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Performance Science: What Is It?

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Disclosures

- We have no financial relationships or conflicts of interest to report.

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The Future is Now…Winning Starts Today

Left: Oct 23, 2017: Alex Cora. Miami Herald
Right: Oct. 28, 2018: The dream. *Alex Trautwig/MLB Photos*

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Outline

- Defining Performance Science
- Factors that influence performance
- Prescreening Athletes
- From Injury to Elite Play
- Conclusion

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Performance Science: Definition

- Multidisciplinary study of human skills, mechanisms, and outcomes needed to optimize performance
  - Biomechanics
  - Physiology
  - Psychology
  - Economics

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The Evolution of Elite Performance

Donald Lippincott, USA
July 6, 1912
1912 Summer Olympics, Sweden
100M Time – 10.6sec (9.43m/s)

Limits to running speed in dogs, horses and humans

Mark W. Denny
Hopkins Marine Station of Stanford University, Pacific Grove, CA 93950, USA
e-mail: mwdenny@stanford.edu

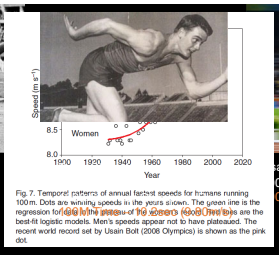
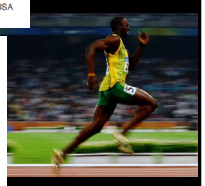


Fig. 7. Temporal patterns of annual fastest speeds for humans running 100 m. Dots are winning speeds in the years shown. The green line is the regression for the years 1900–1932, and the blue line is for the years 1933–1996. The best-fit logistic models. Men's speeds appear not to have plateaued. The recent world record set by Usain Bolt (2008 Olympics) is shown as the pink dot.



ain Bolt, Jamaica
09 Berlin World Championships
0M Time – 9.58sec (10.44m/s)

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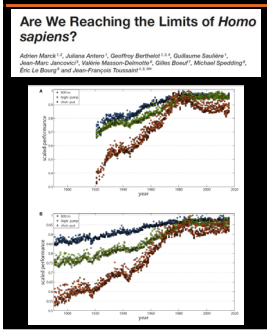
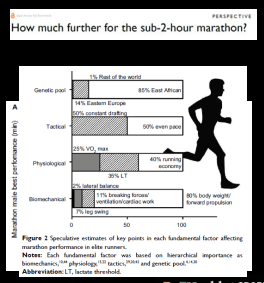
Limits to Maximum Performance





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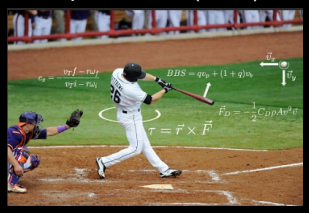
Sports Performance in Baseball

- Domains of Human Performance Optimization (HPO)
  - Physical Performance
  - Nutritional Status
  - Psychological Status
  - Cognitive Performance
  - Environmental Challenges
  - Sleep
  - Pain



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Human Performance Optimization Metrics: Consensus Findings, Gaps, and Recommendations for Future Research

Bradley C. Nindl,[1,2] Dianna P. Jaffin,[3] Michael N. Dretsch,[4] Samuel N. Cheuvront,[5] Nancy J. Wesensten,[6] Michael L. Kent,[7] Neil E. Grunberg,[3] Joseph R. Pierce,[1] Ehin S. Barry,[3] Jonathan M. Scott,[3] Andrew J. Young,[5] Francis G. O'Connor,[3] and Patricia A. Deuster[3]

Physical Performance	Nutritional Status	Cognitive Performance	Psychological Status	Environmental Stress	Sleep	Pain
• Aerobic Fitness • Strength & Endurance • Muscular Endurance • Flexibility & Agility • Power	• Energy Balance • Hydration Status • Body Composition • Blood Labs • Access to Healthy Foods	• Attentional Control • Working Memory • Reasoning • Adaptability • Emotional Intelligence • Perceptional Learning	• Personality • Mental Health • Meaning and Purpose • Social • Appetitive Behavior • Stress	• Temperature • Blood Oxygen Saturation • Injury Rates • Individual Preparedness	• Sleep Onset Latency • Sleep Staging • Subjective Sleep Quality Scales	• Brief Pain Inventory • Visual Analog Scale

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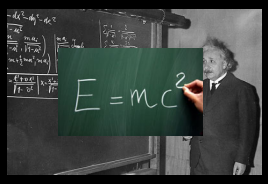
The World's Most Famous Equation

- "If you can't explain it simply, you don't understand it well enough."



