Role of Nutrition in Injury Prevention and Rehabilitation

John Boesch

MS, RD, LD, CSSD, CSCS

TNPerformanceNutrition@gmail.com

EXPERIENCE

Professional Experience

- USASOC Contract Performance Dietitian
- Owner – TN Performance Nutrition
- Texas Tech Sports Dietitian - M & W Basketball and Women's Indoor Volleyball

Certifications

- Registered Dietitian (RD)– Academy of Nutrition and Dietetics
- Certified Specialist in Sports Dietetics – Academy of Nutrition and Dietetics
- Certified Specialist in Strength & Conditioning – National Strength and Conditioning Association

DISCLAIMER

The views expressed in this presentation do not represent those of the DoD, USSOCOM, USASOC, or the 160th SOAR. Any mention of individual products or companies are for educational purposes and do not constitute an endorsement of that brand.

There are no financial conflicts of interest to report.

OBJECTIVES

- Understand a dietitian's role in injury prevention and rehab
- Be familiar with the impact of calorie intake on health and injury risk
- Recognize the importance of protein intake for maintenance of muscle and soft-tissue
- Identify nutritionally relevant micronutrients for injury risk

NUTRITIONAL ASSESSMENT

- Anthropometrics: body composition
- Dietary: energy and nutrient intake
- Biochemical: nutritionally relevant labs
- Clinical: physical signs & symptoms
- Environment: social and lifestyle

Larson-Meyer, et al 2018

ANTHROPOMETRIC: BODY COMPOSITION

Method	Advantages	Disadvantages & Potential Errors
Waist : Hip Ratio	• Convenient and inexpensive • Possible for large groups and mobile	• Variability in frame size/muscularity induces variability in results
Skin Folds	• Convenient and inexpensive • Individual sites can be monitored • Reliable when completed by trained technician	• Samples subcutaneous fat only • Can be intrusive for some athletes • Conversion to body fat % introduces error
Bioelectrical Impedance Analysis	• Minimal technical skill needed by technician • Rapid data acquisition • Minimal subject involvement	• Sensitive to fluid shifts and hydration status • Should avoid exercise food, fluid and exercise for ≥12hr prior to testing

Adapted from Larson-Meyer, et al 2018

DIETARY: INTAKE ASSESSMENT

Method	Advantages	Disadvantages & Potential Errors
Diet recall	• Quick assessment • Low patient burden	• May not reflect usual intake • Relies on patient memory • Usually leads to underreporting
Food frequency questionnaire (FFQ)	• May be more representative of usual intake • Can be self-administered	• Relies on memory • Tendency for regression to the mean • No information on meal timing/pattern
Diet history	• Often correlates with biochemical measures • Useful for assessing usual intake and pattern of eating	• Interview is lengthy (up to an hour) • Difficult to code for analysis
Food records	• Not dependent on memory • Can provide detailed intake • Multiple records more representative of usual intake	• High subject burden • Act of recording may alter diet • Under-recording error

Adapted from Larson-Meyer, et al 2018

DIETARY: ENERGY INTAKE

- Athletes struggle to maintain optimal energy intake
  - Endurance athletes, gymnasts, military recruits

- Short-term (5 days) exposure to energy deficiencies may decrease BMD
  - Females athletes are particularly at risk
  - Infrequent / inadequate load bearing exercise

Papageorgiou M et al. 2017

DIETARY: ENERGY AVAILABILITY (EA)[11,13]

- Energy Availability (EA) =

  Energy Intake (EI) – Exercise Energy Expenditure(EEE) / Fat Free Mass(kg)

- Energy balance equation limitations:
  - Total daily energy expenditure is more difficult to assess than EEE
  - Energy balance assumes optimal physiological function

