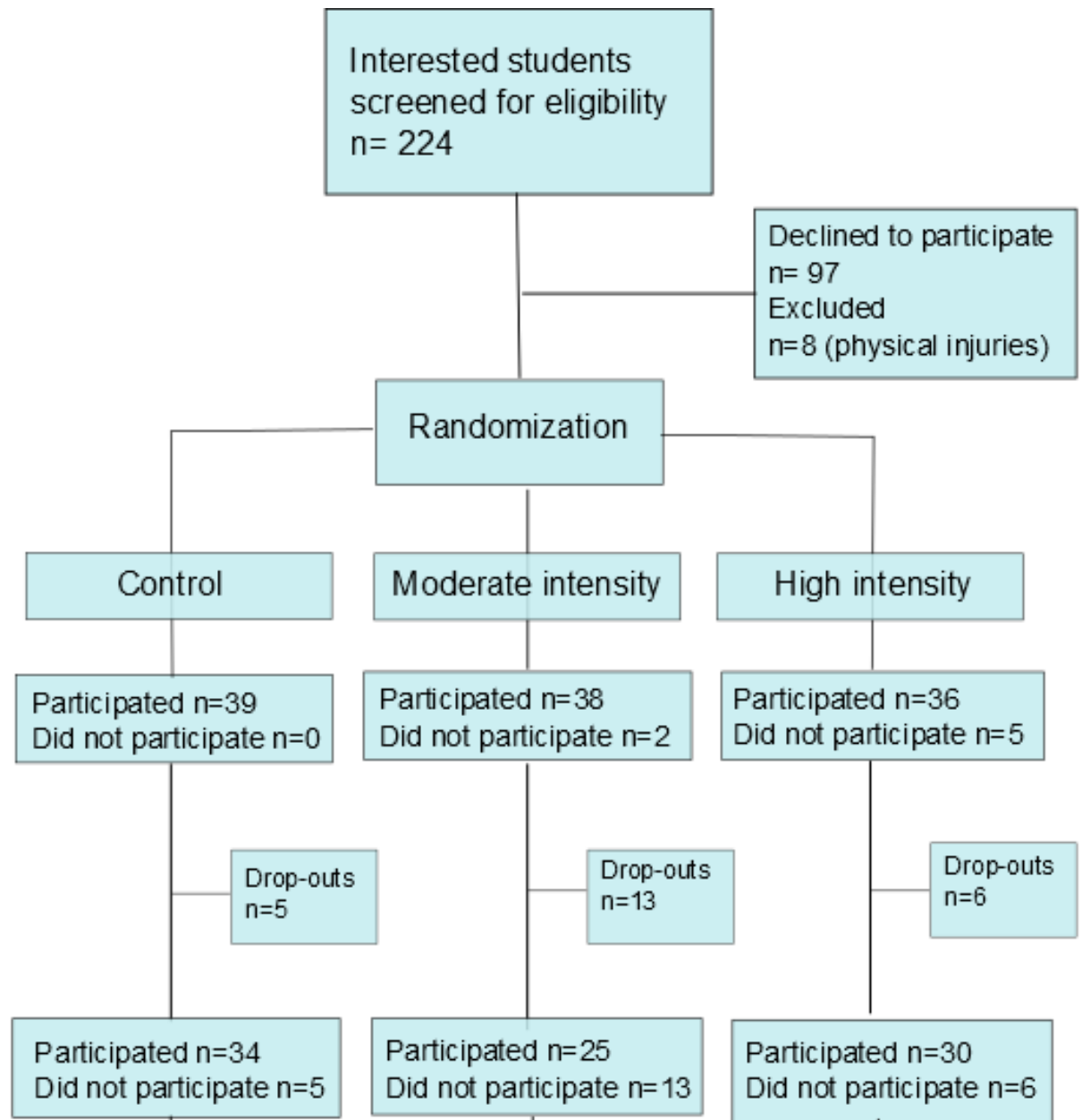
Incongruent

Randomization  
n=120

Baseline  
n=113

Intervention

Follow-up  
n=89



Efficacy vs. effectiveness

Enrollment

Interested students  
screened for eligibility  
n= 224

Declined to participate  
n= 97  
Excluded  
n=8 (physical injuries)

