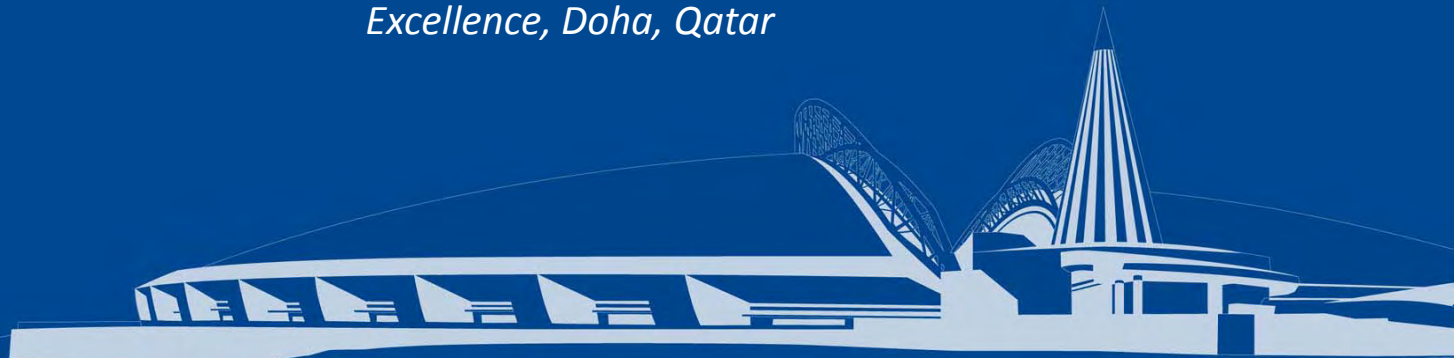
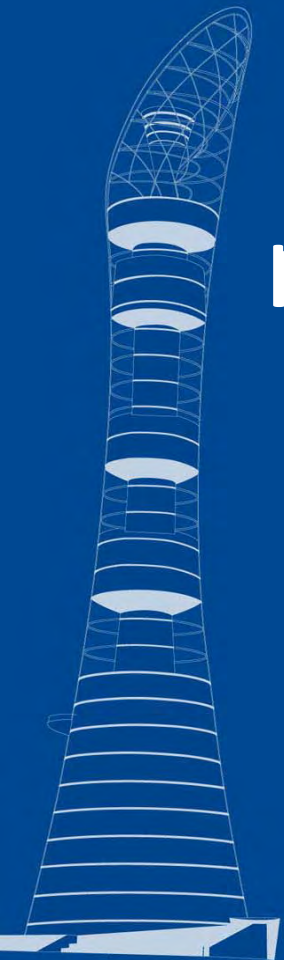




# Monitoring changes in physical performance with heart rate measures in young soccer players

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# Optimizing training process

## Monitoring

- ✓ Training load
- ✓ Fatigue/recovery
- ✓ Adaptation to training
  - Performance
  - Physiology



## Managing / adjusting

- ✓ Training load and contents

# Optimizing training process

## Tools in (youth) football:

- ✓ Practical (field)
- ✓ Objective
- ✓ Reliable
- ✓ Non-invasive
- ✓ Non-fatiguing
- ✓ Time-efficient





# HR measures: the solution?

- **HR during (submax) exercise (HRex)**
  - Cardiorespiratory fitness
  - Changes related to changes in (endurance) performance (*Andrew JAP 1966*)
  - Fatigue? (*Coutts JSMS 2007; Bosquet BJSM 2009*)
  - Marker of performance decrement ? (*Brink SJMSS 2010, Schmikli BJSM 2010*)
- **HR recovery (HRR):**
  - Respond to training loads / volume (*Borresen EJAP 2007, Buchheit AmJP 2006*)
  - Changes related to changes in running performance (both endurance and repeated-sprint ability) (*Buchheit MSSE 2008, EJAP 2010a*)
- **HR variability (HRV):**
  - Cardiorespiratory fitness (*Buchheit AmJP 2006*)
  - Changes related to changes in running performance (both endurance and repeated-sprint ability) (*Buchheit MSSE 2008, EJAP 2010a*)
  - Level of homeostasis disturbance → acute impact of exercise (*Al Haddad IJSP 2009*)
  - Overall training adaptation / recovery (increases when tapering) (*Pichot MSSE 2002*)
  - Psychological stress (*Pichot Pflugers Arch 2002*)