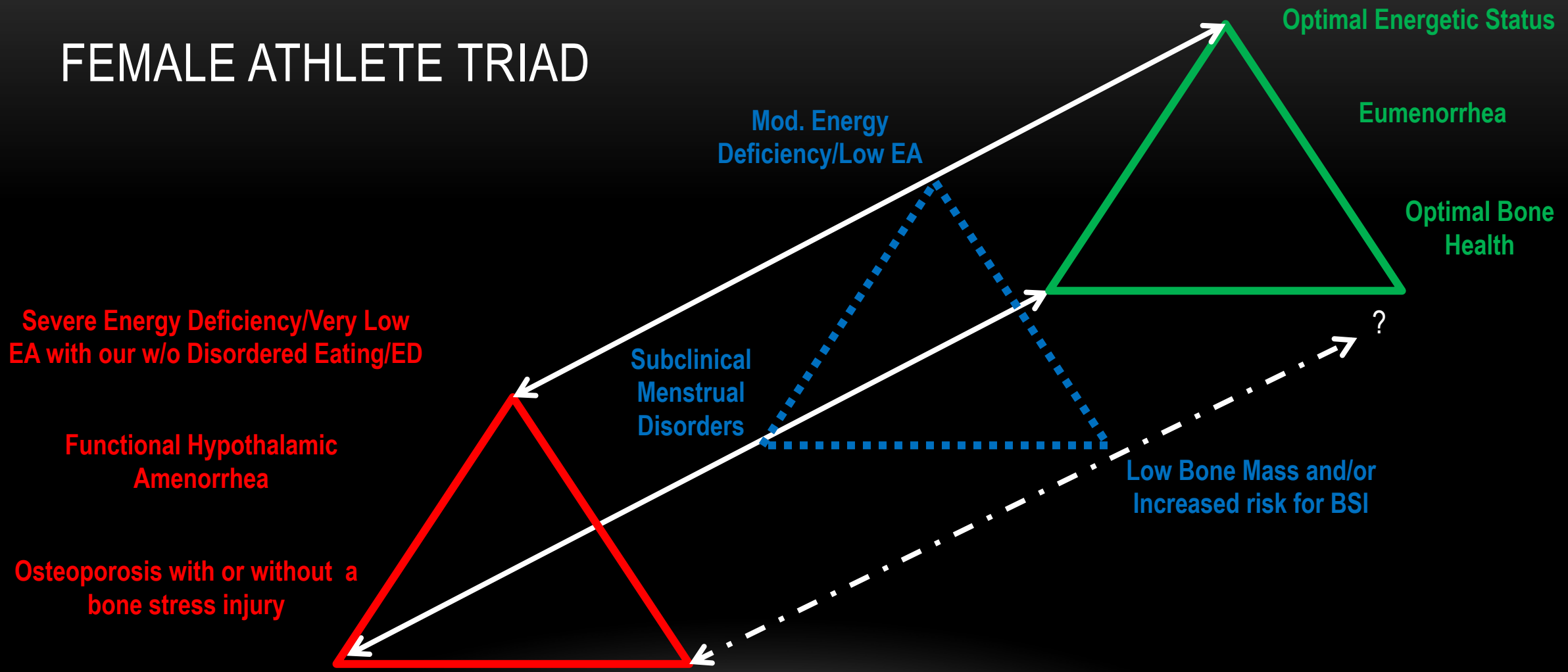
Papageorgiou M et al. 2017

DIETARY: LOW ENERGY AVAILABILITY (LEA)

- Energy intake of ~40-45kcal/kg FFM/day = optimal EA
- In females, ≤30kcal/kg FFM/day:
  - Muscle protein synthesis decreases
  - Bone mineralization declines
  - Insulin, T3 and IGF-1 concentrations decrease
  - Menstrual dysfunction
- Low EA is less defined in males