Randomization  
n=120

Randomization

Control

Moderate intensity

High intensity

Baseline  
n=113

Participated n=39  
Did not participate n=0

Participated n=38  
Did not participate n=2

Participated n=36  
Did not participate n=5

Intervention

Drop-outs  
n=5

Drop-outs  
n=13

Drop-outs  
n=6

Follow-up  
n=89

Participated n=34  
Did not participate n=5

Participated n=25  
Did not participate n=13

Participated n=30  
Did not participate n=6

Excluded from the  
analyses\* n=0

Excluded from the  
analyses\* n=3

Excluded from the  
analyses\* n=4

Analyses  
n=82

Included in the  
analyses n=34

Included in the  
analyses n=22

Included in the  
analyses n=26

# Population

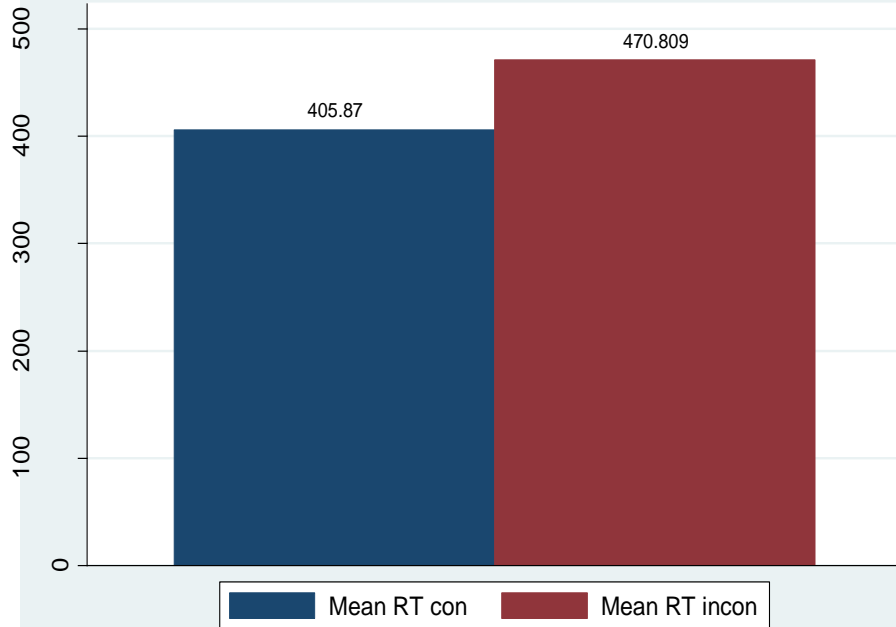
Reported in mean (SD)

	Control		Moderat		High	
Sex	Male (n=8)	Female (n=26)	Male (n=8)	Female (n=14)	Male (n=9)	Female (n=17)
Age (year)	17.8 (.89)	17.9 (.94)	18.2 (.84)	17.8 (.70)	17.8 (1.00)	17.7 (.66)
Weight (kg)	66.9 (21.6)	65.1 (8.2)	66.1 (8.4)	59.5 (7.8)	68.1 (8.3)	58.9 (10.5)
Height (cm)	174.6 (8.2)	169.2 (7.0)	177.5 (6.1)	165.2 (7.9)	177.7 (3.6)	166.0 (5.1)
VO <sub>2max</sub> (L/min)	3.14 (.44)	2.39 (.37)	3.34 (.47)	2.37 (.45)	3.66 (.42)	2.37 (.36)

# The Flanker effect

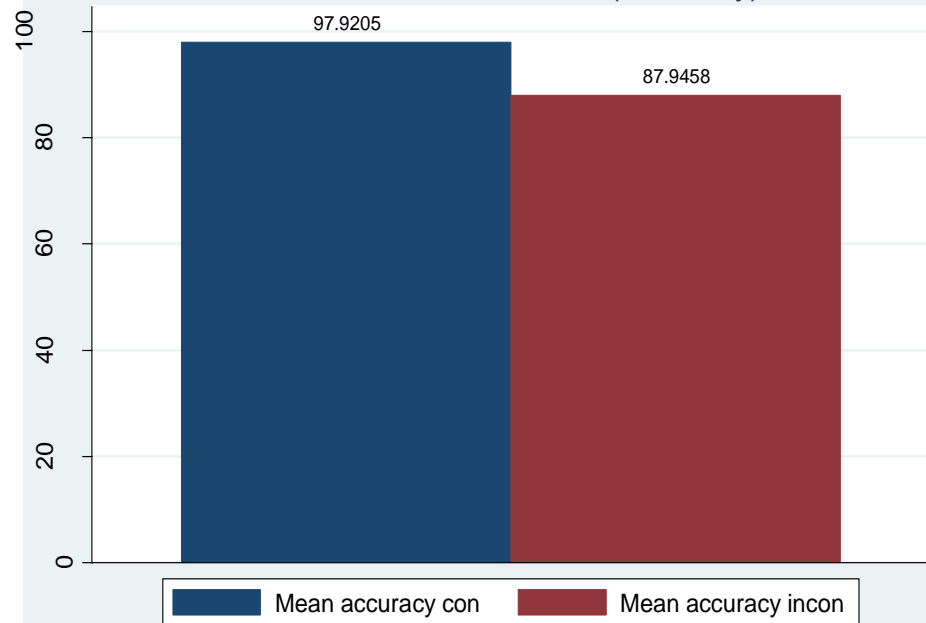
- The Flanker effect /interference control