# Purpose

To verify the validity of using:

✓ Submaximal HR<sub>ex</sub>

✓ HRR

✓ post-exercise HRV

to **predict changes in physical performance** over an entire competitive season in highly-trained **young soccer players.**



# Methods

- 92 young soccer players (age 15.1 +/- 1.5 y)
- 14 hours of combined soccer-specific training and competitive play per week
- Tested 3 times per year (i.e., October, January and May)
  - Performance field tests
  - HReX/HRR/HRV measures (i.e., 5'-5' test)



# Performance tests

- Anthropometry / Peak Height Velocity (PHV)
- Counter movement jump (CMJ)
- 40-m sprint with 10-m split times
  - Acceleration (1<sup>st</sup> 10 m) / MSS (best split)
- Repeated-sprint ability (RS)
- Incremental track test ( $V_{\text{vam-eval}}$ )



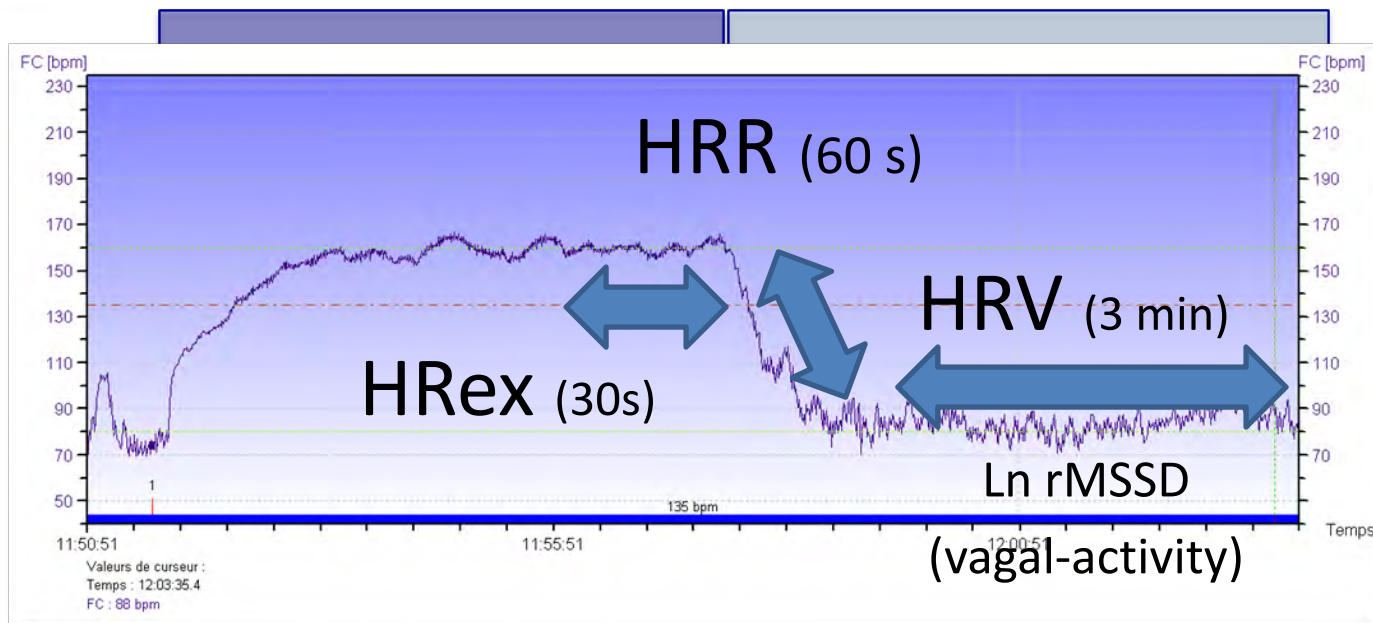


# Submaximal running test: 5'-5'





# 5'-5' test: all in one !



5' @ 9 km/h)



