An Evidence-Based Approach To Relative Energy Deficit in Sport (RED-s)

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Disclosures

- Financial Partners or Donations = NONE!
- Own and operate a private practice for nutrition counseling and consulting services for more than 16 years
- Adjunct professor for The College of St. Elizabeth in Morristown, NJ
- Adjunct professor for Moravian College in Bethlehem, PA
- Serve on the advisory board for The College of St. Elizabeth’s Department of Food and Nutrition & Dietetic Internship programs
- Serve on advisory board for Cedar Crest College’s Department of Nutrition Didactic Program and Dietetic Internship
Workshop Learning Objectives

Each participant will be able to:

- Identify the differing components of the female athlete triad versus the model for relative energy deficit in sport (RED-s).
- Explain how the impacts of starvation relate to an athletic population especially its impacts to an athlete’s physiological systems.
- Identify current best-practices for evaluating an athlete suspected of having RED-s.
- Utilize evidence-based criteria within one’s pre-participation assessment for RED-s.
- Institute an evidence-based decision-making process for an athlete’s playing status and/or return to play which addresses their full physiology to correct a relative energy deficit and eliminate further medical implications.
In Years Past...

- Used to be considered “normal” for female athletes to lose their menstrual cycles
- Loss of menses was supposed to be a good measure that you were training “hard enough”
- In 1997...
  - The Task Force on Women’s Issues of the American College of Sports Medicine (ACSM) released the Female Athlete Triad Position Stand
  - Components of the triad were identified as:
    - Disordered Eating
    - Amenorrhea
    - Osteoporosis

Key Updates To The Triad in 2007

- **A Continuum**
  - Energy availability, menstrual function, and bone health status
  - Impacts to each in response to training volume, intensity of training, stress level, and nutritional status.

- Low percent body fat is not always a reliable indicator

- Clinical eating disorder diagnosis not always present

- Functional hypothalamic amenorrhea due to insufficient energy availability is often inadvertent yet impacts occur rapidly
  - Absence of menses due to the suppression of the hypothalamic-pituitary-ovarian axis, in which no anatomical or organic disease is identified
  - There are three types of FHA: weight loss-related, stress-related, and exercise-related amenorrhea

Key Updates To The Triad in 2007

- Measurable changes in bone mineral density, and bone fractures, take time to develop, present, treat and resolve

- Hormonal replacement therapy does not resolve bone mineral density issues in most cases and definitely does not correct energy availability
2007 The Updated Female Athlete Triad Position Stand, ACSM

What’s Missing...

- We need a means of assessment:
  - For energy balance not solely based on menstrual cycles in females
  - Which does not exclude male athletes
  - Which includes a comprehensive look at total body physiology & functions
Health Consequences of RED-s

Showing an expanded concept of the Female Athlete Triad to acknowledge a wider range of outcomes and the application to male & female athletes

*Psychological consequences can either precede RED-S or be the result of RED-S

Conflict...

- **Female Athlete Triad Coalition**
  - After the IOC 2014 Consensus Statement was released, the Female Athlete Triad Coalition refuted the IOC’s consensus statement in a published article in the British Journal of Sports Medicine.
  - The coalition feels that there is insufficient emphasis placed on the female athlete triad model which has been thoroughly researched and improves the health outcomes of all female athletes.

- **International Olympic Committee**
  - The IOC stand by their recommendations which recommend the sports medicine team work cohesively to increase the understanding and awareness of RED-s to broaden our efforts and connect with all athletes.


