FEMALE ATHLETE TRIAD AND RED-S:
Are You Missing It In Your Clinic?
Kenzie Johnston, MD CAQSM
Objectives

1. Define and discuss the evolving definition of the female athlete triad and relative energy deficiency in sport
2. Discuss screening and diagnosis
3. Discuss both nonpharmacologic and pharmacologic treatment
4. Discuss clearance and return to play for affected athletes
Gender vs Sex
1997: The Task Force on Women’s Issues of ACSM

- Syndrome of 3 distinct but interrelated conditions
  - Disordered eating
  - Amenorrhea
  - Osteoporosis
2007: Triad redefined by ACSM

3 interrelated components:

- Energy availability
- Menstrual function
- Bone Health

EA = Dietary energy remaining after exercise, for all other physiological functions each day
2014 Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad:
1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013
Mary Jane De Souza,1 Aurelia Nattiv,2 Elizabeth Joy,3 Madhusmita Misra,4 Nancy I Williams,1 Rebecca J Mallinson,1 Jenna C Gibbs,5 Marion Olmsted,6 Marci Goolsby,7 Gordon Matheson,8 Expert Panel

The IOC consensus statement: beyond the Female Athlete Triad—Relative Energy Deficiency in Sport (RED-S)
Margo Mountjoy,1 Jorunn Sundgot-Borgen,2 Louise Burke,3 Susan Carter,4 Naama Constantini,5 Constance Lebrun,6 Nanna Meyer,7 Roberta Sherman,8 Kathrin Steffen,2,9 Richard Budgett,9 Arne Ljungqvist9
2014: Relative Energy Deficiency in Sport (RED-S)

“...syndrome resulting from relative energy deficiency that affects many aspects of physiological function including metabolic rate, menstrual function, bone health, immunity, protein synthesis, cardiovascular, and psychological health.”

And also affects men!
Why do we care?
Why did I choose to talk about this here?

In a survey of 931 multispecialty docs, only 37% were even aware of the triad and only ½ of those were comfortable treating or even referring a patient!

Awareness, prevention, and diagnosis are key!
RUN FAST.
COOK FAST
EAT SLOW.
QUICK-FIX RECIPES FOR HANGRY ATHLETES

SHALANE FLANAGAN & ELYSE KOPECKY
New York Times bestselling authors of Run Fast. Eat Slow.
Let's talk about Periods

I've been competing as a professional runner for 10 years. I've had my share of ups and downs, wins, loss, given births to 2 beautiful boys, but through it all I've stayed the course. I've never walked away because it is a part of me, but not something that defines me. A disregard of your identity to your training and performance is dangerous. To me it is what leads to elective, unhealthy decisions, a disbeliever drink for greatness. I've never truly never experienced these because while I want to be great one day, I also know that it's not worth sacrificing my health as a bonus and as a woman.

The Nitty Gritty of Defining and Evaluating the Triad
Energy Availability (EA)

- Dietary energy level for bodily function after exercise expenditure
- Low EA can lead to reduced energy for cellular maintenance, thermoregulation, growth, and reproduction
- EA less than 45 kcal/kg of FFM/day (in women)
What might you see?

- BMI < 17.5 or <85% expected body weight
  - May have stable body weight
- Physiological signs of adaptation to chronic energy deficiency
  - Reduced resting metabolic rate (RMR)
  - Low T3
# 2011 Compendium of Physical Activities