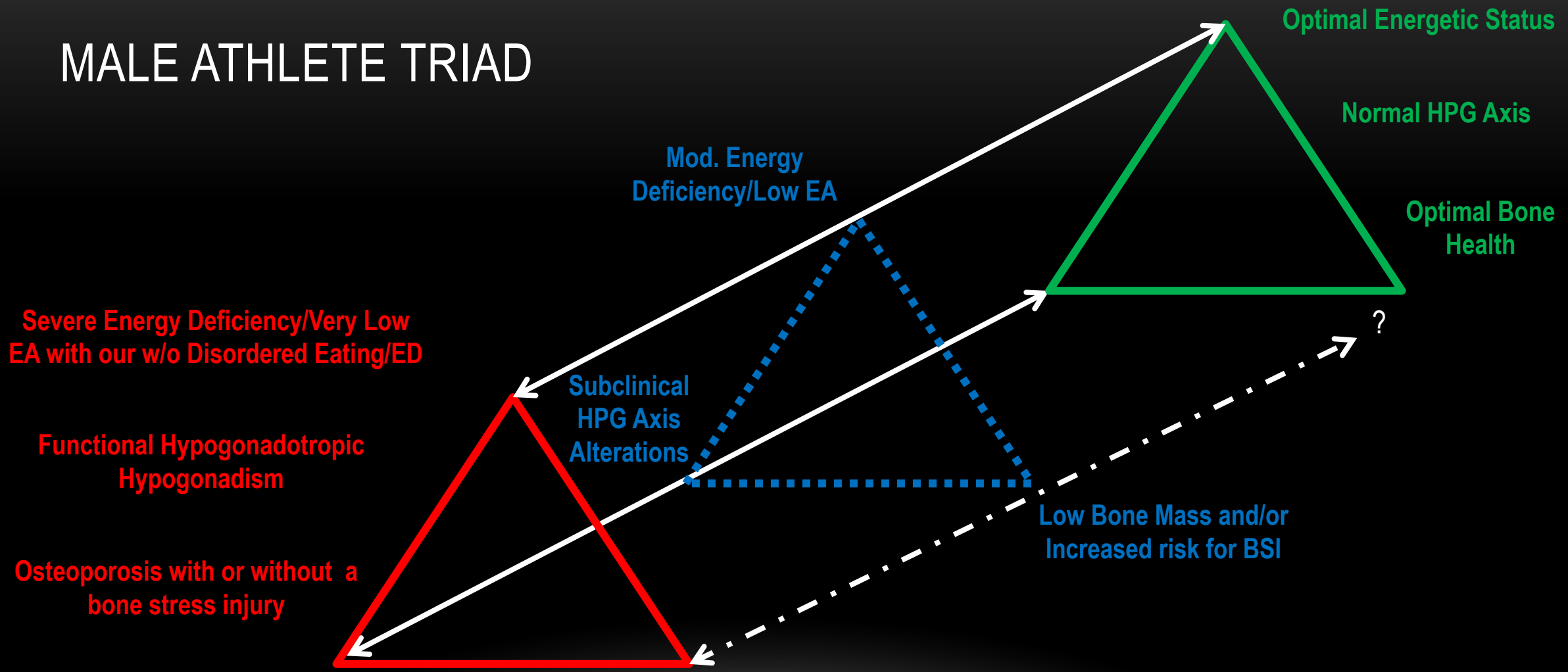
Loucks AB et al 2017
De Souza MJ et al 2014