But, It All Comes Down To Energy Balance…

- **Energy**: Defined as the capacity to do work, and in the case of the human body, this work is of a biological and physical nature
  - Cellular processes
  - Synthesis of compounds
  - Growth & Development
  - Reproduction
  - Activities of Daily Living
  - Exercise (Skeletal muscle contractions)

- **The Energy Balance Equation**
  - “Simple” version = Energy In vs. Energy Out
  - Hypothalamus integrates a host of signals from the liver, gut, and adipose tissue to regulate energy expenditure and the initiation, termination, and frequency of eating
  - Adaptations!
Energy Expenditure

- Three components to total daily energy expenditure
  - **Resting Metabolic Rate (RMR)** The energy expended while lying supine in a post-absorptive, awakened state for cellular processes necessary to maintain life
    - 70-75% of daily energy expenditure
  - **Thermic Effect of Food (TEF)** Energy expenditure above RMR in response to the ingestion of food
    - Approx 10% of energy ingested; Fats have lowest TEF 3%, Carbohydrates 5-10% TEF and Protein 20-30% TEF
  - **Physical Activity**
    - **Non-Exercise Activity Thermogenesis (NEAT)** The Energy expenditure from physical activity which is not considered exercise, such as ADL or fidgeting
    - **Exercise Energy Expenditure (ExEE)** Most variable component which is defined as volitional movement done for the purpose of improving or maintaining one or more features of either health or performance-related physical fitness
      - Up to 30% of daily energy expenditure however in athletes this factor can increase greatly
Energy Availability (EA)

The amount of dietary energy remaining for other body functions AFTER exercise training

\[(EI - EEE) / \text{kg FFM}\]

\[EI = \text{Dietary Energy Intake}\]
\[EEE = \text{Exercise Energy Expenditure}\]
\[FFM = \text{Fat Free Mass (\text{*body comp needed*)}\]

Calculating Fat Free Mass

Bioelectrical Impedance Analysis (BIA)
BodPod
Girth measurement body fat equations
Calipers

Energy Availability (EA) Example

\[
\frac{(EI - EEE)}{kg \text{ FFM}}
\]

EI = Dietary Energy Intake \hspace{1cm} 1800 kcal/day
EEE = Exercise Energy Expenditure \hspace{1cm} 1200 kcal/day “practice”
FFM = Fat Free Mass

140# with body fat% 20%
\[
112\# \text{ FFM} / 2.2 \text{ kg} = 50.91 \text{ kg}
\]

\[
\frac{(1800 - 1200)}{50.91 \text{ kg FFM}} = 11.79 \text{ kcal/kg energy availability}
\]

Energy Availability is reduced by...

- Increased EEE above EI
  - Changes in training volume

- Inadvertent impacts on energy intakes
  - Nutrition as an afterthought
  - Timing of training session conflicting with eating opportunities
    - Short time between training sessions
    - Time, money constraints
    - Back loading intakes

- Dysfunctional Eating Behaviors
  - Dieting, Sub-clinical and clinical eating disorders

Causes of Low Energy Intakes

- Unintentional Low Intakes
- Intentional meeting body composition or weight loss goal
- DSM-V Eating Disorder
- Disordered Eating
Starvation State: 
**Minnesota Starvation Study**

- World War II
- November 1944 to December 1945
- “After you’ve not had food for a while your state of being is just numb. I didn’t have any pain. I was just very weak. One’s sexual desires disappeared“ says Sutton
- Men lost 25% of their body weight
- Anxiety and Depression


Starvation and Fuel Use

<table>
<thead>
<tr>
<th>Time of Starvation</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Origin of Blood Glucose</td>
<td>Exogenous</td>
<td>Hepatic Glycogen; Gluconeogenesis</td>
<td>Renal &amp; Hepatic Gluconeogenesis</td>
</tr>
<tr>
<td></td>
<td>Tissues Using Glucose</td>
<td>All</td>
<td>All except liver. Muscle &amp; Adipose tissue at diminished rates</td>
<td>Brain at a diminished rate; RBCs normal</td>
</tr>
<tr>
<td></td>
<td>Major Fuel of Brain</td>
<td>Glucose</td>
<td>Glucose</td>
<td>Glucose; Ketone Bodies; Glucose</td>
</tr>
</tbody>
</table>
Humans Adapt to Fuel Deprivation

- A) Before a fast
- B) Following three weeks of starvation

- The process of keto-adaptation prevents the ongoing catabolism of lean mass to provide glucose
- Even a small amount of glucose infusion decreases ketoacid and ammonia nitrogen excretion
- Down regulation of metabolic rate
- Assess for urinary ketones

