RESEARCH DIALOGUES 2021

Reactive Agility, Heart Rate Variability, and Injury Associations Among College Basketball Players

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Background

- Perception of environmental stimuli is essential for situational awareness [1, 2]
  - *Brain circuit overlap: perception, decision-making, and motor response*
- Perceptual motor efficiency required for effective sport-specific performance, as well as injury avoidance [3-5]
- Relationships among emotional regulation, goal-directed behavioral effectiveness, and physiologic function have been studied [6]
  - *Suggests that mental states, performance capabilities, and general health status are highly interrelated*
- Clinical assessments can reveal coexisting impairments in different domains of human functioning
  - *Potential for intervention development to address interrelated problems*

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Purpose

- To assess possible associations among serial measurements of resting heart rate variability, perceptual-motor efficiency metrics, survey responses relating to overall wellness, and injuries sustained by college basketball players.

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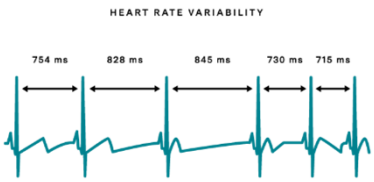
Heart Rate Variability

- Fluctuations in the amount of time that elapses between successive heartbeats [7]
  - *Reflects dominance of parasympathetic vs. sympathetic inputs* [7]



- High Resting HRV mediated by parasympathetic dominance [7]
  - *Optimal executive control of neurocognitive processes* [7]
    - Working memory, selective attention, inhibition, and cognitive flexibility [6]
- Intra-individual HRV measures:
  - *Average of measures obtained on different days (HRV-Avg)*
  - *Coefficient of Variance (consistency) across days (HRV-CoV)*
    - HRV-Avg / SD of HRV

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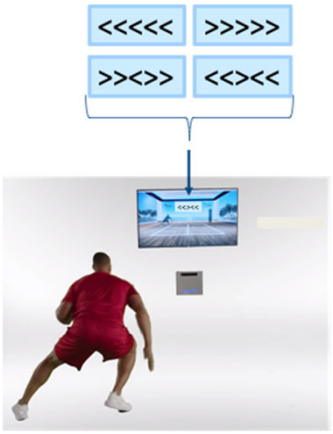
TRAZER

- Dual-Task: Whole-Body Reactive Agility (WBRA) + Perceptual-Motor Efficiency (Flanker Test)
  - *Recognition of Stimulus (perception)*
  - *Rapid Cognitive Processing (interpretation)*
  - *Muscle Response (decision & motor activation)*



- Directional Asymmetries
  - *Right vs. Left Performance*
    - Reaction Time (ms)
    - Speed (m/s)
    - Acceleration (m/s²)
    - Deceleration (m/s²)
  - *Inter-hemispheric transmission of neural information* [3-5]

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Methods

- **Participants:** 17 Division I Male Basketball Athletes
- **Methods:**
  - ***Heart Rate Variability (HRV)***
    - *CorSense* Monitors / "HRV Elite" App
    - Preseason through end of regular season
  - ***WBRA (TRAZER)***
    - Preseason assessment
    - Lateral Agility & Diagonal Agility
    - Dual-Task: Flanker Test
  - ***Surveys***
    - Sport Fitness Index, Overall Wellness Index, Pittsburgh Sleep Quality Index, Depression Anxiety Stress Scale
  - ***Injury Incidence***
    - Data obtained from electronic injury documentation system
    - UE, LE, Time Loss
    - **CLEI:** Core or Lower Extremity Injury

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Injury Incidence

- **UTC Men's Basketball Core or Lower Extremity Injury (CLEI)**
  - n=14; 43% (6/14) sustained at least 1 CLEI
    - 21.4% (3/14) had more than 1 CLEI

1st CLEI Occurrence	
Ankle	0
Achilles	1
Calf	
Foot	1
Knee	2
Hamstring	0
Hip/Groin	1
Low Back	0
Abdomen	0
Total	**6**

All Recorded CLEI	
Ankle	0
Achilles	1
Calf	
	1
Foot	1
Knee	2
Hamstring	0
Hip/Groin	2
Low Back	2
Abdomen	0
Total	**9**