<table>
<thead>
<tr>
<th>CODE</th>
<th>METS</th>
<th>MAJOR HEADING</th>
<th>SPECIFIC ACTIVITIES</th>
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</thead>
<tbody>
<tr>
<td>01003</td>
<td>14.0</td>
<td>bicycling</td>
<td>bicycling, mountain, Uphill, vigorous</td>
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<tr>
<td>01004</td>
<td>16.0</td>
<td>bicycling</td>
<td>bicycling, mountain, competitive, racing</td>
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<td>01008</td>
<td>8.5</td>
<td>bicycling</td>
<td>Biking, BMX</td>
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<td>bicycling, mountain, general</td>
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<td>01010</td>
<td>4.0</td>
<td>bicycling</td>
<td>bicycling, &lt;10 mph, leisure, to work or for pleasure (Taylor Code 115)</td>
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<td>bicycling</td>
<td>bicycling, softball, work, self selected pace</td>
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<td>bicycling, on or off road, moderate pace</td>
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<td>general</td>
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<td>01016</td>
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<td>bicycling, leisure, 5.5 mph</td>
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<td>01019</td>
<td>5.8</td>
<td>bicycling</td>
<td>bicycling, leisure, 9.4 mph</td>
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<td>bicycling, 10-15 mph, leisure, slow, light effort</td>
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<td>bicycling, 12-16 mph, leisure, moderate effort</td>
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<td>01027</td>
<td>10.0</td>
<td>bicycling</td>
<td>bicycling, 15-19 mph, racing, light shuffling or &lt; 10 mph shuffling, very fast, racing general</td>
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<td>01030</td>
<td>15.0</td>
<td>bicycling</td>
<td>bicycling, &gt;20 mph, racing, not drafting</td>
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<tr>
<td>01035</td>
<td>8.5</td>
<td>bicycling</td>
<td>bicycling, 12 mph, seated, hands on brake hoods or bike bars, 80 rpm</td>
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<tr>
<td>01036</td>
<td>9.0</td>
<td>bicycling</td>
<td>bicycling, 12 mph, standing, hands on brake hoods, 60 rpm</td>
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<tr>
<td>01042</td>
<td>2.0</td>
<td>unicycling</td>
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<tr>
<td>02001</td>
<td>2.3</td>
<td>conditioning exercise</td>
<td>activity promoting video game (e.g., Wii Fit), light effort (e.g., balance, yoga)</td>
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<tr>
<td>02002</td>
<td>3.8</td>
<td>conditioning exercise</td>
<td>activity promoting video game (e.g., Wii Fit), moderate effort (e.g., aerobic, resistance)</td>
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<tr>
<td>02005</td>
<td>7.2</td>
<td>conditioning exercise</td>
<td>activity promoting visual and video game (e.g., Evergreen Farm, Dance Revolution), vigorous effort</td>
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<td>02008</td>
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<td>conditioning exercise</td>
<td>military-type obstacle course exercise, boot camp training program</td>
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<tr>
<td>02010</td>
<td>7.0</td>
<td>conditioning exercise</td>
<td>bicycling, stationary, general</td>
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<td>02011</td>
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<td>conditioning exercise</td>
<td>bicycling, stationary, 30-60 w, very light to light effort</td>
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<td>02012</td>
<td>6.8</td>
<td>conditioning exercise</td>
<td>bicycling, stationary, 60-100 w, moderate to vigorous effort</td>
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<td>02013</td>
<td>8.8</td>
<td>conditioning exercise</td>
<td>bicycling, stationary, 101-150 w, very vigorous effort</td>
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<td>02014</td>
<td>11.0</td>
<td>conditioning exercise</td>
<td>bicycling, stationary, 151-200 w, vigorous effort</td>
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<td>02015</td>
<td>14.0</td>
<td>conditioning exercise</td>
<td>bicycling, stationary, 201-270 w, very vigorous effort</td>
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<td>02017</td>
<td>4.8</td>
<td>conditioning exercise</td>
<td>bicycling, stationary, 31-80 w, light to moderate effort</td>
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<td>02019</td>
<td>8.5</td>
<td>conditioning exercise</td>
<td>bicycling, stationary, RPE1-2: light to moderate effort</td>
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<td>02020</td>
<td>3.8</td>
<td>conditioning exercise</td>
<td>calisthenics (e.g., push-ups, sit-ups, pull-ups, jumping jacks), vigorous effort</td>
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<tr>
<td>02022</td>
<td>3.8</td>
<td>conditioning exercise</td>
<td>calisthenics (e.g., push-ups, sit-ups, pull-ups, lunges), moderate effort</td>
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<tr>
<td>02024</td>
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<td>conditioning exercise</td>
<td>calisthenics (e.g., sit-ups, abdominal crunches), light effort</td>
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<td>02026</td>
<td>3.5</td>
<td>conditioning exercise</td>
<td>calisthenics, light or moderate effort, general effort (e.g., back exercises), going up &amp; down from floor (Taylor Code 150)</td>
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<td>02029</td>
<td>4.3</td>
<td>conditioning exercise</td>
<td>circuit training, moderate effort</td>
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<tr>
<td>02030</td>
<td>8.0</td>
<td>conditioning exercise</td>
<td>circuit training, including kettlebells, some aerobic movement with minimal rest, general, vigorous intensity</td>
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<tr>
<td>02035</td>
<td>9.0</td>
<td>conditioning exercise</td>
<td>Curve™ exercise routine, stationary, strength training</td>
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<td>02046</td>
<td>5.0</td>
<td>conditioning exercise</td>
<td>elliptical trainer, moderate effort</td>
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<tr>
<td>02050</td>
<td>6.0</td>
<td>conditioning exercise</td>
<td>resistance training, weightlifting, free weights, weightlifting, general, vigorous intensity (Taylor Code 210)</td>
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<td>02052</td>
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<td>conditioning exercise</td>
<td>resistance training, squats, cheer or optical effort</td>
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<td>02054</td>
<td>3.5</td>
<td>conditioning exercise</td>
<td>resistance training, multiple exercises, 5-15 repetitions at varied resistance</td>
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<td>02060</td>
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<td>conditioning exercise</td>
<td>health club exercise, general (Taylor Code 100)</td>
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<td>02061</td>
<td>7.0</td>
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<td>health club exercise, general, general, (gym) weight training combined in one visit</td>
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<td>02062</td>
<td>7.8</td>
<td>conditioning exercise</td>
<td>health club exercise, conditioning classes</td>
</tr>
<tr>
<td>02064</td>
<td>3.8</td>
<td>conditioning exercise</td>
<td>swimming, general</td>
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<td>02065</td>
<td>8.0</td>
<td>conditioning exercise</td>
<td>stair-climbing, stationary, general, vigorous effort</td>
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<tr>
<td>02066</td>
<td>12.3</td>
<td>conditioning exercise</td>
<td>rope skipping, general</td>
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<tr>
<td>02070</td>
<td>6.0</td>
<td>conditioning exercise</td>
<td>rowing, stationary, general, vigorous effort</td>
</tr>
<tr>
<td>02071</td>
<td>4.5</td>
<td>conditioning exercise</td>
<td>rowing, stationary, general, moderate effort</td>
</tr>
</tbody>
</table>