Ketones

- Ketone bodies are three water-soluble molecules that are produced by the liver from fatty acids during periods of low food intake (fasting) or carbohydrate restriction for cells of the body to use as energy instead of glucose
  - Inefficient back up energy
- The three endogenous ketone bodies: acetone, acetoacetic acid, beta-hydroxybutyric acid
- Acetoacetate and beta-hydroxybutyrate can be reconverted to acetyl-CoA to produce energy, via the citric acid cycle
- Uses in the heart, brain and muscle (but not the liver)
Brain Adaptation

- Brain adapts to using ketones as fuel - but not in the short run
- Keto-adaption starts at day 2-5 depending on activity

Prolonged Starvation

Increased

- **Glucagon**
  - Increases glucose in bloodstream
  - Opposite to insulin

- **Cortisol**
  - Increased in response to stress which increases blood sugar through gluconeogenesis
  - Suppresses the immune system
  - Aids in the metabolism of fat, protein, and carbohydrate
  - Decreases bone formation

- **Epinephrine**
  - Also known as adrenaline
  - Important role in the fight-or-flight response by increasing blood flow to muscles, output of the heart, pupil dilation, and blood sugar

- **Antidiuretic hormone**
  - Prevents the production of dilute urine
  - Fluid controls

Prolonged Starvation

- Increased
  - **Aldosterone**
    - Steroid hormone critical to blood pressure regulation
    - Causes the conservation of sodium & secretion of potassium
    - Causes increase in water retention
    - Causes increase in blood pressure and blood volume
  - **Thyroid hormone**
    - Thyronines act on every cell in the human body by:
      - Increasing basal metabolic rate
      - Affect protein synthesis
      - Assist regulation of long bone growth and neural maturation
      - Increase the body’s sensitivity to catecholamines (such as adrenaline) by permissiveness
      - Regulate protein, fat, and carbohydrate metabolism
      - Affect how cells use energy
      - Stimulate vitamin metabolism

Prolonged Starvation

- Decreased
  - Insulin: Decrease glucose in blood stream
  - Sex Hormones: Male and Females; Non-essential

Changes in Metabolic Rate

**Normal Metabolism—Nonstressed System**

Normal Nutrient Intake

- Efficient pathway to energy for carbohydrates, fat
- Adequate oxygen available for energy production
- Protein intake is used for protein synthesis and maintaining lean mass

Normal metabolic rate
25–30 kcal/kg/d

**Energy Production**

- Pathway to energy
- Pathway to protein synthesis
- Excess calories → Need more energy

**Lean Mass Compartment**

- Protein synthesis adequate to maintain physical and metabolic machinery
- Heat loss blocked

**Metabolism Response to Starvation (Short Term)**

No Injury or "Stress" (Protective Adaptation Occurs)

- Overall energy needs decrease
- Metabolic rate decreases 20–25 kcal/kg/d
- Energy from fat storage >90% of kcal
- Energy from protein <10% for gluconeogenesis
- Protein store protected

Lower metabolic rate
20–25 kcal/kg/d

**Energy Production**

- For obligated users (brain)
- Micronutrients needed
- Alanine → Amino Acids
- Hormone adaptation preserves protein
- Minimal catabolism to meet glucose needs

**Energy Depot**

- Fat, Fatty Acid
- 90% kcal
- Ketones

**Lean Mass**

- Minimal catabolism
- To tissues

**Glucose**

- Pyruvate → Gluconeogenesis (10% kcal)
- Oxygen

**Liver**

- Urea

http://www.medscape.org/viewarticle/432384_4
Starvation & Fuel Use Summary

- If more than 4 hours passes between exogenous fueling then one can start to cross into the underfueled state.
- From 2-24 hours, one’s body can begin to switch to glycogen and gluconeogenesis pathways for fueling.
- Carbohydrate fueling at intervals of every 2 to 4 hours maintains glucose use in all of one’s body tissues.
- “Fat burns in a carbohydrate flame” - Nancy Clark, RD.
Starvation & Fuel Use Summary

- Consuming inadequate energy through CHOs can cause protein breakdown (catabolism) and losses of lean mass as well as impair organ function and cell structures.