5' seated recovery

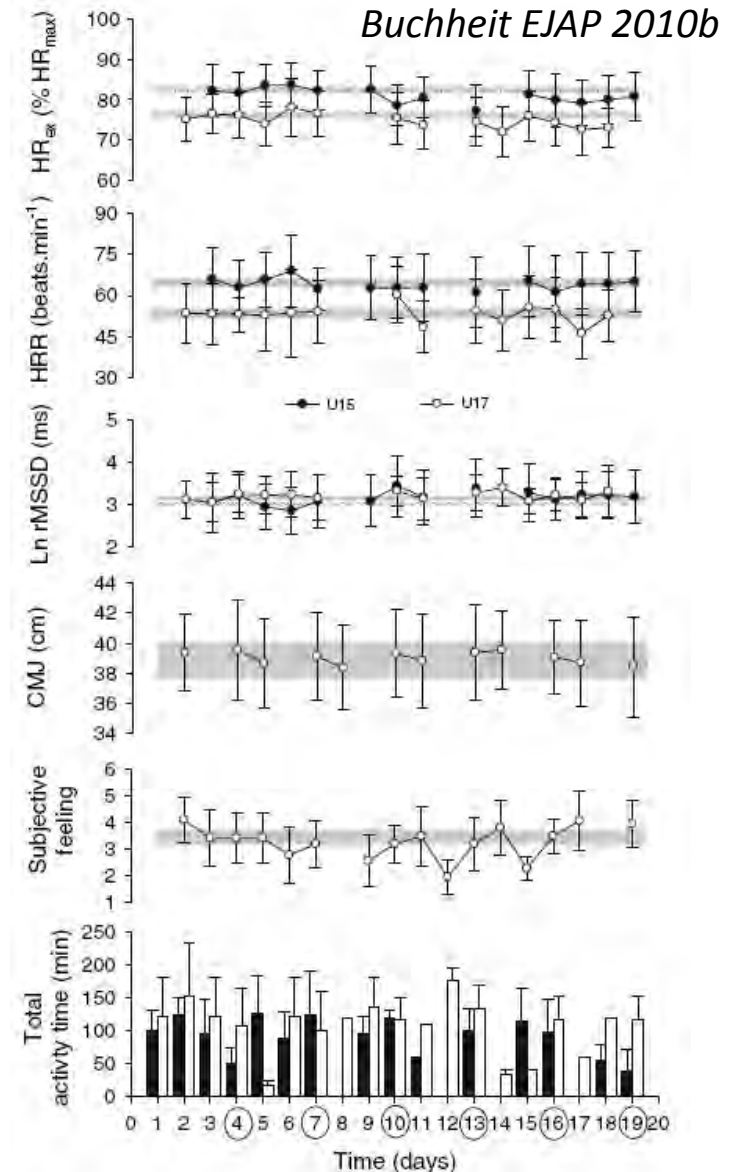


# Data analysis

No overload  
= stable data

CV:

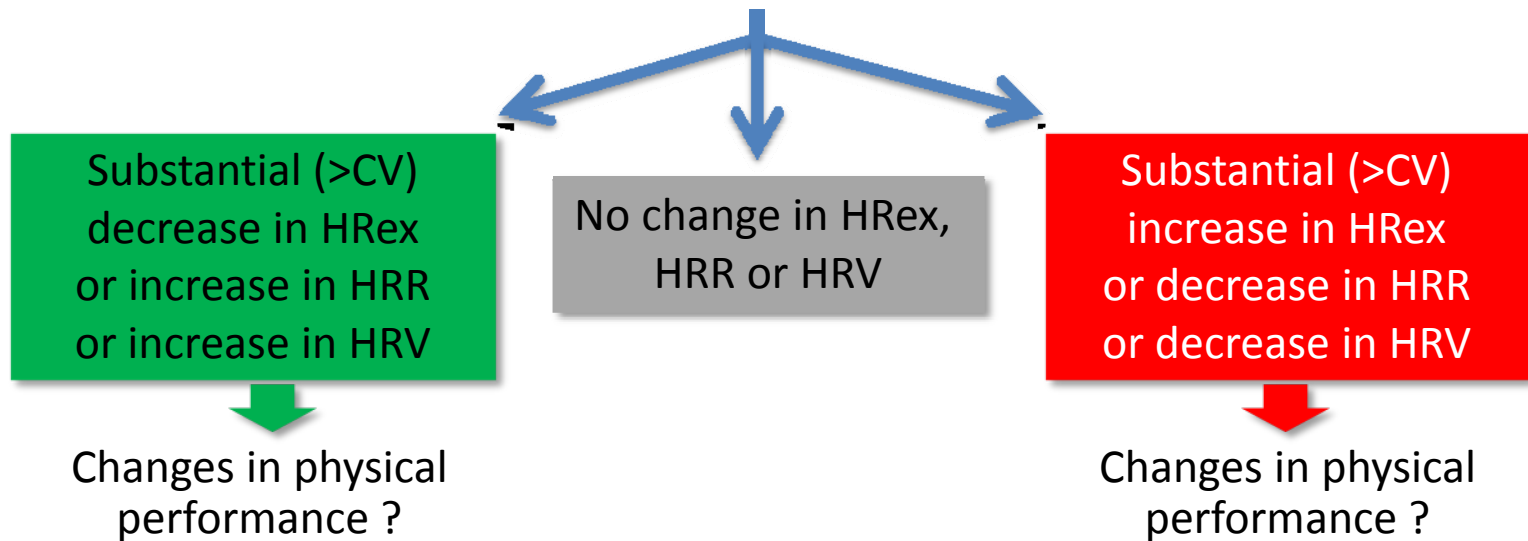
- ✓ 3 % for HRex
- ✓ 13% for HRR
- ✓ 10% for HRV



# Data analysis

- 65 complete data sets available (46 players)