*Italicized codes and METS are estimated values*
Use the form below to calculate your estimated energy availability (EA) based on your body weight, body fat percentage, exercise volume, and food intake.

Calculated Form

- **Body weight**: 150 lbs
- **Body Fat Percentage**: 20%
- **Exercise Energy Expenditure**: Unknown
- **Exercise Duration**: Unknown
- **Caloric Intake**: Unknown

The field below will show the calculated energy availability in calories per day.
Who is at most risk for low EA?

Those who:

- Restrict dietary intake
- Exercise for long periods of time
- Vegetarians
- Limit the types of foods they eat

Also:

- Environmental and social factors
- Psychological predisposition
- Low self esteem
- Family issues
- Abuse
- Biological and genetics
FHA/Menstrual Dysfunction

Amenorrhea: Absence of menstrual cycle for more than 3 months

- Primary: Delay of onset of menarche (recently reduced to 15 years)
- Secondary: Amenorrhea after onset of menarche

Not always apparent by loss of period,
Low EA alters metabolic hormones like GH and IGF-1 and this is thought to disrupt GnRH pulsatility which in turn effects LH pulsatility

Disruption of LH pulsatility results in anovulation and luteal deficiencies

LH pulsatility disrupted within 5 days when EA is reduced to <30kcal/kg
Consider checking:
- TSH
- FSH
- Prolactin
- Urine pregnancy

If physical exam or history suggests:
- Total and free testosterone
- Estradiol
- DHEA/S
- Early morning 17-hydroxyprogesterone
- Pelvic US
History and Examination

Initial Investigation (based on H&P)
- LH, FSH, hCG
- Prolactin
- TSH, free T4
- Estradiol, testosterone (total and free), DHEAS ± 8AM 17(OH) progesterone
- Progesterone challenge test
- ± Pelvic ultrasound

- Uterine pathology or outflow tract disorder
- Disorders of sexual differentiation
- Rule out Pregnancy

**Findings**
- Low to normal gonadotropins
  - Negative progesterone challenge test
  - Possibly ↑ prolactin
- Normal gonadotropins
  - Possibly ↑ LH/FSH
  - ↑ Total/free testosterone
  - Positive progesterone challenge test
- ↑ Gonadotropins
  - Negative progesterone challenge test

**Diagnosis**
- Hypothalamic-pituitary etiology
  - Rule out outflow tract obstruction if not done so previously
  - Consider FHA (prolactin typically not elevated)*
- Chronic anovulation/PCOS
- Primary ovarian insufficiency
- Abnormal TSH, prolactin, DHEAS or 8 AM 17(OH) progesterone
  - Specific investigation of endocrine disorder

* If energy deficiency-related amenorrhea, including exercise, weight loss, or disordered eating related, consult with sports dietitian and obtain a bone mineral density test (site of testing should be based on the age of the patient: spine and whole body for growing children and adolescents, spine and hip for adult women); Refer or consult with endocrinologist if not experienced in treatment.
What about the men?