- In the course of an overnight fast, nearly all reserves of liver glycogen and most muscle glycogen have been depleted.

- After 3 days of fasting, liver releases ketone bodies (from fat oxidation) as alternative fuel for the brain; Gluconeogenesis provides glucose to RBCs and brain.

Energy Recovery Creates A Hypermetabolic State

- As much as 40% decrease to one’s metabolic rate
- Refeeding is a hypermetabolic state
- The increase in metabolic rate reflects an increase in energy demands
- This demand persists for weeks to months even after complicated surgery or tissue damage
- Increased calories are required

http://www.medscape.org/viewarticle/432384_4
How Much Energy Do We Need?

- Normal Metabolic rate: 25-30 kcal/kg FFM/day
- Goal for Athletes (Gold Standard) approx. 45 kcal/kg FFM/day
- Disruptions occur < 30 kcal/kg FFM/day
- 30 kcal/kg FFM/day corresponds to the energy expended in resting metabolism in healthy adults

Prolonged Starvation RED-s Disruptions

- **Cardiorespiratory**
  - Heart Palpitations
  - Arrhythmias (EKG)
  - SOB
  - Edema
  - Postural Orthostatic Tachycardic Syndrome (POTS)
  - Syncope

- **Endocrine**
  - Amenorrhea or Oligomenorrhea
  - Loss of libido
  - Low bone mineral density
  - Infertility

- **Gastrointestinal**
  - Gastroparesis
  - Delayed gastric emptying & Early satiety
  - Constipation
  - Gastroesophageal Reflux (GERD)
  - Decreased hunger

- **Hematological**
  - Glucoregulatory hormones do not maintain normal plasma glucose concentrations below energy availability of 30 kcal/kg FFM per day
  - Low RBC count
  - Anemia
Prolonged Starvation RED-s Disruptions

- **Immune**
  - Low WBC count
  - Increased risk for illness or injury
  - Poor wound healing

- **Growth and Development**
  - Loss of height/stature progression
  - Lack of physical development (Tanner stages)
  - Cold intolerance

- **General**
  - Fatigue, Weakness
  - Hot flashes, Sweating episodes
  - Not just weight loss - may be weight maintenance or failure to gain in children or adolescents

- **Psychological***
  - Can occur prior to the energy restriction or as consequence to post-restriction
  - Decreased focus / brain function
  - Anxiety
  - Depression
Physiological Consequences Associated with Energy Restriction: 
*What are Athletes Concerned About?*

- **Performance Issues**
  - Fatigue
  - Inability to finish workout
  - Getting “slower” “weaker”
  - Focus and concentration lost

- Coaches and ATs hear “I need to train more” not “I'm underfueled”

- These findings should launch your assessment

**ASK!**
Four-Step Nutrition Care Process for Achieving Goals

- **Nutrition Assessment & Reassessment**
  - The RDN collects and documents information such as food or nutrition-related history; biochemical data, medical tests and procedures; anthropometric measurements, nutrition-focused physical findings and client history

- **Nutrition Diagnosis**
  - Data collected during the nutrition assessment guides the RDN in selection of the appropriate nutrition diagnosis (i.e., naming the specific problem)

- **Nutrition Intervention (Action Plan)**
  - RDN selects the nutrition intervention that will be directed to the root cause (or etiology) of the nutrition problem and is aimed at alleviating the signs and symptoms of the diagnosis

- **Nutrition Monitoring & Evaluation**
  - The final step where RDN determines if the patient/client has achieved, or is making progress toward, the planned goals

http://www.eatrightpro.org/resources/practice/nutrition-care-process
Nutrition Assessment

