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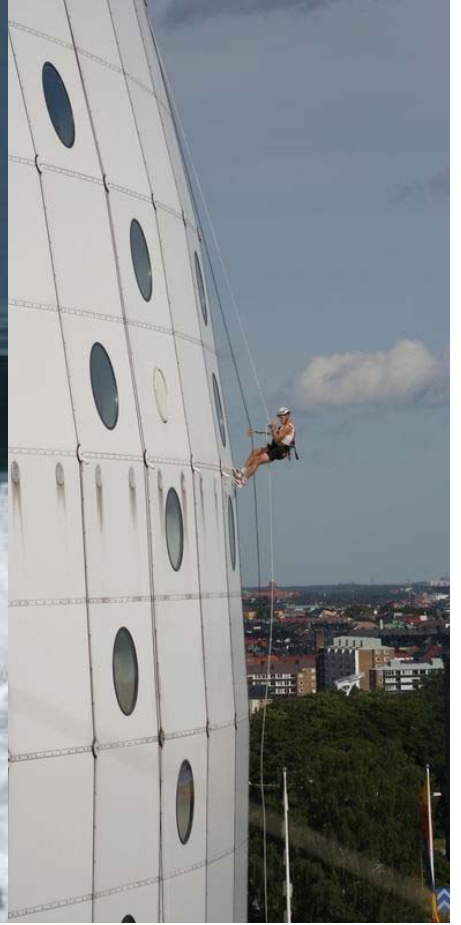


# Physiological demands and cardiac fatigue during ultra-endurance exercise

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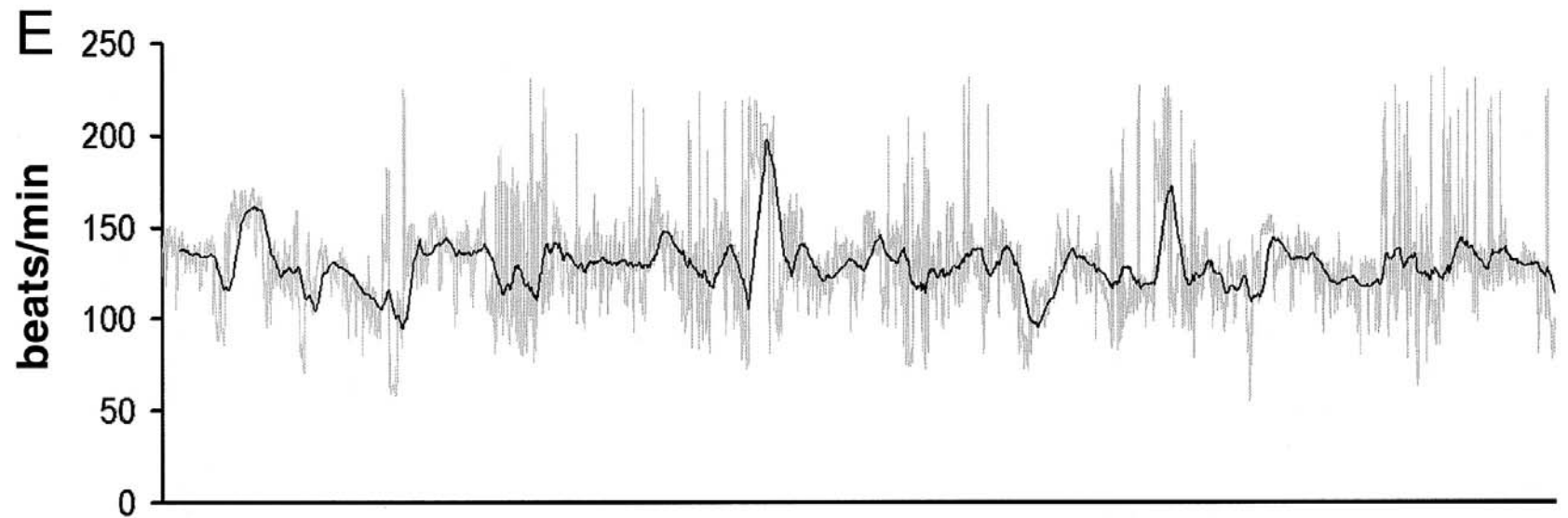