Baseline Flanker effect (RT)



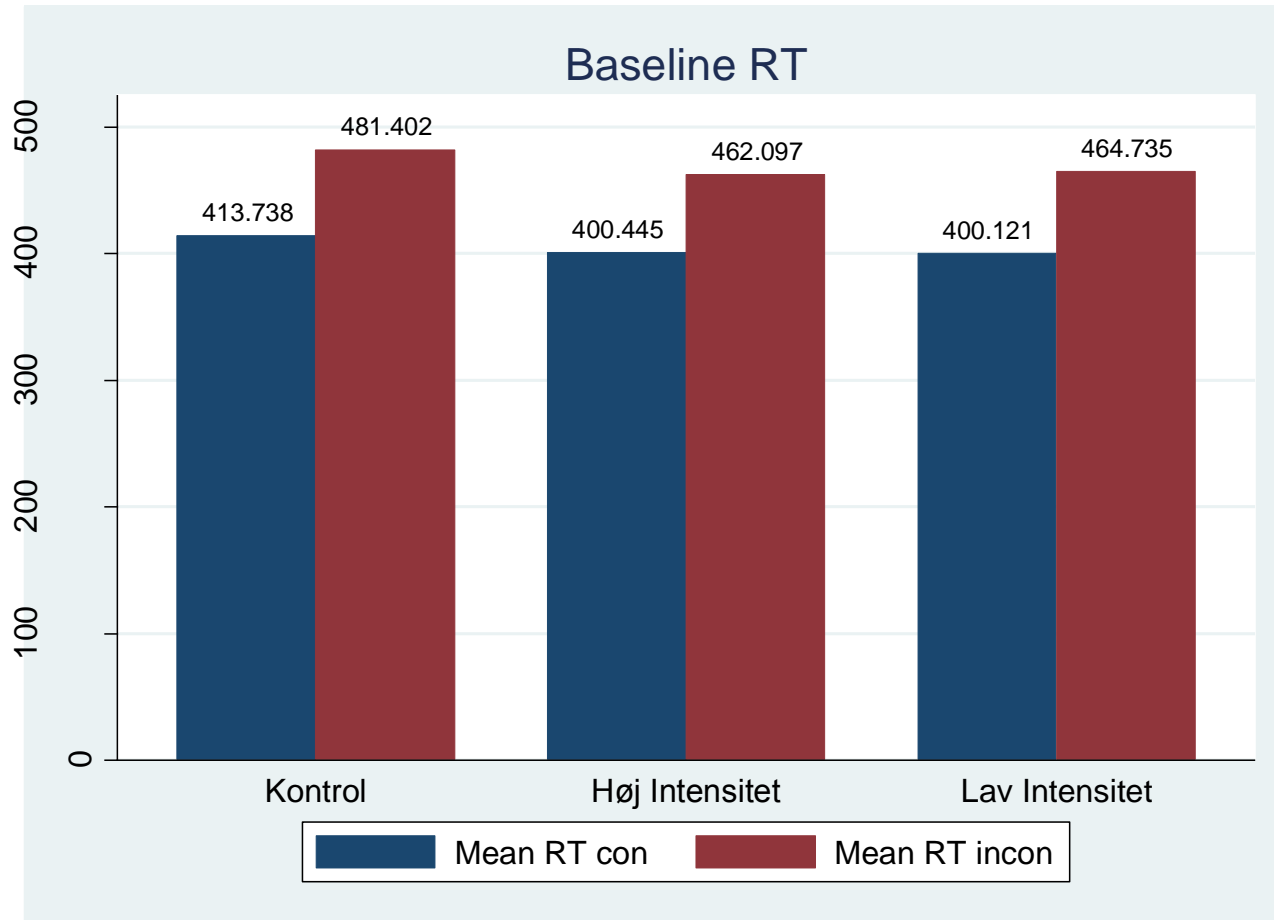
$P < 0.001$

Baseline Flanker effect (accuracy)



