COLLEGE OF REHABILITATION SCIENCES

Monitoring Training Load in Collegiate Soccer Athletes

Jefferson
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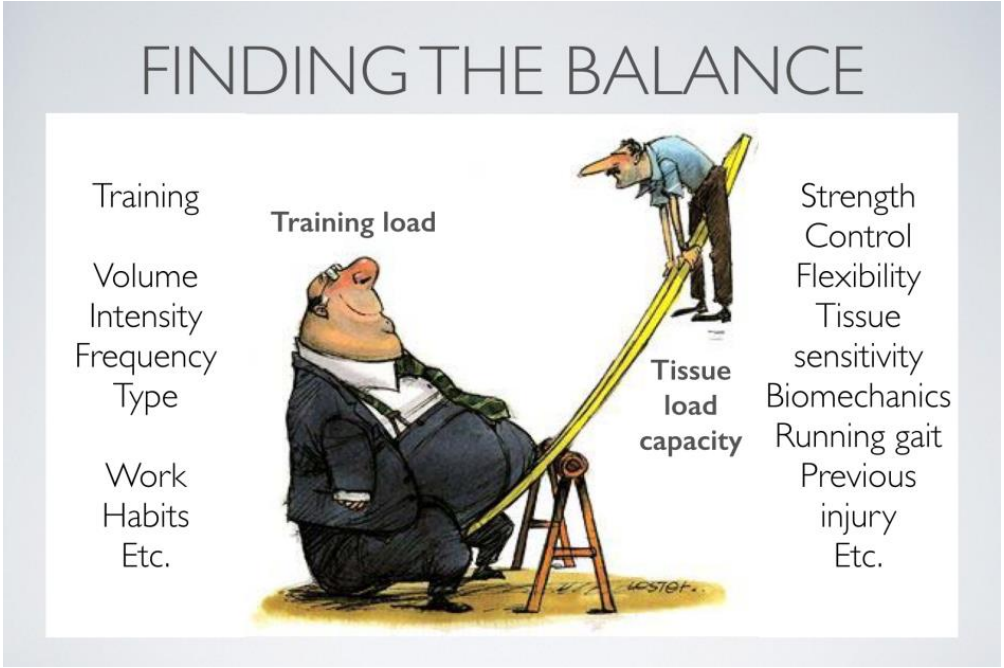
Disclosure

I have no financial or other associations with companies having a direct link and/or financial relationship that is related to the topic/content of their presentation to disclose.


NO PAIN, NO GAIN...

Clinical Question

- What is training load?
- Why is it relevant to individual athletes?



Objective

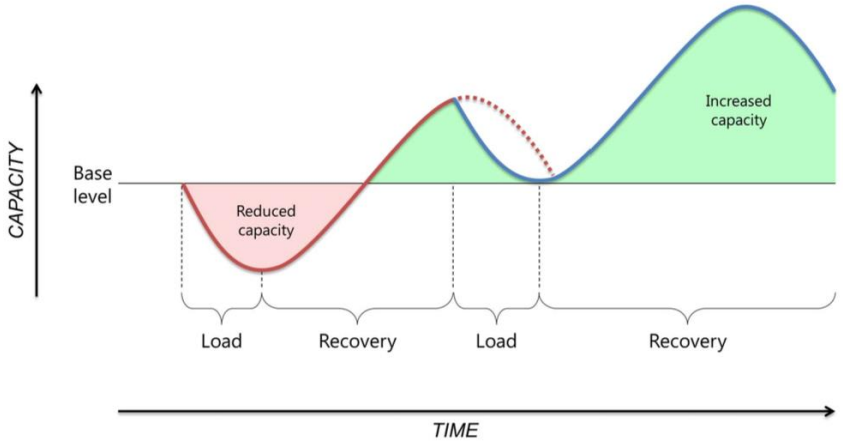
1. Describe objective methods of evaluating training impact on external and internal load