# Background

- Ultra-endurance exercise (Adventure Racing)
  - >24h of (almost) continuous exercise in various modes
  - Extreme physiological strain: At the limit of human performance.
  - Adventure racing facilitates extended time of high systemic strain due to the different modes of exercise

# Heart rate during competition



90 hours

Ashley *et al.* 2006

# Set-up: 140-160 h Adventure Race

- 800 km competition (self chosen work rate, energy intake and time for rest).
- Average work rate 40-50% av  $VO_{2peak}$  (incl. rests and sleep)



# Set-up: 140-160 h Adventure Race

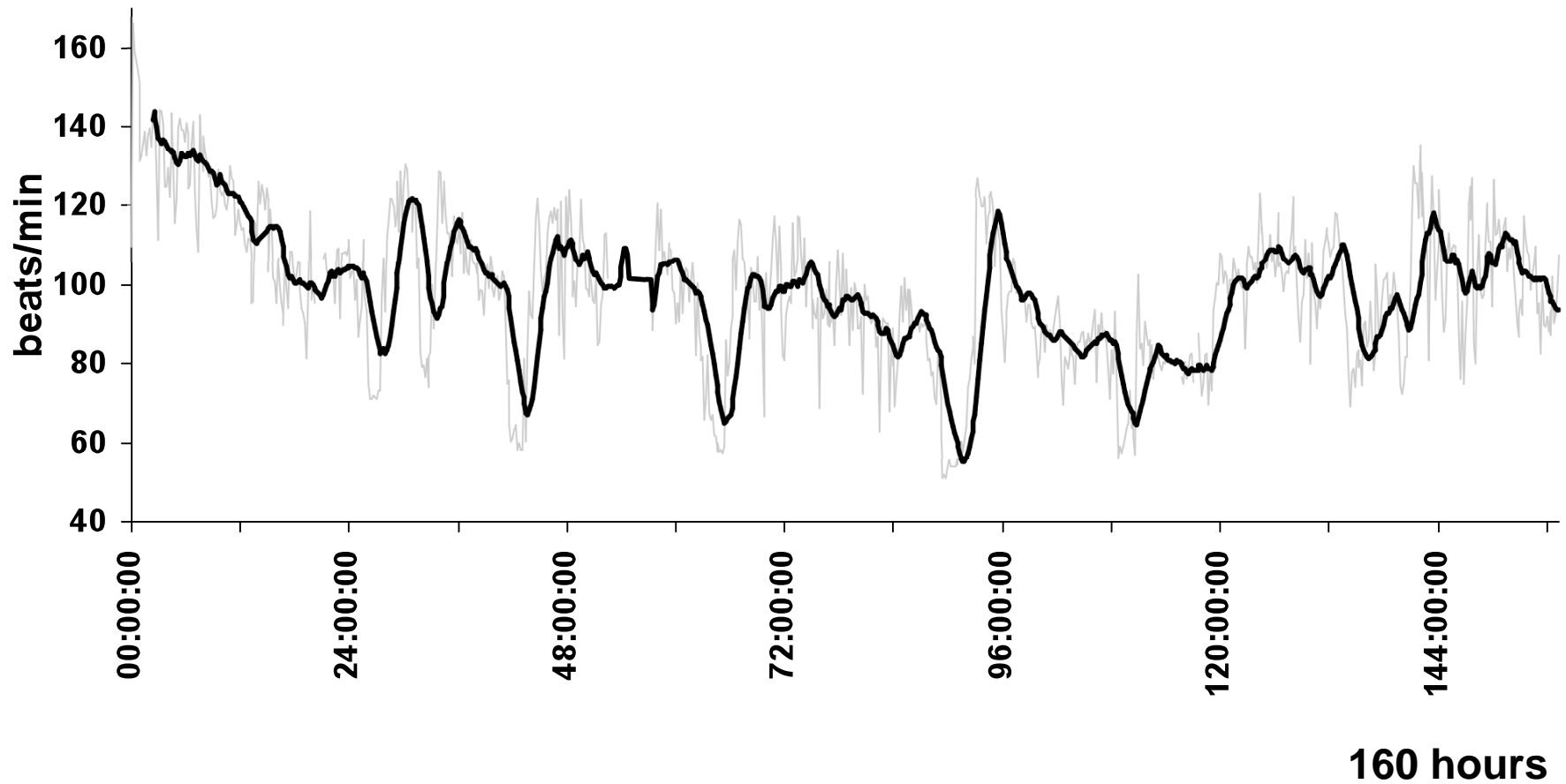
**Circulatory measurements and blood samples for analysis of heart markers approx. every 24<sup>th</sup> h.**