FEMALE ATHLETE TRIAD



Adapted from De Souza MJ et al. 2014

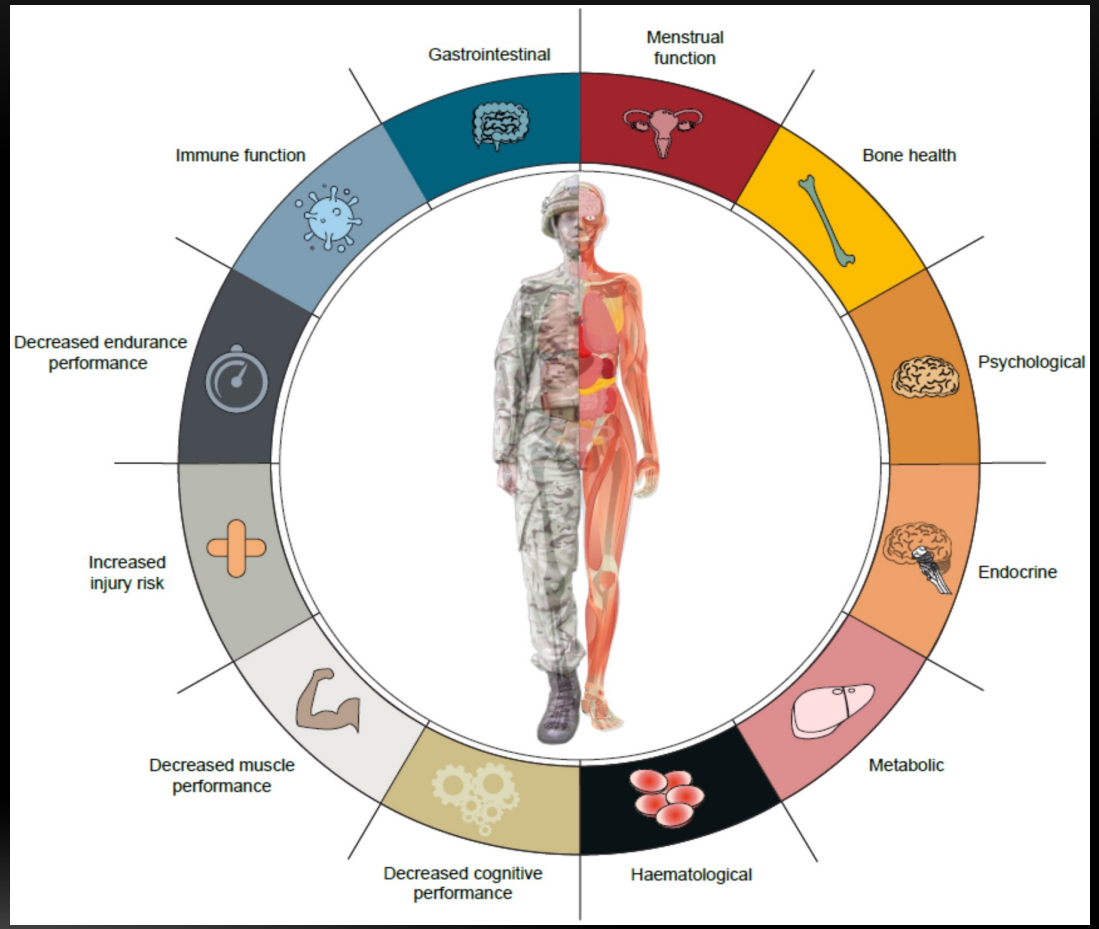
MALE ATHLETE TRIAD



Adapted from Nativ et al. 2021

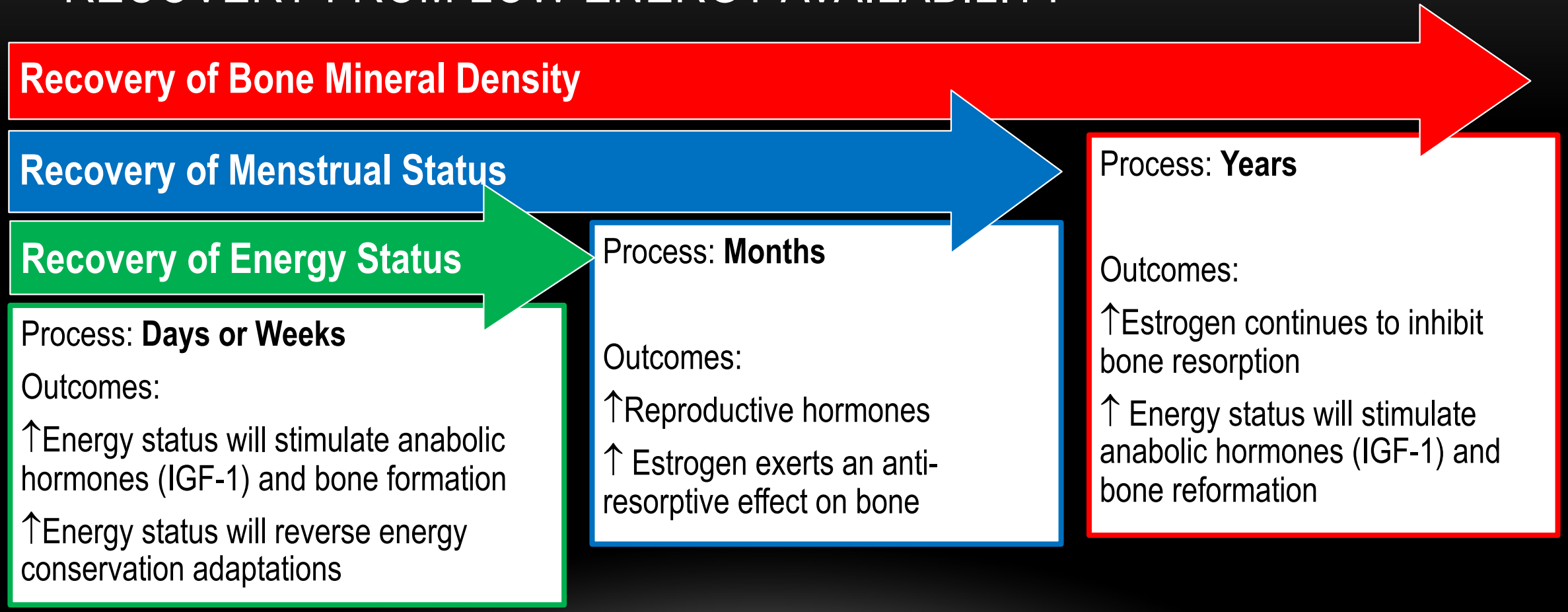
RELATIVE ENERGY DEFICIENCY IN SPORT (RED-S)

- Also impairs:
  - Cognitive/physical performance
  - Endocrine/metabolic function
  - Immune function
  - GI Function