2. Assess relationship between heart rate and countermovement jump

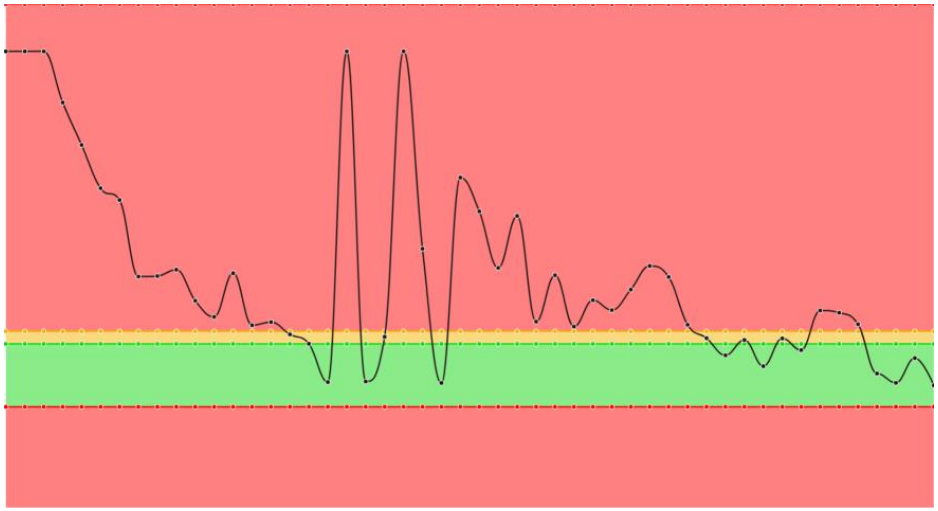
3. Assess changes in heart rate and countermovement jump across competition season

Training Load

- From a training perspective, cardiovascular and neuromuscular adaptations are suggested to be stimulated through a high training load
  - Induced through manipulation of intensity, duration, and frequency of training



Workload Management



- Excessive fatigue plays a key role in sport injuries
  - Impairs decision-making ability, coordination and neuromuscular control
  - Risk of injury increases when the external load exceeds the capacity of the athlete

Soligard 2016

Workload Management: Injuries

1. Athletes are psychologically and/or physically unfit to tolerate the prescribed workload

2. Athletes are fit and well-trained but in need time off

Risk is Multifactorial

Training Load

- **Load:** sport and non-sport burden (single or multiple physiological, psychological or mechanical stressors) as a stimulus that is applied to a human biological system (including subcellular elements, a single cell, tissues, one or multiple organ systems, or the individual)

Hawley 2014

Types of Training Load

- **External Load:** Any external stimulus applied to the athlete that is measured independently of their internal characteristics

- **Internal Load:** Load measurable by assessing internal response factors within the biological system, which may be physiological, psychological, or other