Parameters:

1. *(Oxygen uptake and heart rate on standard work rate (150 W men, 100 W women).)*
  2. Heart markers (Troponin I, CKMB, BNP, NT-proBNP)
  3. The hearts contraction patterns (TDI – baseline, immediately after and 24h post)
  4. Self and team reported performance.
- N = 15 (12 men, 3 women)



# Heart rate during competition



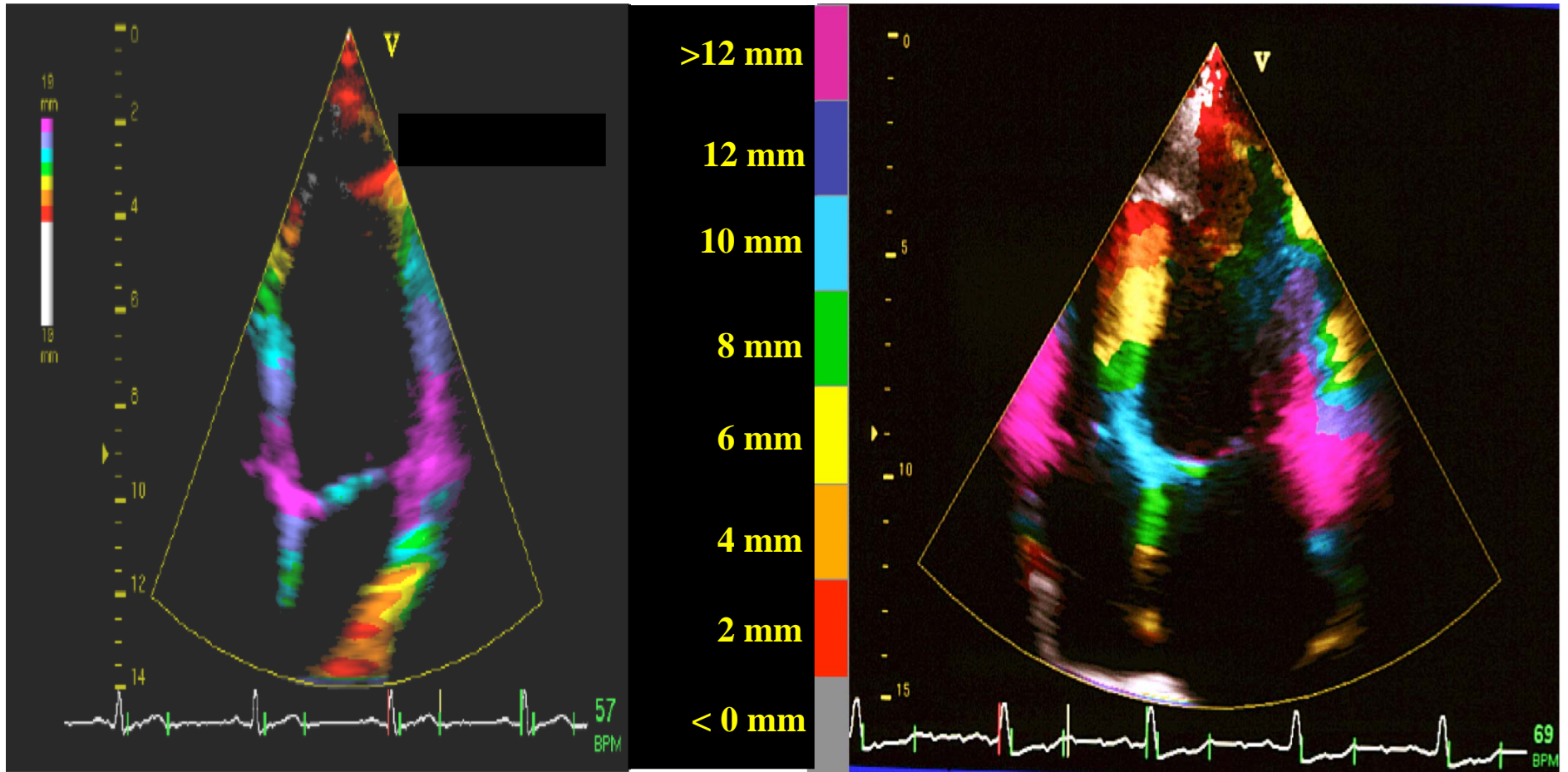
# Results

At the finish:

- The athletes were all healthy without any clinical signs or symptoms of heart failure.
- Increased levels of Trl in 20% of the athletes.
- Increased levels of NT-proBNP in **ALL** athletes.
- High levels of NT-proBNP (>900 up to 2500 ng/l) in 20% (*not the same 20 %*).

# Decreased function

Tissue Tracking – Amplitude of movement



**BASELINE**

**AFTER EXERCISE**

## Same as previous studies

- Previous studies on marathon (4h), triathlon (<15h), 24 hours run, 90 h Adventure race.
  - Elevation in cardiac troponin, CKMB and BNP
  - Decreased ejection fraction
  - Abnormalities in cardiac motility
- Rapid reversal (<24h) indicates fatigue not damage.

# Gained knowledge & remaining questions

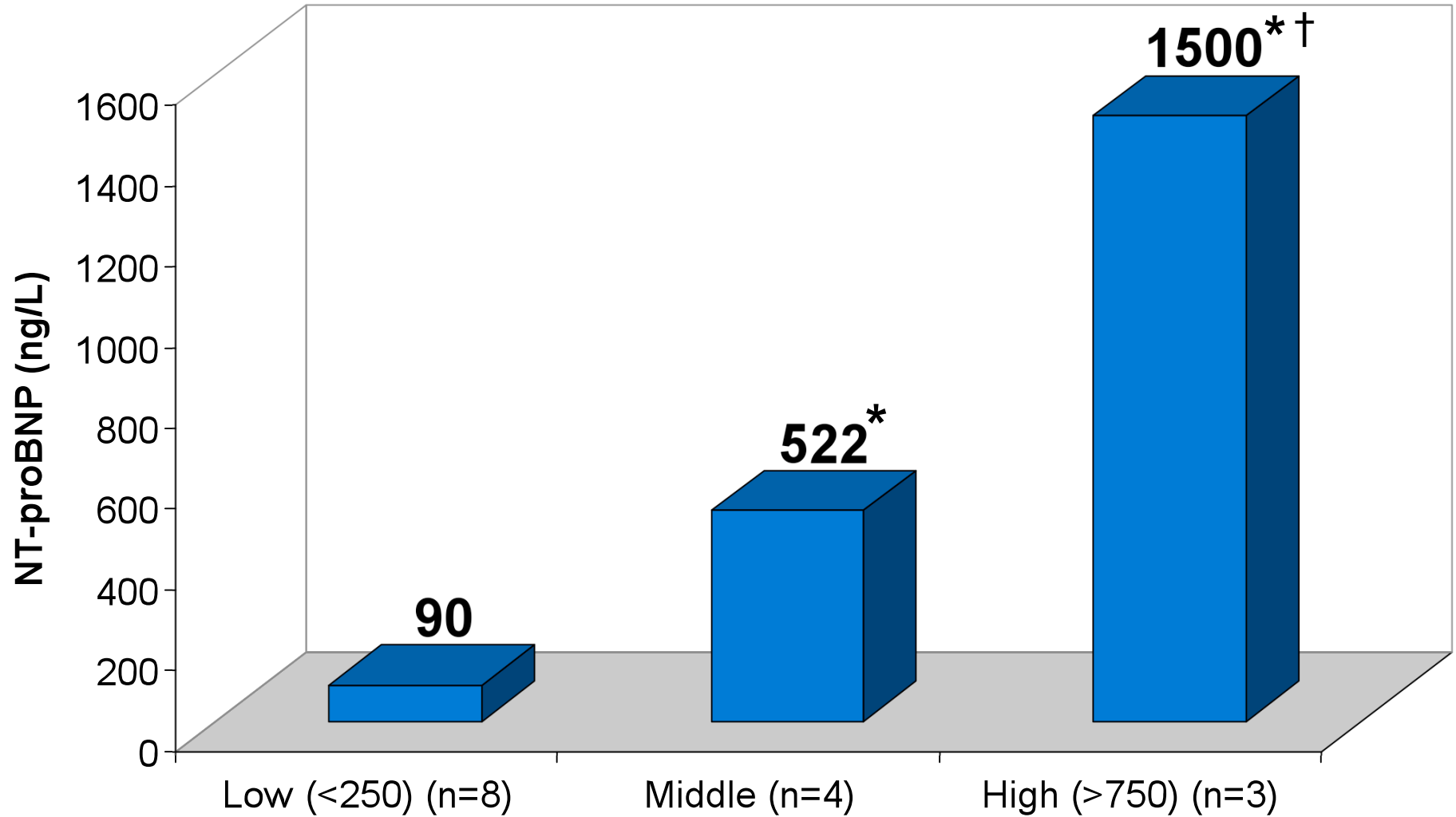
## Answers

- Reversible even after 6 days of exercise.
- Not a single athlete displayed a pathological heart (*few subjects*).