- Specific changes in male sex hormones are not completely understood and more research is needed.
Low BMD/osteoporosis

In our population, comes from decreased accrual of bone

Increased risk of stress fractures
Box 2  Definition of low bone mineral density (BMD) and osteoporosis in children and adolescents (ages 5–19)

The diagnosis of osteoporosis in children and adolescents requires the presence of both a clinically significant fracture history AND low bone mineral content (BMC) or low BMD.

- A clinically significant fracture history is one or more of the following:
  - Long bone fracture of the lower extremities.
  - Vertebral compression fracture.
  - Two or more long-bone fractures of the upper extremities.

- Low BMC or BMD* is defined as a BMC or areal BMD Z-score that is ≤−2.0, adjusted for age, gender and body size, as appropriate.

Source: Lewiecki et al.80

*American College of Sports Medicine (ACSM) defines low BMC or BMD as a Z-score that is less than −1.0 in female athletes in weight-bearing sports.2

Box 3  Definition of low bone mineral density (BMD) and osteoporosis in premenopausal women

- The diagnosis of osteoporosis in premenopausal women cannot be diagnosed on the basis of BMD alone.
- A BMD Z-score of ≤−2.0* is defined as ‘below the expected range for age’.
- A BMD Z-score above −2.0 is ‘within the expected range for age’.
- Osteoporosis is diagnosed if there is a BMD Z-score of ≤−2.0 plus secondary causes of osteoporosis.

Source: Lewiecki et al.80

*American College of Sports Medicine (ACSM) defines low bone mineral content or BMD as a Z-score that is less than −1.0 in female athletes in weight-bearing sports.2
Who should have a DXA?

>= 1 ‘High risk’ triad factors

a. History of DSM-V dx eating disorder
b. BMI < 17.5, < 85%ile estimated weight, or recent weight loss > 10% in 1 month
c. Menarche >= 16
d. Current or history of <6 menses over 1 year
e. 2 prior stress reactions/fractures, 1 high risk stress reaction/fracture, or low energy non traumatic fracture
f. Prior Z score < -2.0

>= 2 ‘Moderate risk’ triad factors

a. Current of history of DE for 6 months or greater
b. BMI between 17.5 and 18.5, < 90% estimated weight, or recent weight loss 5-10% in 1 month
c. Menarche between 15 and 16
d. Current or history of 6-8 menses over 1 year
e. One prior stress reaction/fracture
f. Prior Z score between -1.0 and -2.0 (after at least 1 year interval from baseline DXA)
How to use DXA

- **Z scores, not T scores**
  - Adult women age >= 20
    - Weight bearing sites (PA spine, total hip, femoral neck)
    - Radius if weight bearing sites cannot be assessed
  - Children, adolescents, women < 20
    - PA lumbar spine bone mineral content and areal BMD
    - Whole body less head if possible BMC and areal BMD
    - Adjust for growth delay or maturational delay
    - Use peds reference data with height adjusted Z scores
Screening for the Triad

Box 1 Triad Consensus Panel Screening Questions*

- 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 female hormones (oestrogen, progesterone, 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 (ostepenia or osteoporosis)?

*The Triad Consensus Panel recommends asking these screening questions at the time of the sport pre-participation evaluation.
What to look for on your physical exam
Treatment

Nonpharmacologic

1. Inadvertent undereating - referral for nutritional education
2. Intentional weight loss without Disordered eating - nutritional education
3. Disordered eating - physician and nutritional counseling
4. Clinical ED - physician, nutritional education, referral to mental health provider
Treatment targets

May include one or more of the following:

- Reversal of recent weight loss
- Return to body weight associated with normal menses
- Weight gain to achieve BMI > 18.5 or >= 90% of predicted weight
- Energy intake minimum of 2000 kcal/day
Stepwise approach

1. Perform assessment of baseline energy needs
2. Using appropriate target for EA, develop meal plans
   a. Macronutrients and micronutrients - in particular: Ca, Vit D, Iron, Zinc, and Vit K.
      i. Calcium 1000-1300 mg/day
      ii. Vitamin D optimized between 32-50
   b. Increase real foods vs dietary or meal supplements
   c. Consider small and frequent meals if history of GI discomfort
3. Perform standardized period monitoring of body weight, consider weekly
Special consideration for ED
Special considerations in those with low BMD

- Amenorrhoeic women will lose 2-3% of bone mass per year if remains untreated
Recovery of Bone Mineral Density

Recovery of Menstrual Status

Recovery of Energy Status

**PROCESS:** Days or Weeks

**OUTCOMES:**
- Energy status will stimulate anabolic hormones (IGF-1) and bone formation
- Energy status will reverse energy conservation adaptations

**PROCESS:** Months

**OUTCOMES:**
- Reproductive hormones
- Estrogen exerts an anti-resorptive effect on bone

**PROCESS:** Years

**OUTCOMES:**
- Estrogen continues to inhibit bone resorption
- Energy status will stimulate anabolic hormones (IGF-1) and bone formation
Pharmacologic treatment

Treat comorbid contributing conditions
What about OCPs? Won’t they fix it?