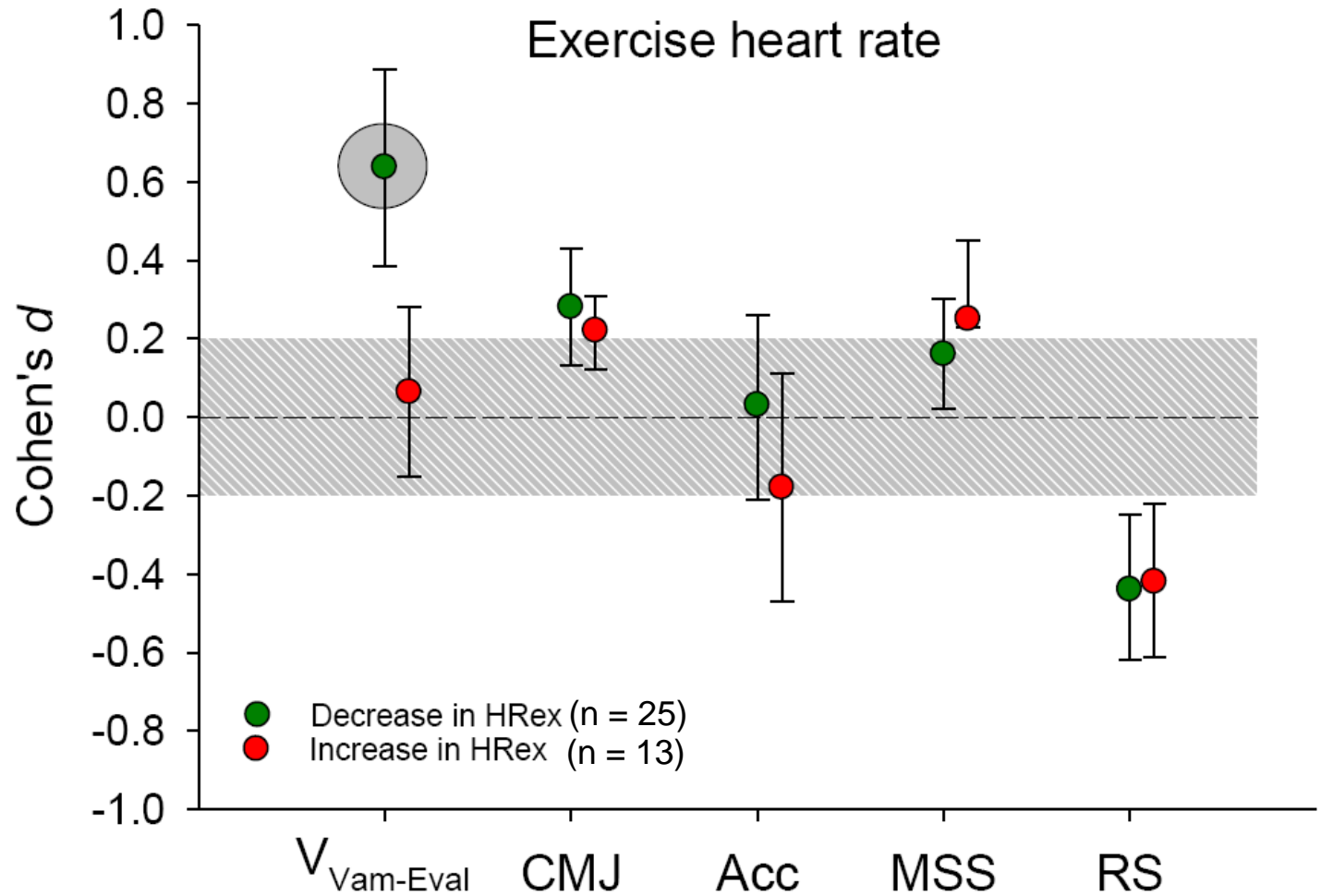
- October to January  
and/or
- January to May



- Changes in performances
  - Adjusted for changes in body mass
  - Expressed as **Cohen's d**