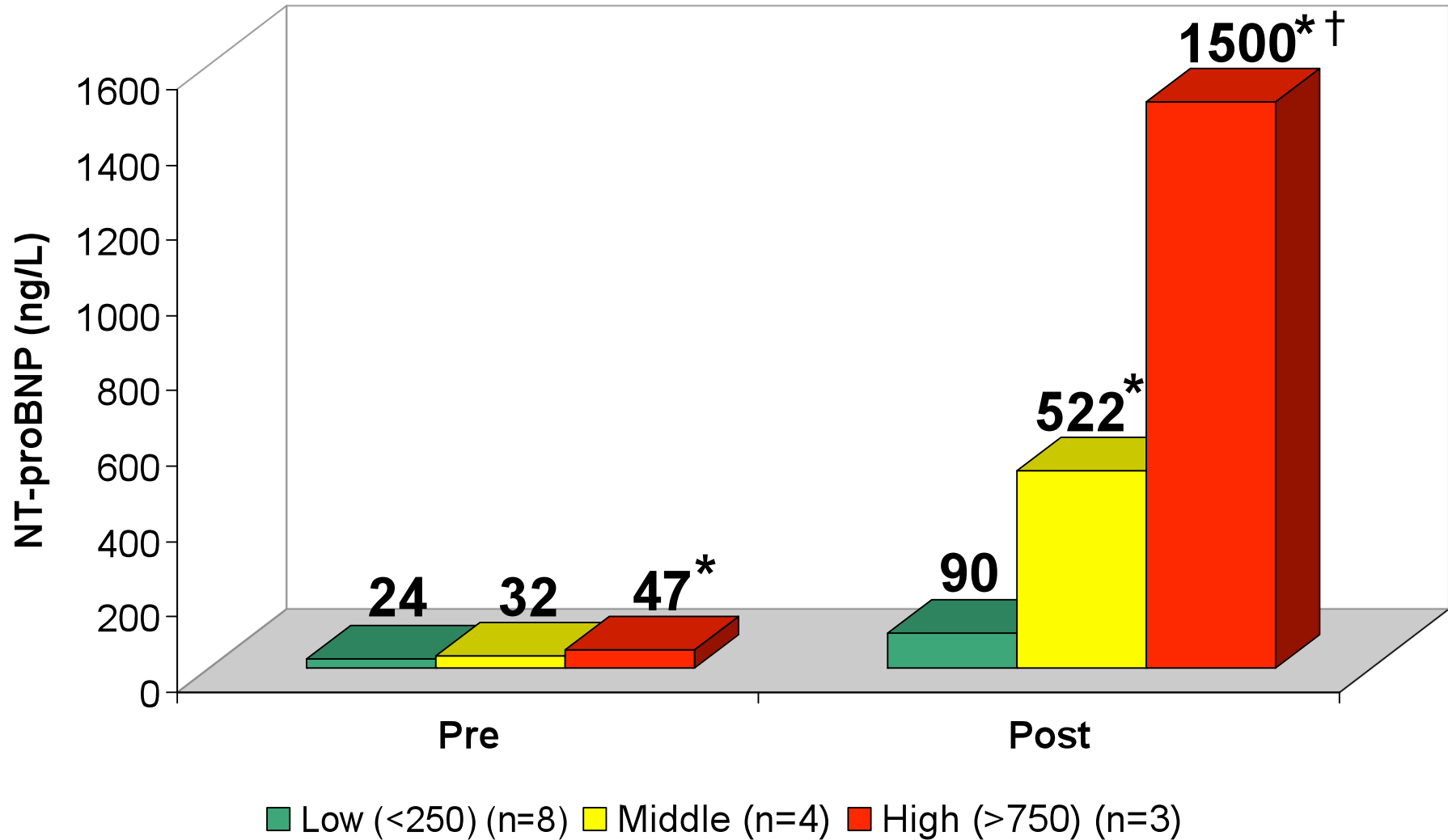
## Questions

- Does it matter? Relation to performance.
- Measurements at rest vs. during the exercise