Hawley 2014

External Load

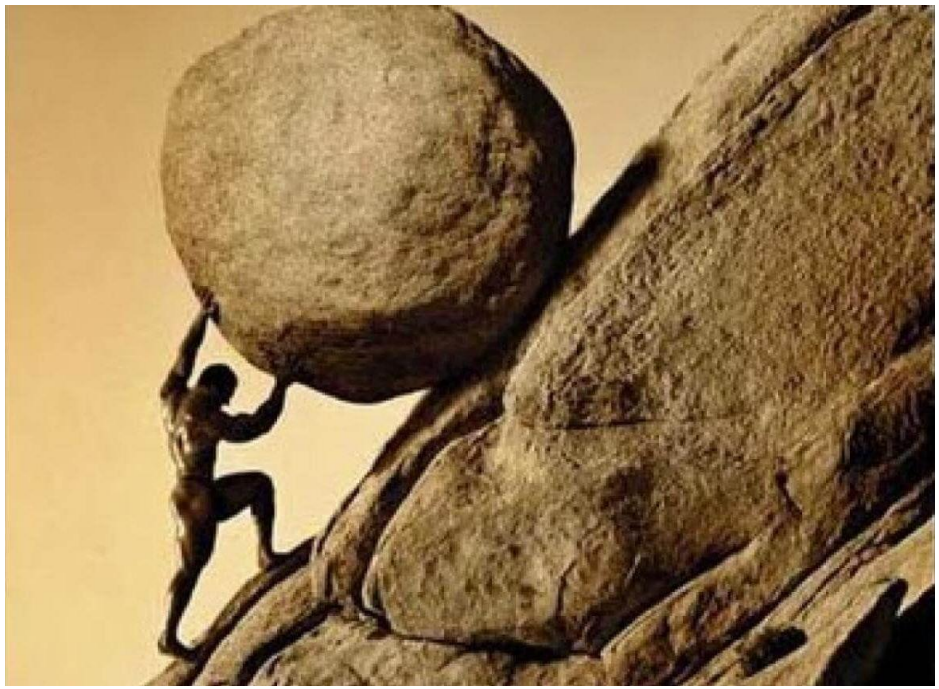
- Training or competition time (minutes, hours) or frequency (per day, week, month)
- Power output, speed, acceleration
- Neuromuscular function (jump test, isokinetic dynamometry and plyometric push-up)
- Movement repetition counts (pitches, throws, jumps)
- Distance (kilometres run, cycled or swam)

Internal Load

- Perception of effort (rating of perceived exertion, RPE)
- HR, HR recovery/variability
- Blood lactate concentrations

Internal Load

- Athletes may perform longer and/or more intense training **OR** perceive loads as significantly harder than what was intended by the coach or prescribed in the training program
  - May lead to maladaptation