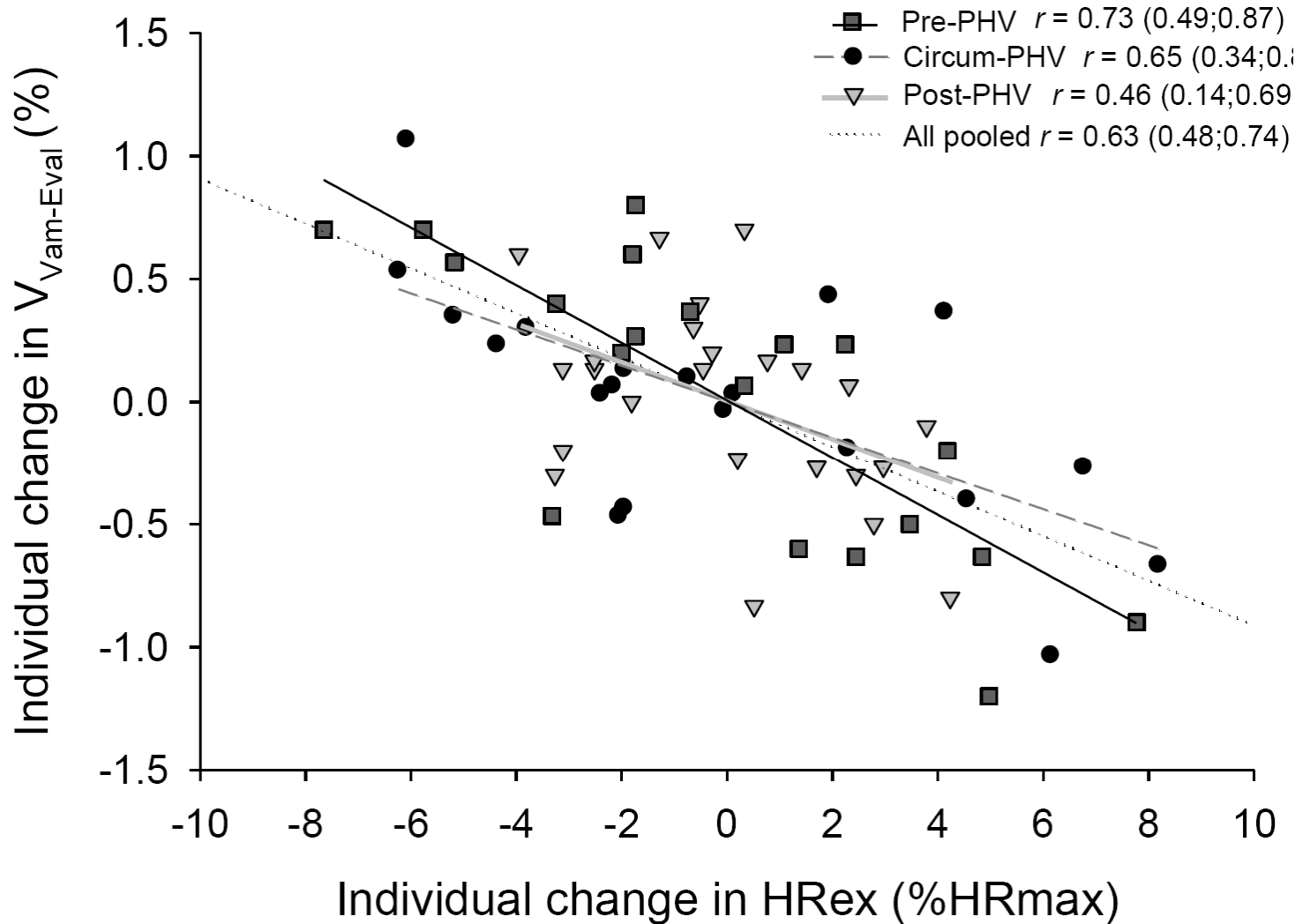
# Results



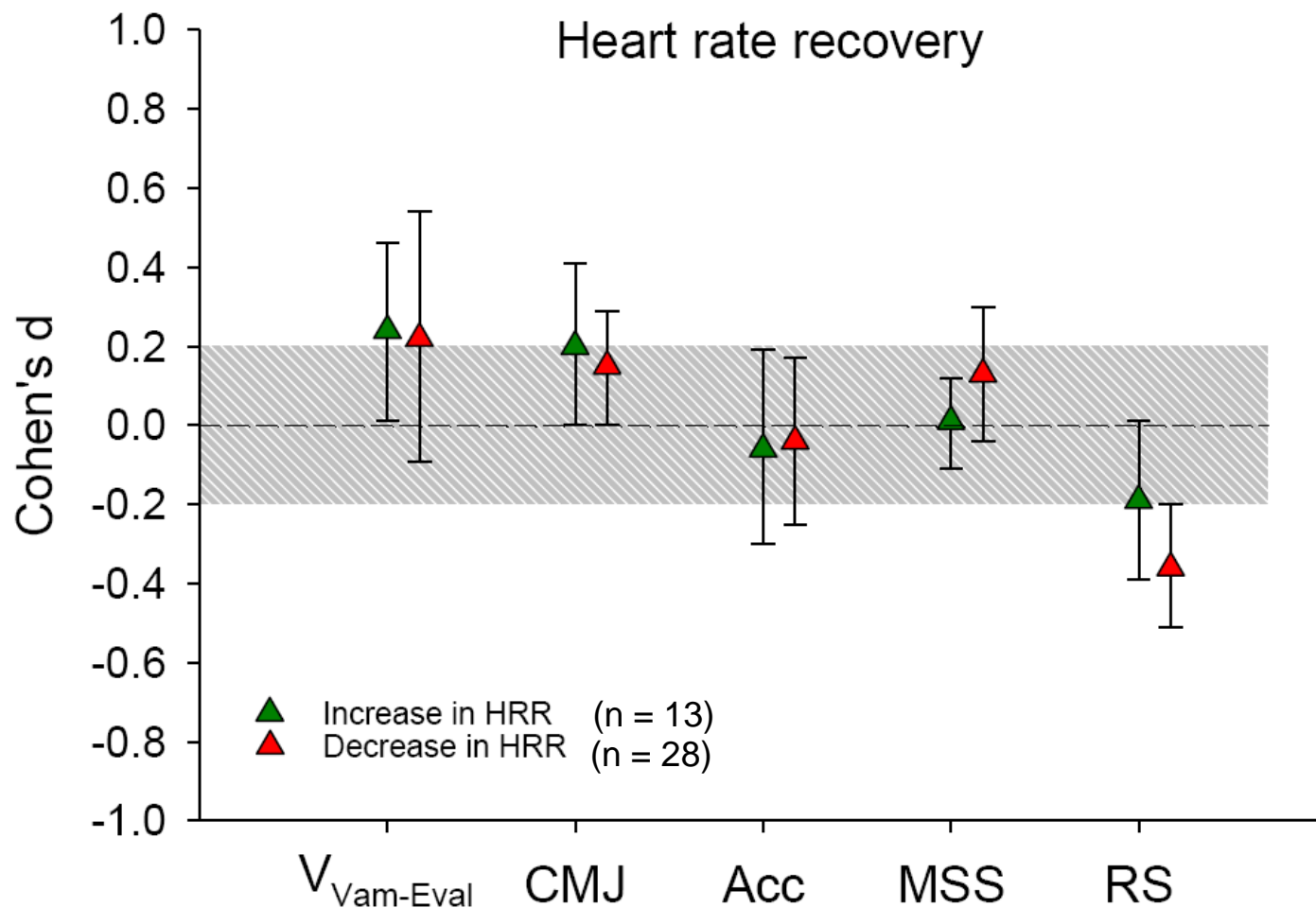
Adjusted for changes in body mass

*Buchheit et al. Ejap 2011*

# Results



# Results

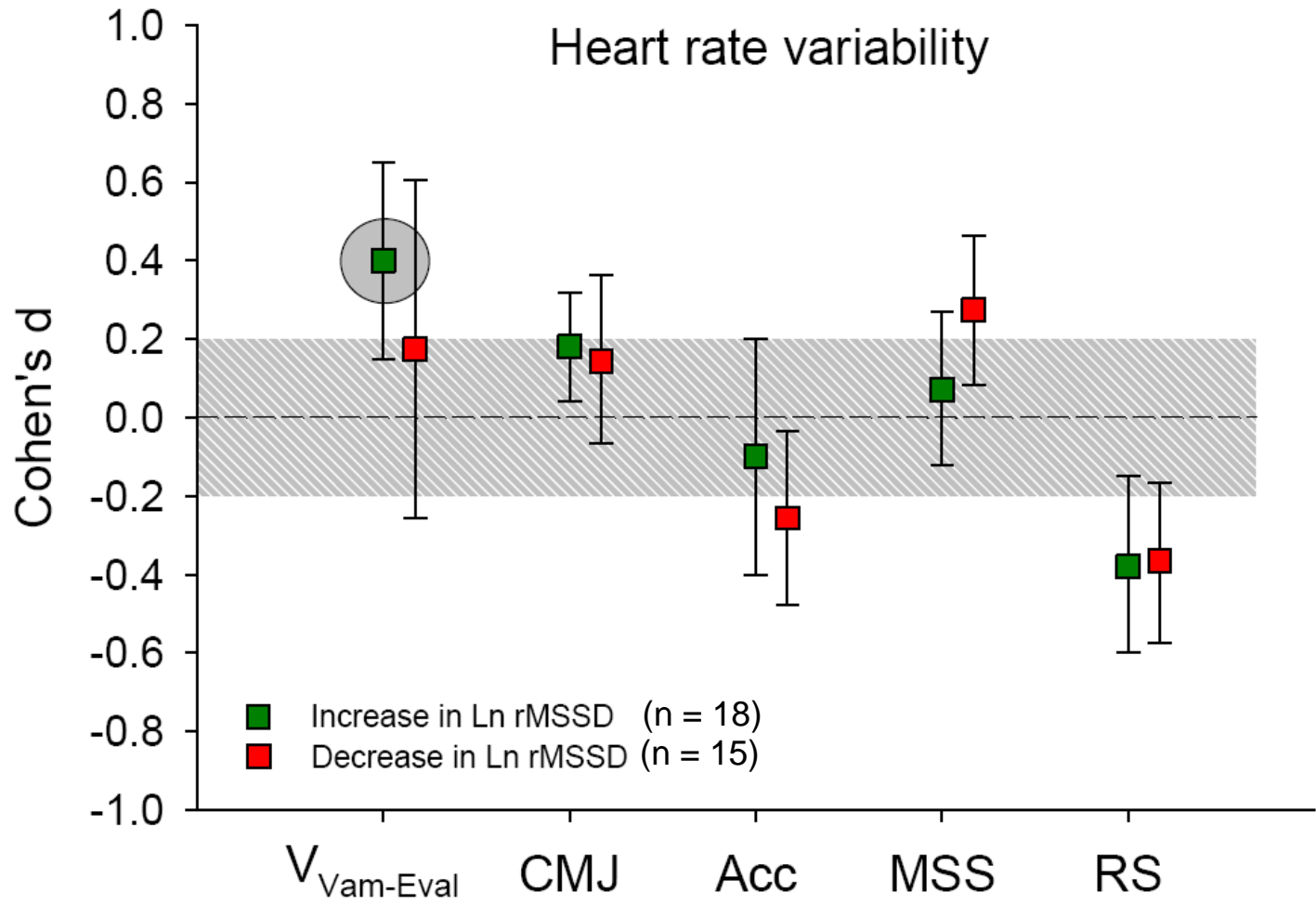


Adjusted for changes in body mass

*Buchheit et al. Ejap 2011*



# Results



Adjusted for changes in body mass

*Buchheit et al. Ejap 2011*

# Results

Controlled for changes in body mass

| Baseline values ( $n$ pairs of data = 25) |                  |                        |                        |
|---|------------------|------------------------|------------------------|