# Differences between athletes



# Pre-values as predictor



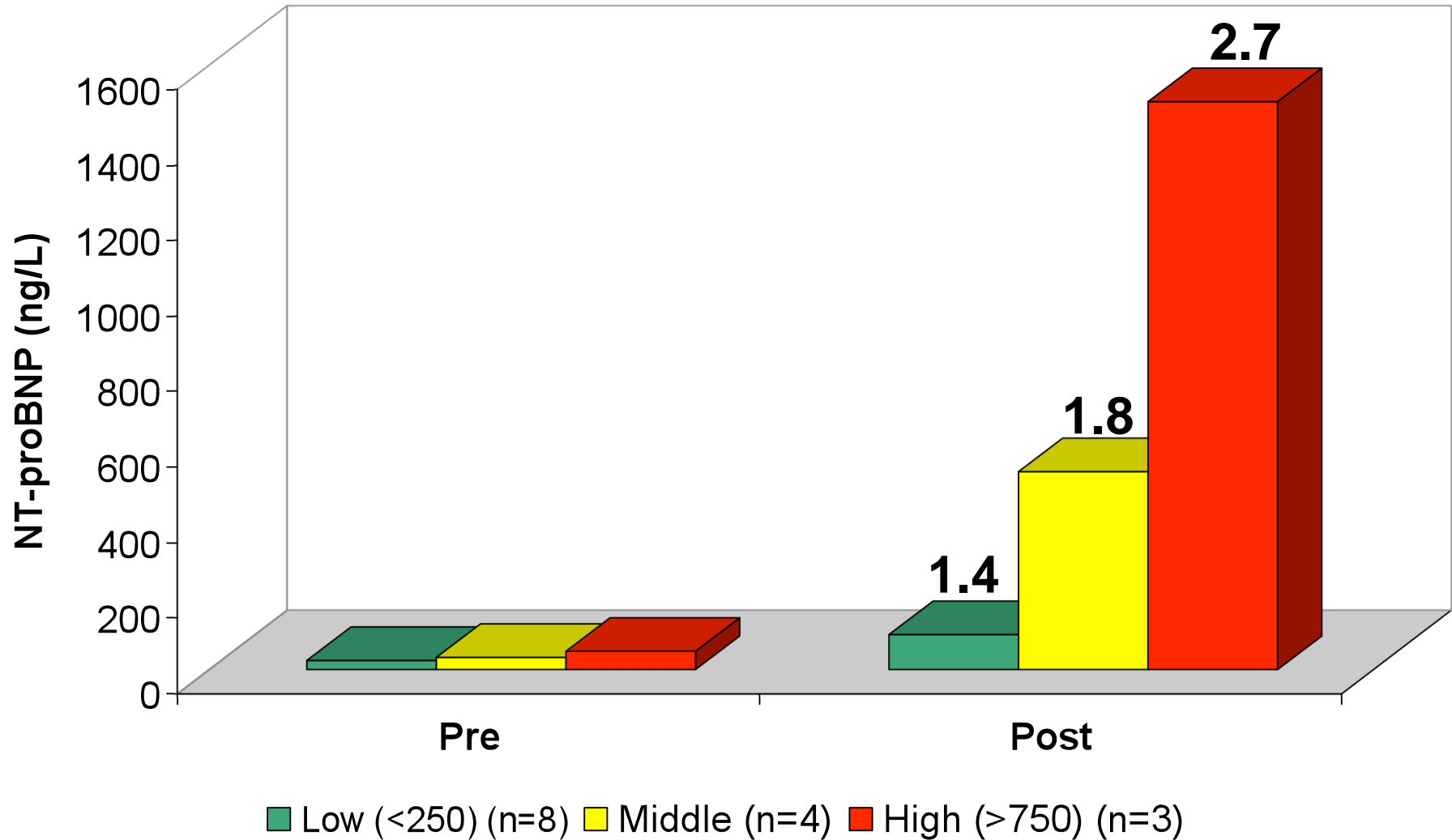