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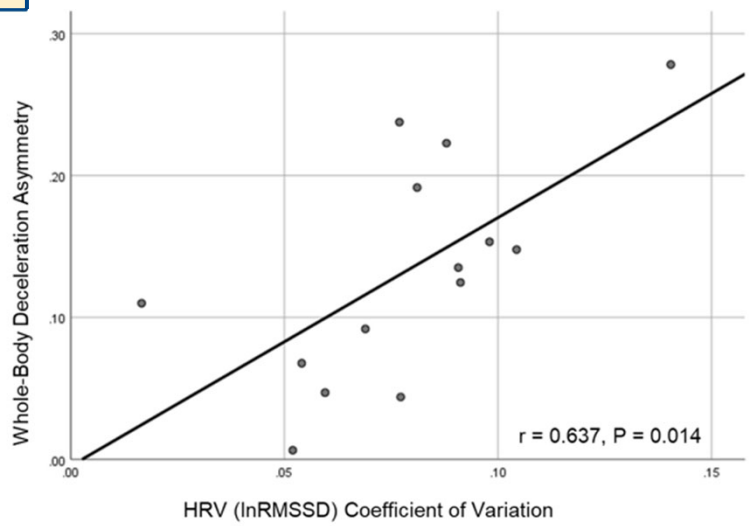
Results

n = 14



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Results: Associations with CLEI

Predictor Variable	AUC	Cut-Point	Sensitivity	Specificity	OR	95% CI
WBRA Deceleration Asymmetry	.854	≥ 14%	.83	.88	35.00	1.74, 702.99
HRV Coefficient of Variance	.771	≥ 9.5%	.50	1.00	17.00*	0.68, ∞
Self-Reported Concussion Hx	–	≥ 1	.50	.88	7.00	0.50, 97.75
Sport Fitness Index – Item 8	.740	≤ 2	.80	.63	6.67	0.49, 91.33
Sport Fitness Index – Item 5	.688	< 1	.67	.63	3.33	0.37, 30.70
Overall Wellness Index	.542	≤ 90	.83	.50	5.00	0.039, 64.39

* Estimated OR (0.5 added to each cell)

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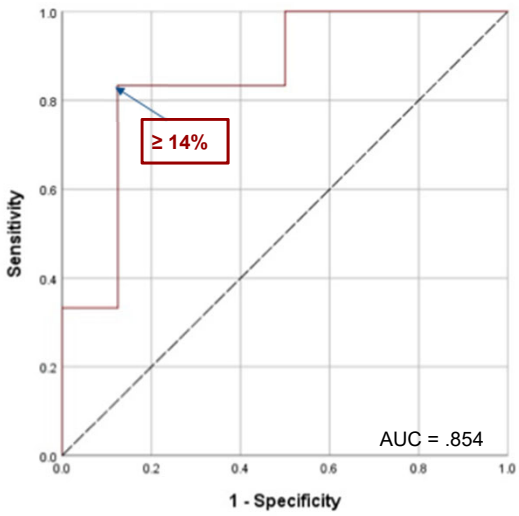
Results: WBRA Dec. Asym association with CLEI



		Core or LE Injury		
		Yes	No	Incidence
WBRA Dec. Asym	≥ 14%	5	1	83%
	< 14%	1	7	12%
	Total	6	8	

Sensitivity 83% Specificity: 88%

$\chi^2(1) = 7.02$
1-Sided $P = .016$

OR=35.00*
95% CI: 1.74, 702.99

YX

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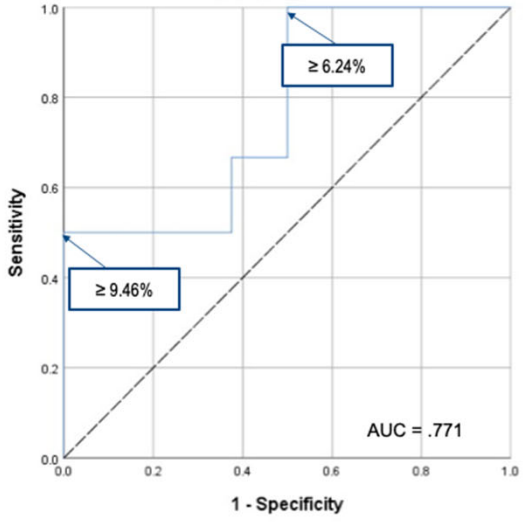
Results:
HRV CoV association with CLEI



		Core or LE Injury		
		Yes	No	Incidence
HRV-CoV	≥ 9.5%	3	0	100%
	< 9.5%	3	8	27%
	Total	6	8	