- Dietary Intake and Red Flag screens
  - Energy Availability
- Medical Assessment
  - Scope of practice
- Can you calorie count?
  - Lost art, now you can get the APP!
  - Athletes are often better at it than professionals
- Disordered Eating Behaviors
  - Food “allergies”
  - Gluten restricted for no reason
  - Veganism / Vegetarianism
  - Eating Alone
  - Leaving the table for bathroom
Eating Disorder Assessment Tools

General Population

- **Eating Attitudes Test (EAT)**
  - See Copy
  - *The EAT-26 has been reproduced with permission. Garner et al. (1982). The Eating Attitudes Test: Psychometric features and clinical correlates. Psychology Medicine, 12, 871-878. (On 12-15-15 by Jennifer Doane)*

- **Eating Disorder Examination Questionnaire (EDE-Q)**
  - Historically considered the gold standard in ED/DE assessment
  - See Copy

- **Eating Disorder Inventory (EDI)**
  - 64 questions with 8 subscales
  - 20 minutes to complete, 20 minutes to “grade”
Eating Disorder Assessment Tools

**Athletic Population**

- **Female Athlete Screening Tool (FAST)**
  - *See copy*
  - 33-item questionnaire developed specifically for female athletes
  - Approximately 15 min to complete and validated in collegiate populations with subjects from both Division I and III NCAA schools

- **Athletic Milieu Direct Questionnaire (AMDQ)**
  - 119 item, self-report questionnaire to screen for eating disorders and disordered eating in female athletes

- **Survey of Eating Disorders among Athletes (SEDA)**
  - 33-item self-report questionnaire mentioned in the NATA recommendations
  - 30+ years old, is based on outdated diagnostic criteria, and lacks recent validation


Eating Disorder Assessment Tools

**Athletic Population**

- **Health, Weight, Dieting, and Menstrual History Questionnaire**
  - 54 item, self-report questionnaire
  - Test items are composed of four categories including musculoskeletal health, menstrual history, dieting behaviors, and weight history

- **College Health-Related Information Survey (CHRISY73)**
  - 32 item, self-report screening test for male and female collegiate athletes based on the Juvenile Wellness and Health Survey
  - Has not been validated

- **BEDA-Q**
  - Screening tool not included in the NATA position stand due to the timing of its publication
  - Developed in elite high school female athletes (ages not reported) in three phases.
  - Version 2 had 95% confidence interval

**Pre-Season Nutrition Assessment**

- Screening for Eating Disorders esp. High Risk Sports
- **BEDA-Q: Brief Eating Disorder in Athletes - Questionnaire**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Always</th>
<th>Usually</th>
<th>Often</th>
<th>Sometimes</th>
<th>Rarely</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>I feel extremely guilty after overeating.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am preoccupied with the desire to be thinner.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I think that my stomach is too big.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel satisfied with the shape of my body.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My parents have expected excellence of me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>As a child, I tried very hard to avoid disappointing my parents and teachers.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are you trying to lose weight now?</td>
<td>Yes</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you tried to lose weight?</td>
<td>Yes</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If yes, how many times have you tried to lose weight?</td>
<td>1-2 times</td>
<td>3-5 times</td>
<td>&gt;5 times</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BEDA-Q Rating

Version 2: Highest possible score 18 points

- Positive scores are rated as follows (reverse-scored items are weighted in the opposite manner):
  - 3 points - always
  - 2 points - usually
  - 1 point - often
  - 0 points - sometimes
  - 0 points - rarely
  - 0 points - never

The Panel recommends asking these screening questions at the time of the sport preparticipation evaluation.

- Have you ever had a menstrual period?
- How old were you when you had your first menstrual period?
- When was your most recent menstrual period?
- How many periods have you had in the past 12 months?
- Are you presently taking any hormone replacement? (estrogen, progesterone, oral birth control pills)

**Do you worry about your weight?**

- Are you trying to or has anyone recommended that you gain or lose weight?
- Are you on a special diet or do you avoid certain types of foods or food groups?

**Have you ever had an eating disorder?**

- Have you ever had a stress fracture?