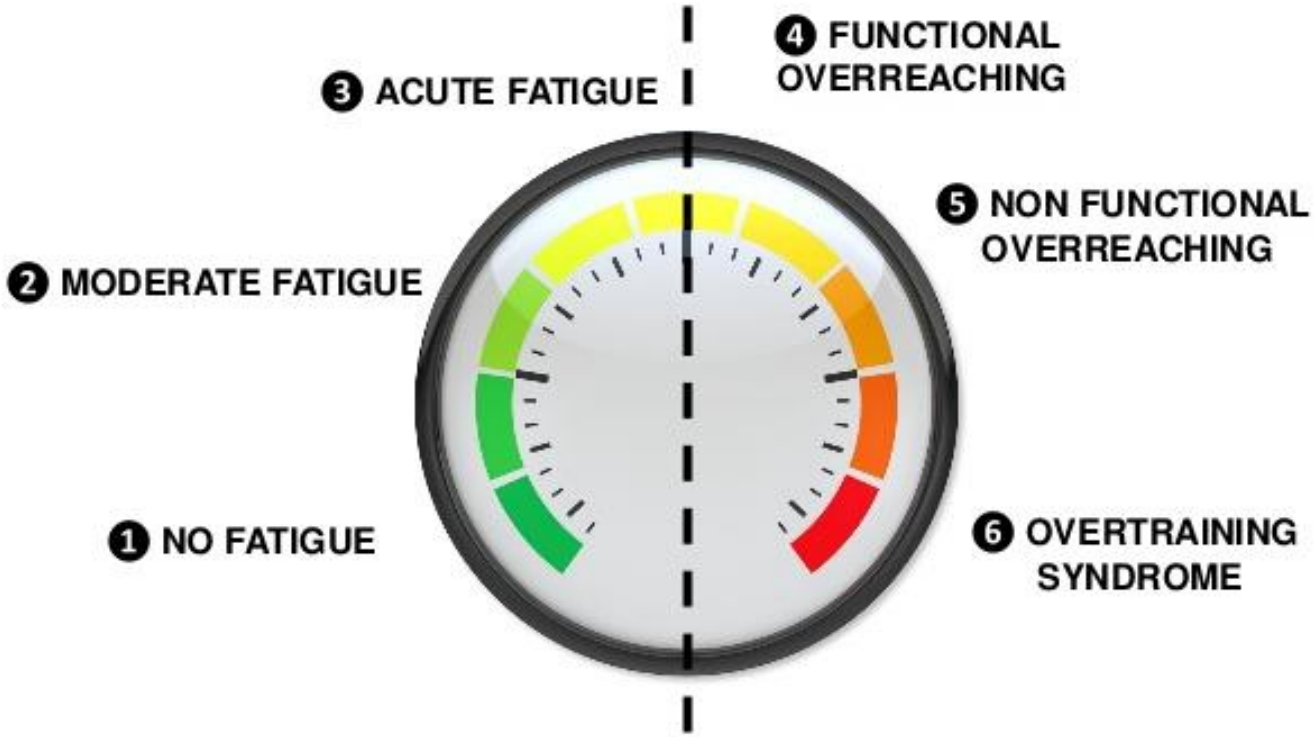


Murphy 2014

Integrating Internal and External Load

- Dissociation between external and internal load reveal the state of fatigue of an athlete
- Low responder has a lower response to the same internal load
  - Athletes who exhibit a lower internal load to standardized external load completed in similar conditions, would be assumed to reflect increased fitness
    - However, the athlete may be losing fitness or suffering from fatigue

Stages of Fatigue



Meeusen 2013

Overtraining

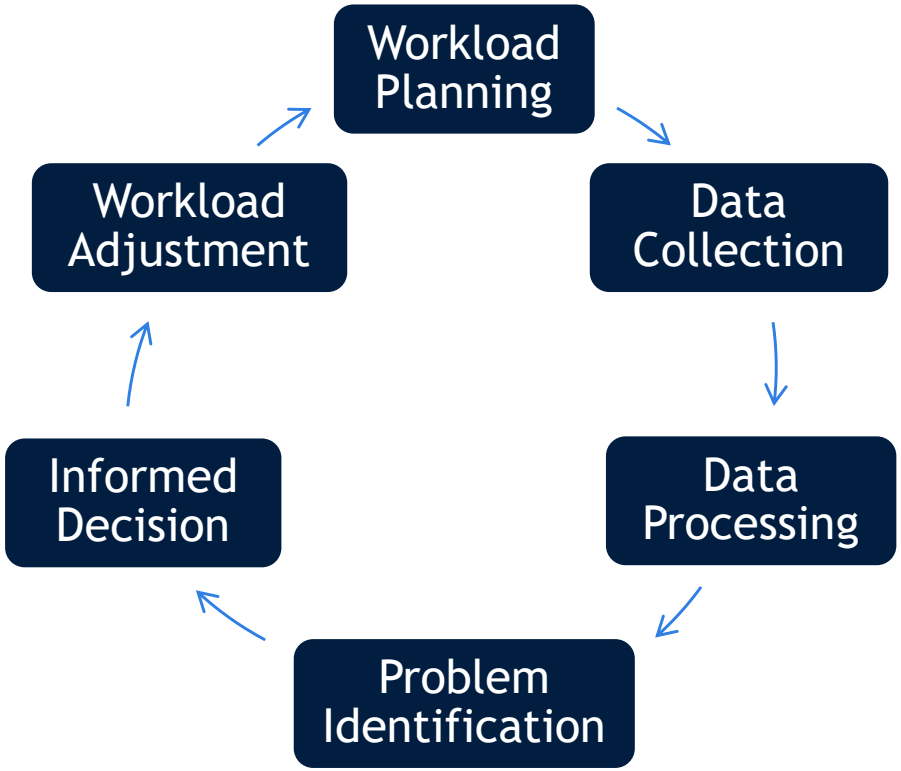
- May be caused by systemic inflammation and subsequent effects on the central nervous system
  - Decreased sympathetic activation and parasympathetic dominance
  - Depressed mood, **central fatigue** and resultant neurohormonal changes