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Sleep is Critical for Optimal Performance

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Sleep Constraints Amongst Athletes

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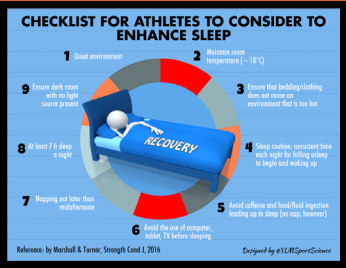
Sleep Enhancement for Athletes



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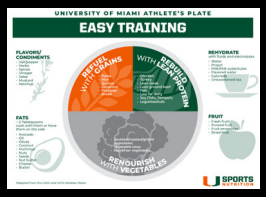
Fueling Based on Required Performance

- Whole Grains= Energy Enhancing Foods
- Lean Proteins = Recovery & Muscle building foods
- Fruits and Vegetables = Antioxidant-rich foods
- Fat = Immunity/Flavor boosting food
- Water = Hydration Promotion

Off Season / Light Training



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Hydration & Fluid Recovery

- Sweat = 99% H2O
- Dehyd ce
  - >2
- Sports T, the workou er than an HC

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Does Iron Supplementation Improve Performance in Iron-Deficient Nonanemic Athletes?

Amity Rubeor, DO, CAQSM,*† Carmen Goojha, MD,‡ Jeffrey Manning, MD, CAQSM,† and Jordan White, MD, MPH†

60% OF FEMALE NCAA ATHLETES ARE AFFECTED BY **IRON DEFICIENCY**

- Heme iron is found in animal sources and is more readily absorbed in the body (25-35%)
- Vitamin C can enhance the absorption of both Non-heme and heme iron.

HOW MUCH IRON DO I NEED?

- **MEN** at least 10 mg iron/day
- **WOMEN** at least 18 mg iron/day

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Review Article

Effects of Vitamin D on Skeletal Muscle and Athletic Performance

Am J Sports Med. 2015 May;43(5):1241-5. doi: 10.1177/0363546514567297. Epub 2015 Feb 3.

Vitamin D p

J Sports Sci. 2013;31(4):344-53. doi: 10.1080/02640414.2012.733822. Epub 2012 Oct 22.

Maroon JC[1], Math
Author infor

Assessment of vitamin D concentration in non-supplemented professional athletes and healthy adults during the winter months in the UK: implications for skeletal muscle function.

Close GL[1], Russell J, Cobley JN, Owens DJ, Wilson G, Gregson W, Fraser WD, Morton JP.

ıcreased risk of stress fracture during Royal Marine recruit training.

Davey T[1], Lanham-New SA[2], Shaw AM[3], Hale B[4], Cobley R[3], Berry JL[5], Roch M[6], Allsopp AJ[3], Fallowfield JL[3].

and labeling errors of two dietary supplements made in the United States

Araki T[1], Holick MF, Alfonso BD, Charlap E, Romero CM, Rizk D, Newman LG.
Author information

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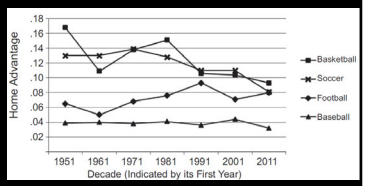
Determinants of Performance: Environment

- Home Field Advantage?

Perceptual & Motor Skills: Motor Skills & Ergonomics
2015, 121, 3, 791-804. © Perceptual & Motor Skills 2015

THE HOME ADVANTAGE IN MAJOR LEAGUE BASEBALL[1]

MARSHALL B. JONES
The Pennsylvania State University



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Effects of Weather on Sport

- Temperature
  - Hot vs Cold
- Precipitation
  - Delay of Play
- Wind
  - Alters pitching
  - Alters hits
- Visibility
- Altitude
  - Decreased oxygen
  - Decreased air density
  - "Live high, Train Low"

- 5,280 Ft above sea-level
- Averages more runs/game than any other MLB ballpark

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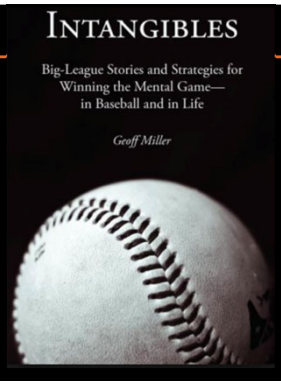

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When the Unexpected Happens

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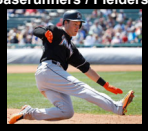
Common Injuries in Baseball Athletes