**Have you ever been told you have low bone density (osteopenia or osteoporosis)?**

Nutritional Intervention

- Progression necessary due to potential for refeeding concerns
  - Add 500 calories at a time
- Liquids better tolerated than solids
- Reassess vitals at minimum weekly
  - Refeeding can have multiple concerns
  - Gradual improvements in HR
  - Improving body temperature
  - Correcting any nutrients imbalances from lab work
    - Iron, Vitamin D, Phosphorous, electrolytes, etc...
- Monitor weight (?BLIND) - must be consistent towards recovery goals
- When weight plateaus, add an additional 500 calories
Nutrition Intervention

How Much Energy Do We Need?

- Normal Metabolic rate: 25-30 kcal/kg FFM/day

- Energy Availability Goal for Athletes (Gold Standard) approx. 45 kcal/kg FFM/day

- Disruptions occur ≤ 30 kcal/kg FFM/day

- 30 kcal/kg FFM/day corresponds to the energy expended in resting metabolism in healthy adults

Nutrition Intervention

Is Exercise OK?

- Medical Concerns about exercise in treatment and recovery
  - Might prolong energy imbalance
  - Increase risk for organ damage
  - Undermine weight gain
  - Increased cardiac risk
  - Increase risk of injury
Medical Clearance for Adding Exercise in Treatment

- BMI
- DEXA
- EKG
- Blood Pressure / Pulse, Postural VS (POTS)
- Comprehensive Metabolic Panel (CMP)
- Magnesium, Phosphorous
- Urinalysis
- Complete Blood Count (CBC)
- Nutritional Labs (Vit D, Serum Iron, Ferritin)

Nutrition Intervention

Returning To Sport

- Work with a “team”: AT, RD, MD in treatment planning
  - Sport psychologist very beneficial
  - Clinical ED diagnosis should be mandated to work with a counselor / therapist
- Set goals for return to sport and/or maintenance of participation
- Monitor safety
- Energy availability goal is greater than 45 kcals/kg FFM
  - Test exercise load and eating to assure energy balance / weight stabilization
- Ideal = No stress fractures, menstrual dysfunction or “disruptions”
Decision-Based Return-to-Play (RTP) Model for the Female Athlete Triad

- RTP decision is determined by the primary care or team physician
- Based on a complex and comprehensive synthesis of health status, cumulative risk assessment, participation risk, sport and decision modifiers.

Abbreviations:
- 25(OH) Vit D, 25-hydroxyvitamin D
- BMI, body mass index
- BP, blood pressure
- CBC, complete blood count
- DXA, dual-energy X-ray absorptiometry
- ED, eating disorder
- OCD, obsessive compulsive disorder
- TFTs, thyroid function tests
- TSH, thyroid stimulating hormone

### Female Athlete Triad: Cumulative Risk Assessment


<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>MAGNITUDE OF RISK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Risk = 0 points each</td>
</tr>
<tr>
<td>Low EA with or without ED/DE</td>
<td>No dietary Restrictions</td>
</tr>
<tr>
<td>Low BMI</td>
<td>BMI &gt;18.5 or &gt;90% IBW or weight stable</td>
</tr>
<tr>
<td>Delayed Menarche</td>
<td>Menarche &lt; 15 y/o</td>
</tr>
<tr>
<td>Oligomenorrhea and/or Amenorrhea</td>
<td>&gt;9 menses in 12 months</td>
</tr>
<tr>
<td>Low BMD</td>
<td>Z-score &gt;-1.0</td>
</tr>
<tr>
<td>Stress Reaction / Fracture</td>
<td>None</td>
</tr>
<tr>
<td>Cumulative Risk (total each column, then add for total score)</td>
<td>_____ points +</td>
</tr>
</tbody>
</table>
Female Athlete Triad: Clearance and Return-to-Play (RTP) Guidelines by Medical Risk Stratification

*Cumulative Risk Score determined by summing the score of each risk factor (low, moderate, high risk) from the Cumulative Risk Assessment