O'Leary TJ et. al. 2020

RECOVERY FROM LOW ENERGY AVAILABILITY



Adapted from De Souza MJ et al. 2014

CAUSES OF LOW ENERGY AVAILABILITY

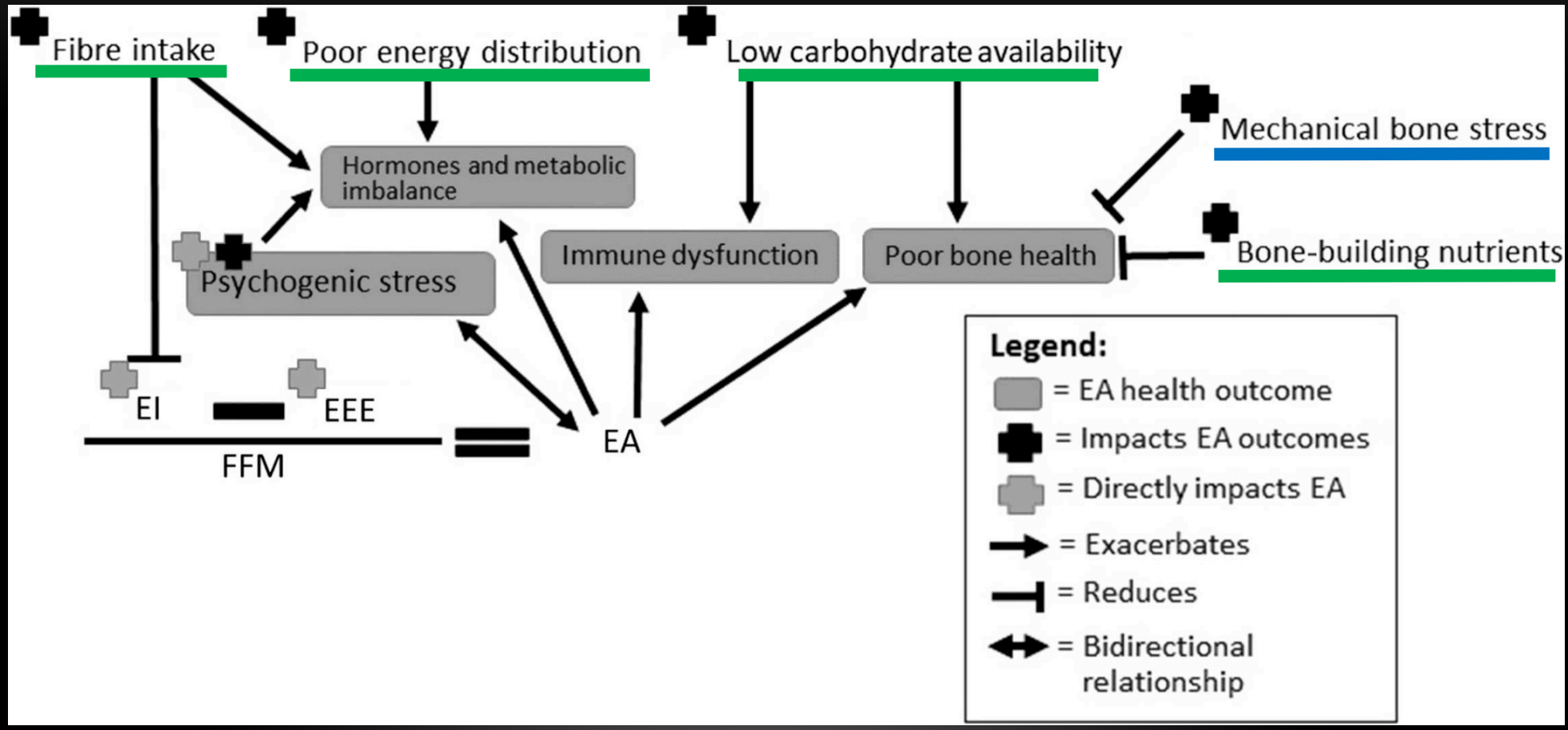
- Eating disorder/disordered eating
- Compulsive or excessive exercise
- Lack of understanding of energy needs
- Low energy dense diet
- GI disorder

TREATMENT OF LOW ENERGY AVAILABILITY

- Increase calories by 200-600kcals/day
  - Goal of at least 45kcal/kg of FFM
- Decrease exercise energy expenditure
- Return to body weight associated with normal menses/metabolic health
  - 0.5kg every 7-10 days

De Souza MJ et al. 2014

TREATMENT OF LOW ENERGY AVAILABILITY



Kuikman MA et. al. 2021

DIETARY: PROTEIN

- Disuse/immobilization from injury:
  - ↓ muscle protein synthesis (MPS)
  - ↑ muscle protein breakdown (MPB)
  - ↓ muscle mass, strength and function
  - ↓ tendon structure and function

- Decreased muscle strength in as little as 36 hours of physical inactivity

Tipton KD 2015

DIETARY: PROTEIN

- Essential Amino Acids (EAA's) are necessary to stimulate MPS
- 0.25-0.30g/kg body mass maximizes MPS
  - Ex: 175lbs athlete = 20-24g protein
- >2.0g/kg body mass may be required to prevent muscle loss
  - Type, dose, frequency?