$P < 0.001$

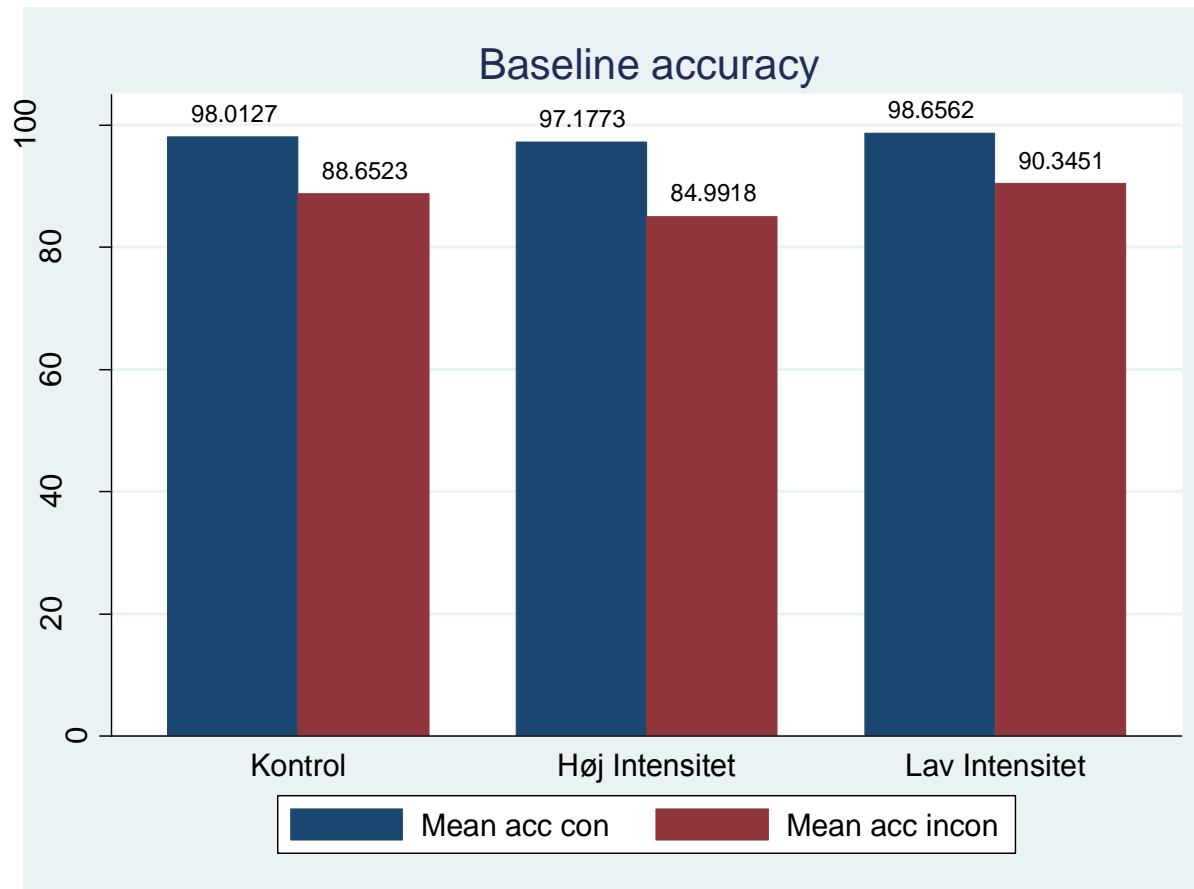
# Baseline Reaction time (RT)



- No difference in RT between groups at baseline

# Baseline

## Accuracy (%correct)



- No difference in accuracy between groups at baseline

# Challenges..

- Outliers
- Male vs. females
- Fit vs. low fit
- Outcome measures
  - Change in strategy should be taken in to consideration
  - Combination of RT and accuracy?

# What to do next?

- Intention to treat analysis
- Imputation of data?
- Post-hoc analysis
  - Subjects with a participation rate > 65%
    - Exclusion from the ex groups and not control
  - Subject with a low/normal aerobic fitness
  - Only girls
  - Correlation between changes in aerobic fitness and changes in Flanker outcomes
- AX-CPT and IQ
- Analysis of data from the study of acute exercise:  
The influence of exercise intensities and -duration

# Thank you!

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