Kreher 2012

Monitoring Load

- Invest in scientific methods to monitor athlete's load and detect meaningful change
- Always monitor load *individually*
- Combination of external and internal load measures relevant and specific to each sport
- Frequent monitoring to enable acute adjustments to training and competition loads

Monitoring Individual Athletes



How to Monitor Fatigue

- HR, resting HR, HR variability, HR recovery, HR at lactate threshold to measure autonomic control
  - Monitor cardiac load

Borresen 2008

How to Monitor Fatigue

- Countermovement jump (CMJ)
  - Popular for monitoring fatigue due it is simplicity, and because it takes little time to measure
  - Measure power, velocity, and/or jump displacement and shown to be sensitive to match-induced fatigue

Johnston 2015

Current Study

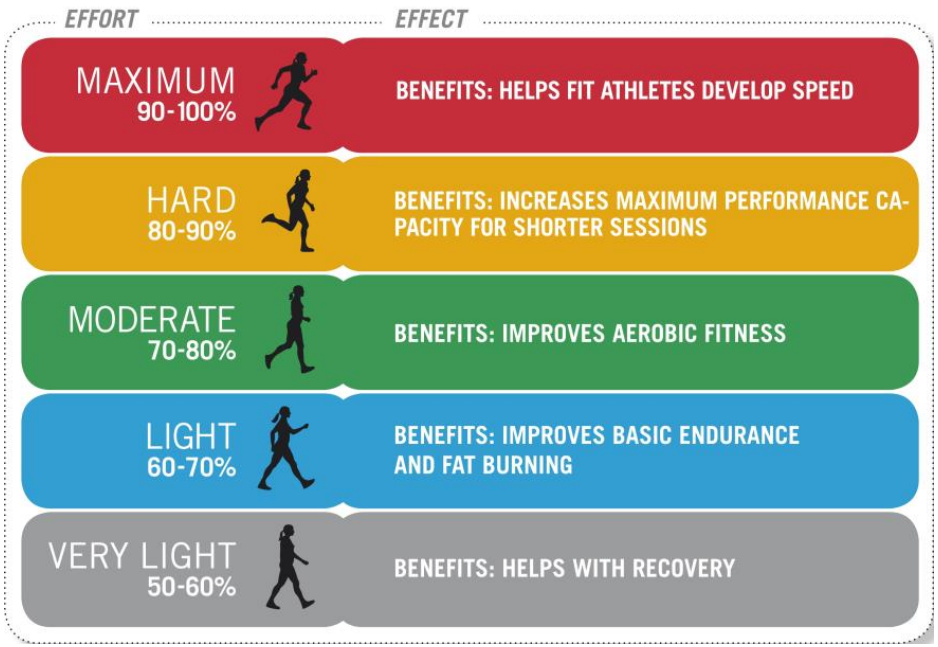
1. Objective of the study was to examine if an association exists between measures of heart rate and vertical jump

2. Also examined measurements of internal load to determine if and when fatigue occurs during a competition season
   - Defined as significant change in measurements

Participants

- 15 Division III men's soccer athletes
  - 19.4±1.7 years
  - 180.6±9.0 cm
  - 77.0±9.7 kg
- Completed 11 weeks of training load monitoring

Data Collection



- Heart rate measurements recorded for training sessions and competitions
  - Zone 1 (50-59%)
  - Zone 2 (60-69%)
  - Zone 3 (70-79%)
  - Zone 4 (80-89%)
  - Zone 5 (90-100%)

Data Collection

- CMJ was measured 2x weekly prior to training sessions
  - Average jump height
  - Power

baseline CMJ collection games

MAY

MO	TU	WE	TH	FR	SA	SU
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
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JUNE