Tipton KD 2015

DIETARY: COLLAGEN AND SOFT-TISSUE INJURY

- Increasing collagen synthesis can improve recovery

- Collagen rich foods or supplements can increase collagen synthesis
  - Rich in hydroxyproline, proline, glycine, and hydroxylysine
  - Gelatin, bone broth, collagen peptides

- Protocol: 15g collagen + 48mg vitamin C prior to physical activity

Shaw G. et. al. 2017

DIETARY: BONE STRESS INJURY

- Paradox of exercise and stress fracture (SFx) risk
- SFx risk:
  - Female military recruits: 1.6% – 21.0%
  - Male military recruits: 0.2% – 5.2%
  - Track and field athletes: 10.0 % – 31.0%
- Estimated cost of $26 million lost over 1 year at one U.S Army base

Lappe J. et. al. 2008

DIETARY: CALCIUM AND VITAMIN D SUPPLEMENTATION

1. Calcium and vitamin D intake is typically less than optimal
2. Females <30yr still can increase peak bone mass
3. Intense training increases calcium demands
4. Substantial cutaneous calcium losses occur during training
5. Micro-fracture repair through remodeling requires calcium

Lappe J. et. al. 2008

BIOCHEMICAL: VITAMIN D

- 36-57% of Americans are Vitamin D deficient

- Assessed via 25-hydroxyvitamin D
  - Deficiency: <20ng/mL
  - Insufficiency: 21-29ng/mL
  - Sufficient: 30-39ng/mL
  - Optimal: 40-50ng/mL

Sikora-Klak J et al. 2018

BIOCHEMICAL:

- Suboptimal vitamin D status is linked to:
  - Decreased calcium absorption
  - Increased parathyroid hormone
  - acute illness
  - inflammatory injury
  - Increased incidence of stress fractures
  - muscle pain/weakness or poor performance

BIOCHEMICAL: VITAMIN D

- Risk factors for low 25-OH(D):
  - Living above 35°N latitude in winter months
  - Darker skin tones are at higher risk for vitamin D deficiency
  - Regular sunscreen use

- Prevention:
  - Sensible sun exposure
  - Regular vitamin D supplementation (1,500-2,000 IU/day)

Townsend JR et al. 2021
Sikora-Klak J et al. 2018

DIETARY: CALCIUM AND VITAMIN D

Calcium and Vitamin D Supplementation Decreases Incidence of Stress Fractures in Female Navy Recruits

Joan Lappe,[1] Diane Cullen,[1] Gleb Haynatzki,[1] Robert Recker,[1] Renee Ahlf,[2] and Kerry Thompson[2]

- Randomized, placebo-controlled trial
  - Treatment group (n=2608) received 2,000mg calcium and 800IU vitamin D
- Total of 309 (5.9%) recruits diagnosed with stress fractures over 8 weeks
  - 20% lower SFx risk in treatment group (6.8% versus 8.6%, p = 0.02)
  - 91% greater SFx risk in recruits with amenorrhea

Lappe J. et. al. 2008

BIOCHEMICAL: 25-HYDROXY VITAMIN D

CATEGORY	LAB VALUE (ng/mL)	SUPPLEMENTATION	RE-EVALUATION
Deficiency	≤20	6,000 – 10,000 IU D3/day	60-90 days
Insufficiency	21-29	4,000 – 10,000IU D3/day	90 days
Sufficient, yet suboptimal	30-39	3,000-4,000IU D3/day	90 days
Optimal	40-50	1,000-2,000IU D3/day	Annually

Adapted from USSOCOM Human Performance Dietitian Work Group. 2018

SUMMARY

- <30kcal/kg/FFM increases injury risk and impairs recovery
- Optimal protein intake can minimize LBM loss during rehab
- Calcium supplementation may be necessary during intense training
- 25-hyroxyvitamin D should be assessed in at-risk populations

QUESTIONS

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