|   | HRe <sub>x</sub> | HRR                    | Ln rMSSD               |
| $V_{\text{Vam-Eval}}$                     | 0.47 (0.17;0.69) | Unclear                | Unclear                |
| CMJ                                       | Unclear          | Unclear                | Unclear                |
| Acc                                       | Unclear          | Unclear                | -0.52<br>(-0.23;-0.73) |
| MSS                                       | Unclear          | 0.39 (0.07;0.64)       | 0.57 (0.30;0.76)       |
| RS  | Unclear          | -0.38<br>(-0.05;-0.64) | -0.37<br>(-0.05;-0.62) |

*changes in physical performance variables **over a season***

# Conclusions

- Monitoring **HRex** and **HRV** is effective in tracking improvements in  $V_{\text{Vam-Eval}}$
- The use of **HRex**, **HRR** and **HRV** as systematic markers of physical performance decrements in youth soccer players (*Brink SJMSS 2010, Schmikli BJSM 2010*) is questioned





# Applications

- Monitoring changes in performance
- Assess training effectiveness
- Trainability?
- Acute/chronic fatigue?
- Readiness to perform ?

→ Adjust training contents  
→ Adapt playing strategies



## When?

- ✓ Start of the season
- ✓ Before/after each training cycle
- ✓ When needed on an individual basis