MO	TU	WE	TH	FR	SA	SU
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JULY

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AUGUST

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SEPTEMBER

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NOVEMBER

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DECEMBER

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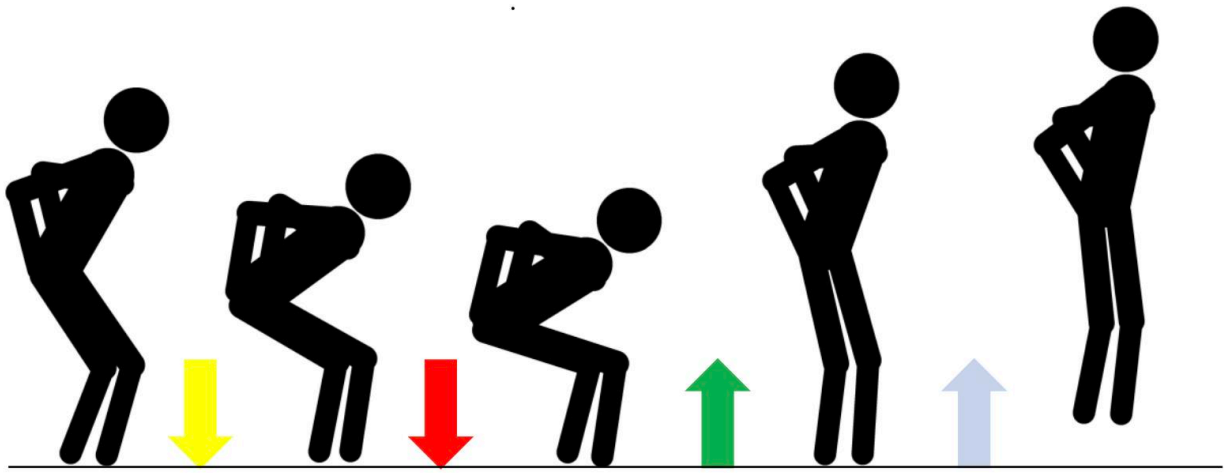
Statistical Analysis

- Statistical analyses performed using SPSS Statistics 26
- Pearson correlation coefficient to determine strength of association between training session average heart rate and vertical jump height
- Zone (Zone%), countermovement jump height (CMJh) and countermovement jump power (CMJp) assessed using a repeated measure analysis of variance (RM ANOVA)
- HR, (CMJh), (CMJp) assessed with a paired sample t-test

Pearson Correlation Coefficient

- On the dates CMJ was collected with HR data, **no significant correlation** was found between training session average HR and CMJh or CMJp



Repeated Measure ANOVA

- Zone1% p = 0.189
- Zone2% p = 0.302
- Zone3% p = 0.119
- Zone4% p = 0.265
- Zone5% p = 0.068