Sensitivity 50% Specificity 100%

$\chi^2(1)=5.09$ 1-Sided $P=.055$

OR=17.00* 95% CI: 0.68, ∞

YY

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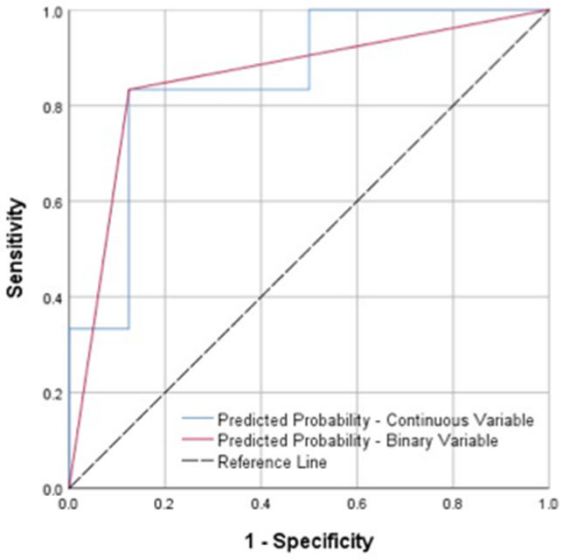
Deceleration Asymmetry



WBRA Dec. Asym:
Range of values 1-28%

WBRA Dec. Asym:
Binary categories ≥ 14% vs <14%

Identical AUC = .854

YZ

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3-Factor Predictor Model

1. **WBRA Deceleration Asymmetry (≥ 14%)**
2. **HRV Coefficient of Variation (≥ 9.5%)**
3. **Concussion History (≥ 1)**

Risk Factors	Injury	No Injury	Incidence
0	0	3	**0%**
1	1	4	**25%**
2	2	1	**67%**
3	3	0	**100%**
Total	6	8	**43%**

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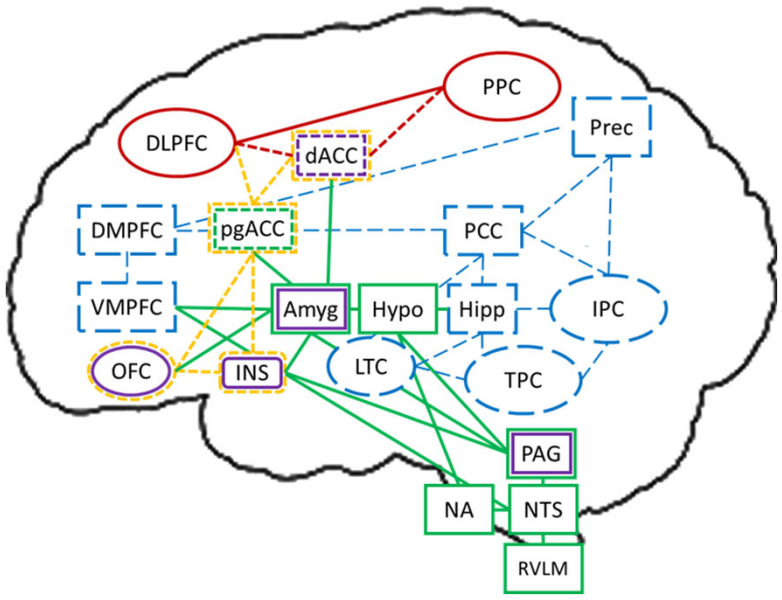
Default Mode Network
Executive Control Network
Salience Network
Central Autonomic Network
Rostral Limbic System



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Conclusions & Clinical Relevance

- Autonomic balance (HRV), perceptual motor efficiency (WBRA), persisting effects of prior injuries (SFI & OWI), and concussion history appear to be interrelated
  - *Potential indicators of integrated processes critical for injury avoidance*
- Research supports potential for improvement of emotional and physical health through interventions designed to promote self-regulation (inhibitory control)
  - *Paced breathing, progressive muscle relaxation, and mindfulness training*
- Perceptual-motor efficiency, as well as directional asymmetry, can be improved
  - *Dual-task training that imposes cognitive demand and complex movements*
- Neural processing efficiency within interrelated brain networks may represent an important aspect of athlete health and performance that has been neglected
  - *Pre-participation assessment and targeted training may prevent injuries*

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References

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