<table>
<thead>
<tr>
<th>Cumulative Risk Score *</th>
<th>Low Risk</th>
<th>Moderate Risk</th>
<th>High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full</td>
<td>0-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provisional / Limited Clearance</td>
<td>2-5</td>
<td></td>
<td>Provisional</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Limited</td>
</tr>
<tr>
<td>Restricted from Training / Competition</td>
<td>≥ 6</td>
<td></td>
<td>Restricted from Training / Competition - Provisional</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Disqualified</td>
</tr>
</tbody>
</table>
# The RED-s Decision-based Return-to-Play Model

**Table 3**

(modified from Creighton et al.143)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Risk modifiers</th>
<th>Criteria</th>
<th>Red-S Specific Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> Evaluation of health status</td>
<td></td>
<td>Patient demographics, Symptoms, Medical history, Signs, Laboratory tests, Psychological health, Potential seriousness</td>
<td>Age, sex, Recurrent dieting, Menstrual health, Bone health, Weight loss/fluctuations, Weakness, Hormones, electrolytes, ECG and DXA, Depression, anxiety, Disordered eating/eating disorder, Abnormal hormonal and metabolic function, Stress fracture</td>
</tr>
<tr>
<td><strong>Step 2</strong> Evaluation of participation risk</td>
<td>Sport risk modifiers</td>
<td>Type of sport, Position played, Competitive level</td>
<td>Weight sensitive, Jeannness sport, Individual vs team sport, Elite vs Re-creational</td>
</tr>
<tr>
<td><strong>Step 3</strong> Decision modification</td>
<td>Decision modifiers</td>
<td>Timing and season, Pressure from athlete, External pressure, Conflict of interest, Fear of litigation</td>
<td>In/out of season, travel, environmental factors, Desire to compete, Coach, team owner, athlete family and sponsors, If restricted from competition</td>
</tr>
</tbody>
</table>

# The IOC consensus statement: beyond the Female Athlete Triad—Relative Energy Deficiency in Sport (RED-S)

**Table 3: The Relative Energy Deficiency in Sport Return-to-Play Model** (modified from Skårderud et al, 2012)

<table>
<thead>
<tr>
<th>High risk red light</th>
<th>Moderate risk yellow light</th>
<th>Low risk: green light</th>
</tr>
</thead>
<tbody>
<tr>
<td>▶ No competition</td>
<td>▶ May compete once medically cleared under supervision</td>
<td>▶ Full sport participation</td>
</tr>
<tr>
<td>▶ Supervised training allowed when medically cleared for adapted training</td>
<td>▶ May train as long as is following the treatment plan</td>
<td></td>
</tr>
<tr>
<td>▶ Use of written contract (see sample)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Nutritional Assessment

**REDS: Green Light or Low Risk**

- Healthy eating habits
- Normal hormonal and metabolic function
- Healthy BMD
- Healthy musculo-skeletal system
- Absence of POTS

_This is where we want athletes to be!_

Nutrition Assessment

**REDs: Moderate Risk**

- Prolonged abnormally low % body fat or weight loss >5-10% in one month
- Abnormal menstrual cycle: Functional Hypothalamic Amenorrhea (FHA) > 6 months
- Menarche > 16 years
- Abnormal Hormone profile in men
- Reduced bone mineral density (BMD)
  - History of one or more stress fractures associated with hormonal/menstrual dysfunction and/or low energy availability (EA)
- Athletes with physical/psychological complications related to low EA / disordered eating
  - ECG abnormalities, lab abnormalities, etc...
- Prolonged relative energy deficiency
- Disordered eating behavior negatively affecting other team members
- Lack of progress in treatment and/or non-compliance

Nutritional Assessment

**REDs: High Risk**

- Anorexia nervosa and other clinically diagnosed eating disorders
- Other serious medical conditions related to low energy availability
  - Diagnosis
  - Physiological and/or psychological
    - Example: Repeat stress fractures
      - Syncope
      - Abnormal EKG, etc...
- Extreme weight loss techniques leading to dehydration induced hemodynamic instability and other life-threatening conditions