# Rating performance

## Status:

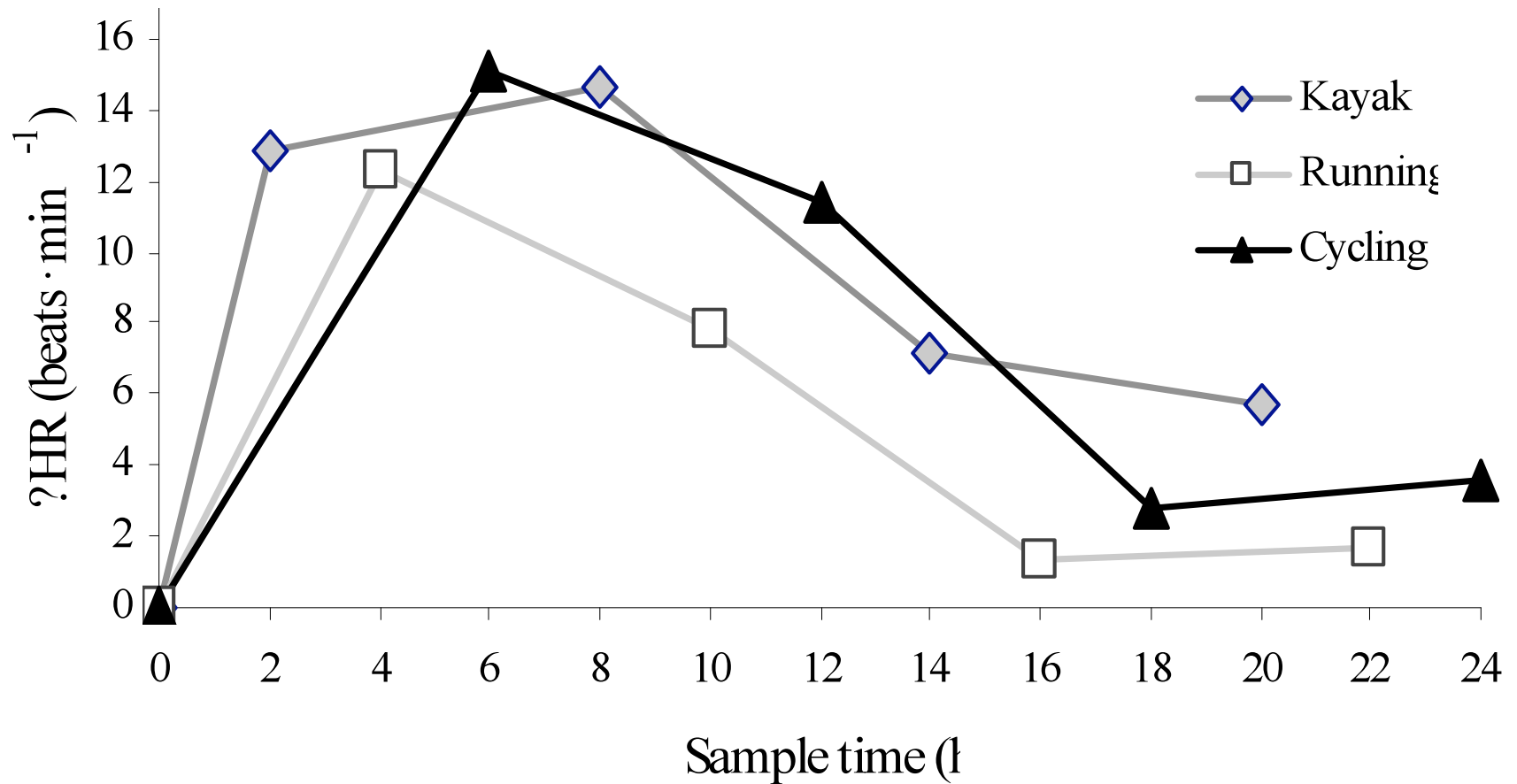
Self- and team reported performance the last 24 h of the race.