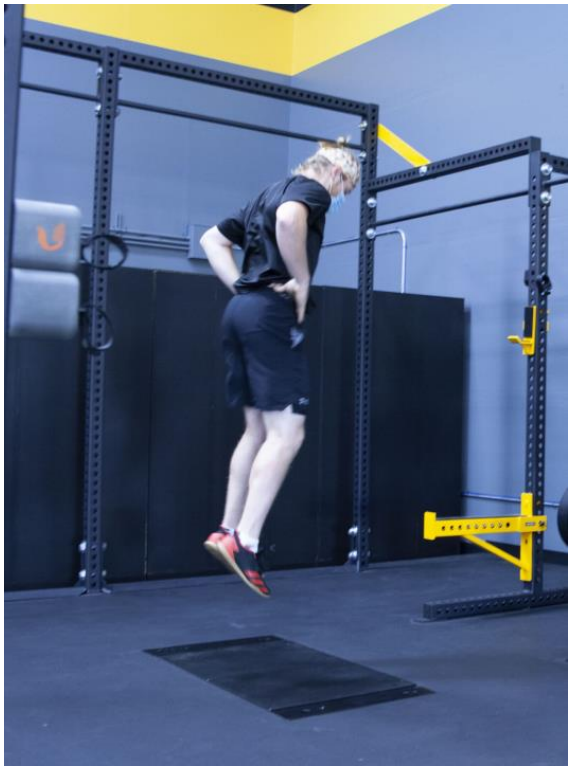
- CMJh p = 0.076
- CMJp p = 0.179

Paired Sample t-test

- Zone 2%
  - Oct 9th p = 0.045
- Zone 3%
  - Oct 22nd p = 0.011
- Zone 4%
  - Oct 1st p = 0.036
  - Oct 7th p = 0.014
- Zone 5%
  - Oct 9th p = 0.021

baseline games significant change HR

Paired Sample t-test



- CMJ height
  - Sept 17th p = 0.41
  - Sept 26th p = 0.026
  - Oct 3rd p = 0.012
  - Oct 8th p = 0.017
  - Oct 15th p = 0.039
- CMJ power
  - Oct 8th p = 0.031

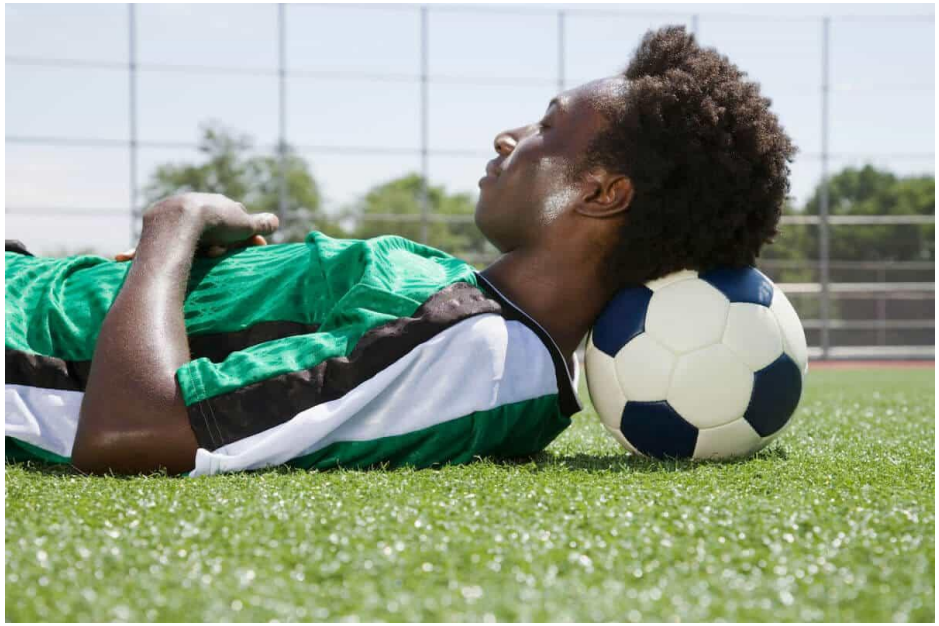
baseline games significant change CMJ

Conclusion

- In Division III male soccer athletes, CMJ using the Just Jump system may not be an adequate replacement of HR in monitoring changes due to fatigue

Conclusion

- Significant changes from baseline were seen in
  - HR Zones after 7 weeks
  - CMJ height after 4 weeks
  - CMJ power after 7 weeks



Future Research

- Determine what field measure correlates with HR
- Evaluate the relationship between change in CMJ and HR to overuse injury

- Athletic Trainers' Society of New Jersey
- Victor Cruz, Paige Ryan, Frank McHugh, Catelyn Dietrich
- Coach Matt Baker and Justin Abbey

- Soligard T, Schwellnus M, Alonso JM, et al. How much is too much? (Part 1) International Olympic Committee consensus statement on load in sport and risk of injury. *Br J Sports Med*. 2016;50(17):1030-1041.
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