RED-s Implications for Sports Medicine

- Underfueled athletes
- Distance runners, Wrestlers, Ballerinas
- Nutrition Assessment and Intervention needs to be comprehensive!
  - Hypothermia
    - Less than 97.5 degrees, cool hands & feet
  - Bradycardia (less than 50bpm women, 40 bpm men)
    - Defined as less than 60 beats per minute
  - POTS (postural orthostatic tachycardic syndrome)
    - Lightheaded, dizzy, syncope
    - Lying to standing, HR changes 30 bpm
  - Urinary Ketones (Use keto strips)
  - Increase in urine specific gravity - ketones increase specific gravity
  - Weight change
    - Weight status is one variable but not the only one
Treatment Approach Within Athletics

- Team Approach
- Experienced RD with CSSD
- Education for Athletes and Coaches (Separately)
  - Female Athlete Forum
  - Help connect normal physiological functions with optimal performance
  - Help individuals and teams to find their own “recipe” for fueling success
  - Dispel “Eating Disorder” label
- Regularly assess risk for subclinical ED
- Consider Treatment Contracts
Treatment Contracts

- Team physician support is critical
- Athletes in moderate and high-risk categories should receive a written contract reviewed & presented by the team physician
- Although a verbal contract may be sufficient, it is recommended to utilize a written contract.
- The Legal Duty of a College Athletics Department to Athletes with Eating Disorders: A Risk Management Perspective (1999)
  Available at: http://scholarship.law.marquette.edu/sportslaw/vol10/iss1/6
- The goal of the written contract is to:
  - Specify the criteria necessary for ongoing or future clearance and return to play for the athlete with the multidisciplinary team members
  - To ensure a shared understanding of how the clinical status of the athlete will be followed with each member of the multidisciplinary team.

http://bjsm.bmj.com/content/suppl/2014/03/11/48.7.491.DC1/bjsports-2014-093502supp.pdf
Treatment Contracts

- The team physician coordinates the treatment goals with each multidisciplinary team member, and includes:
  - The specific recommendations in the contract
  - The requested frequency of visits
  - Expectations for each team member

- The team physician then reviews the recommendations with the athlete, and answers any questions.
  - In the case of the written contract, athlete and team physician sign the contract after it is discussed
  - Written contract which can be modified based on the athlete's clearance status.

SAMPLE

http://bjsm.bmj.com/content/suppl/2014/03/11/48.7.491.DC1/bjsports-2014-093502supp.pdf
Summary

- Relative energy deficit in sport encompasses the female athlete triad
- However, REDs expands the assessment areas which are multi-faceted
Recommendations to address RED-S

- **For the Athlete**
  - Educational programs on RED-S, healthy eating, nutrition, EA, the risks of dieting and how these affect health and performance
  - Reduction of emphasis on weight, emphasizing nutrition and health as a means to enhance performance
  - Development of realistic and health-promoting goals related to weight and body composition
  - Avoidance of critical comments about an athlete’s body shape/weight
  - Use of reputable sources of information
  - Promotion of awareness that good performance does not always mean the athlete is healthy
  - Encouragement and support of appropriate, timely and effective treatment
Recommendations to address RED-S

- **For The Healthcare Professional**
  - Identification of a multidisciplinary athlete health support team including sports physician, nutritionist, psychologist, physiotherapist and physiologist
  - Education of the medical team in the detection and treatment of all aspects of RED-S
  - Implementation of the RED-S Risk Assessment Model in the PHE and the RED-S Return-To-Play Model inclusive of the Female Athlete Triad
Incorporate a “team” approach when assisting your athletes with their nutrition related health and performance goals.

Many loopholes (Medically, Psychologically, Nutritionally)

Set guidelines and adherence will be key to your program’s successful management of RED-s for your athletes.

Use SCAN DPG for finding an RD/CSSD in your area.

**Sports, Cardiovascular and Wellness Nutrition Group**

* A Dietetic Practice Group of the Academy of Nutrition & Dietetics (AND)

[www.scandpg.org](http://www.scandpg.org)
THANK YOU!

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