- 1) **Strong**, carried extra weight, helped other teammembers.
- 2) **Intermediate**, took care of oneself.
- 3) **Weak**, got towed in, took help from teammembers.

# Relation to rated performance

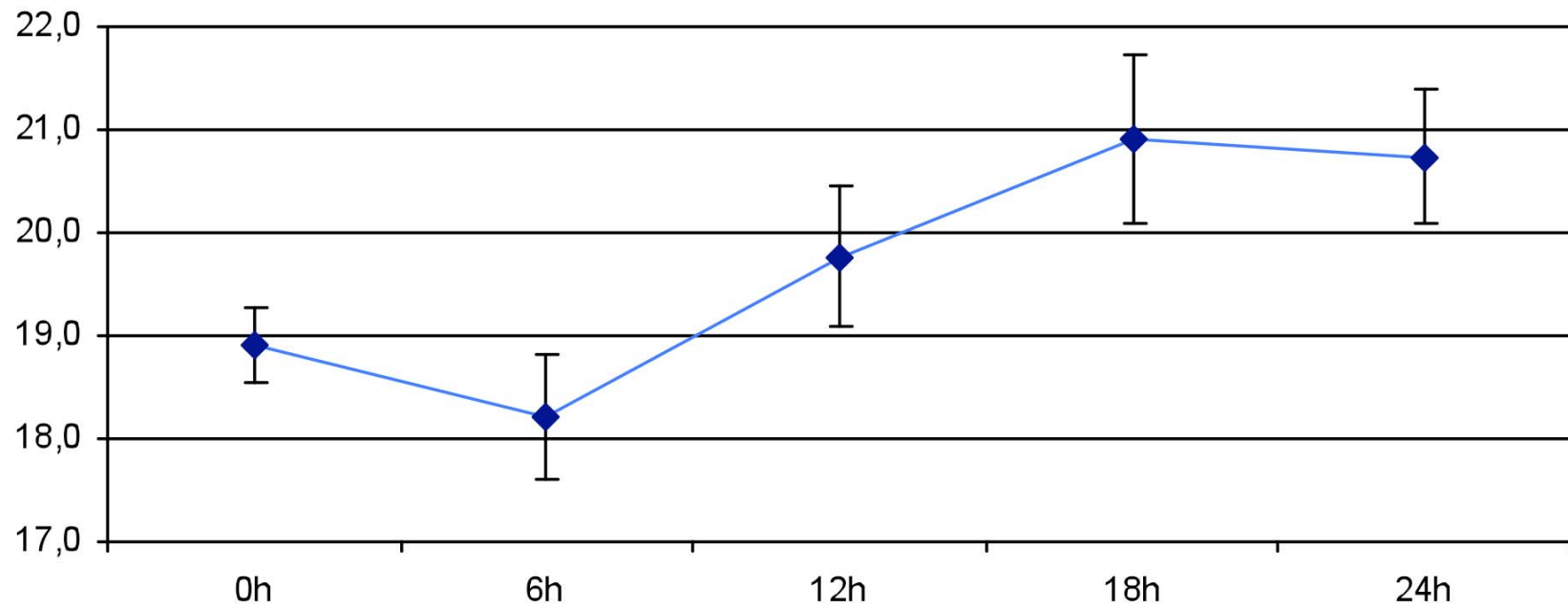


# What happens during exercise?



(Laboratory study: 24 h standardized exercise.)

# Oxygen uptake / heart rate



**0 – 18/24 h  $VO_2/HR$ : +0,10 %**

## Novelty and conclusion

- **Reversed drift in HR** after 6 h of exercise.
- High oxygen drift, despite relatively low work intensity.
- **Increased oxygen pulse** (either by increased SV and/or by increased central a-v O<sub>2</sub> diff)
- More efficient work of the heart?
- Prel. result: **Increased SV and decreased MAP during exercise >50 h.**



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**Thank you for your attention!**

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**[www.gih.se/multisport](http://www.gih.se/multisport)**

*(Sorry, so far only in Swedish)*