Pitchers

- Labrum Tears
- Rotator Cuff Injuries
- UCL Strain / Tears
- Finger Blisters

Baserunners / Fielders



- Knee Injuries of menisci/ligaments
- Hamstring sprain/strains
- Ankle injuries

Power Hitters

- Lower Back strains
- Abdominal Oblique strains
- Head injuries from pitch

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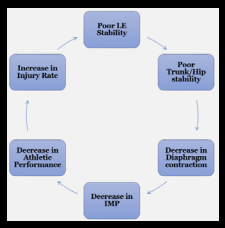
The Cycle of Injury in Baseball



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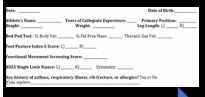
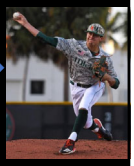
Prescreening at the University of Miami

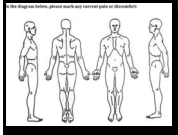


Preseason Baseline Assessment

Intervention with PT, AT, S&C

Maximize Performance





Identify Deficits, enroll athlete into appropriate protocol, mitigate injury and reduce functional sports related deficits

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CHAMP-S

Comprehensive High Level Activity Mobility Predictor – Sports

- Single Limb Test

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CHAMP-S

Comprehensive High Level Activity Mobility Predictor – Sports

- Edgren Side Step

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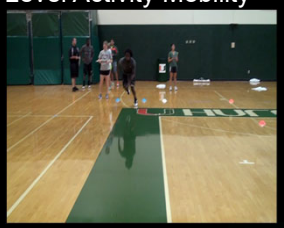
CHAMP-S

Comprehensive High Level Activity Mobility Predictor – Sports

- L-Test



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CHAMP-S

Comprehensive High Level Activity Mobility Predictor – Sports

- Illinois Agility Test

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Protocol for Max Performance

Eight Week Long Preseason Rehabilitation

- Lower Body Mobility and Proprioception
- Upper Body Endurance and Strength
- Inspiratory Muscle Performance

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Clinical Relevance of Preseason Prescreening

- Natural asymmetries occur with baseball pitchers due to hand dominance
- Internal and external rotators of the shoulder play a dual role with being able to throw a baseball and assist with respiration
- Secondary inspiratory muscles play a significant role in SMIP, which can relate to athletic endurance performance during length of baseball game
- Poor symmetry in single limb stance places an individual in significant risk of injury
- Lower MIP is significantly correlated with increased risk of injury

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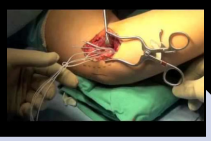
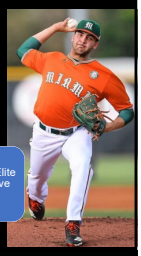
From Injury to Competitive Play

ReLOAD system & CHAMP-S App





Prescreening Athletes → Clinical / Surgical Intervention → Physical Therapy and Rehabilitation → Position Training, Optimization of Performance Training → Return to Elite Competitive Play

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Athlete Rehabilitation

Pre-Hab → Immediate Post-Op (Day 1-7) → Early Rehab (Week 2-4) → Controlled Ambulation (Week 4-10) → Advanced Activity (Week 10-16) → Return to Activity (Week 16-22)

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Return to Play Metrics

- Strength
  - Quadriceps Index Symmetry ≥ 90%
  - Anterior Excursion Reach Test ≤ 4cm
- Power
  - Symmetric tuck jump scores
  - Isokinetic scores at 180°/sec and 300°/sec at normalized values based on Peak Torque/Body Weight %
- Range of Motion
  - Symmetric prone knee flexion
  - symmetric supine knee extension

- Function
  - CHAMP-S Scores > 95% baseline
  - Uncompensated running gait and fulfillment of sport-related movement demands
- Self report
  - KOOS scores at/near 100
  - TSK-11 < 22

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Maximal Performance

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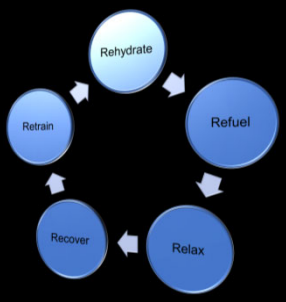
Recovery after Play



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A Quote to Remember

- "Treat everything like it's your first project. Like it's your first day like back when you were an intern."

  -Christopher George Wallace: "Biggie Smalls"

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Final Thoughts & Future Directions

- Optimizing an athlete's performance requires a multidiscipline team
- Athletes may not be knowledgeable in the multiple domains that affect their training sessions and game day performance
- Prescreening protocols can identify correctable deficits and mitigate risk of injury
- At UM, athletes are screened and performance is optimized by
  - Clinicians
  - Dietitians
  - Physical Therapists
  - Athletic Trainers
  - Strength and Conditioning
  - Position Coaches

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- Brian Gabriel, MS, ATC, CSCS
- University of Miami Baseball

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