COCs or non-oral routes of contraceptive therapy DO NOT restore spontaneous menses

COCs are not associated with improved BMD
Whom to consider for pharmacologic treatment

1. BMD Z scores $\leq -2.0$, clinically significant fx history, and lack of response to 1 year of non-pharm treatment
2. BMD Z scores between -1.0 and -2.0, significant fx history, and $\geq 2$ additional Triad risk factors, and lack of response to 1 year of non-pharm treatment

Transdermal estrogen therapy with cyclic progesterone may be considered in ages 16-21 with FHA to prevent further bone loss during this time if they have:

1. BMD Z scores $\leq -2.0$ without significant fx history and at least 1 Triad risk factor and lack of response to 1 year of non-pharm treatment
What do use: Estrogen replacement (women)

Transdermal estradiol 100 microgram twice weekly along with cyclic progesterone (2.5 mg daily for 10 days of the month) increased BMD

May work to maintain BMD but may not help bone accrual exceed controls
What about bisphosphonates?

Pharmacologic therapy for osteoporosis is recommended in postmenopausal women but we are lacking data in our age group.

Bisphosphonates are not approved by FDA for increasing BMD or fracture reduction in young or adult athletes. They may not be as effective in our population because they work by preventing resorption (which is happening at a much lower rate in our population - our issue is lack of accrual).
<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Low Risk = 0 points each</th>
<th>Moderate Risk = 1 point each</th>
<th>High Risk = 2 points each</th>
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</thead>
<tbody>
<tr>
<td><strong>Low EA with or without DE/ED</strong></td>
<td>□ No dietary restriction</td>
<td>□ Some dietary restriction†; current/past history of DE;</td>
<td>□ Meets DSM-V criteria for ED*</td>
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<tr>
<td><strong>Low BMI</strong></td>
<td>□ BMI ≥ 18.5 or ≥ 90% EW** or weight stable</td>
<td>□ BMI 17.5 &lt; 18.5 or &lt; 90% EW or 5 to &lt; 10% weight loss/month</td>
<td>□ BMI ≤ 17.5 or &lt; 85% EW or ≥ 10% weight loss/month</td>
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<tr>
<td><strong>Delayed Menarche</strong></td>
<td>□ Menarche &lt; 15 years</td>
<td>□ Menarche 15 to &lt; 16 years</td>
<td>□ Menarche ≥ 16 years</td>
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<tr>
<td><strong>Oligomenorrhea and/or Amenorrhea</strong></td>
<td>□ &gt; 9 menses in 12 months*</td>
<td>□ 6-9 menses in 12 months*</td>
<td>□ &lt; 6 menses in 12 months*</td>
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<tr>
<td><strong>Low BMD</strong></td>
<td>□ Z-score ≥ -1.0</td>
<td>□ Z-score -1.0*** &lt; -2.0</td>
<td>□ Z-score ≤ -2.0</td>
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<tr>
<td><strong>Stress Reaction/Fracture</strong></td>
<td>□ None</td>
<td>□ 1</td>
<td>□ ≥ 2; ≥ 1 high risk or of trabecular bone sites†</td>
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Cumulative Risk (total each column, then add for total score)

- 0 points +
- 1 point +
- 2 points = Total Score
<table>
<thead>
<tr>
<th></th>
<th>Cumulative Risk Score*</th>
<th>Low Risk</th>
<th>Moderate Risk</th>
<th>High Risk</th>
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<td><strong>Full Clearance</strong></td>
<td>0 – 1 point</td>
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<td><strong>Provisional/Limited Clearance</strong></td>
<td>2 – 5 points</td>
<td></td>
<td>□ Provisional Clearance</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ Limited Clearance</td>
</tr>
<tr>
<td><strong>Restricted from Training and Competition</strong></td>
<td>≥ 6 points</td>
<td></td>
<td></td>
<td>□ Restricted from Training/Competition-Provisional</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ Disqualified</td>
</tr>
</tbody>
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### Table 1  Relative Energy Deficiency in Sport risk assessment model for sport participation (modified from Skårderud et al)\(^{140}\)

<table>
<thead>
<tr>
<th><strong>High risk: no start red light</strong></th>
<th><strong>Moderate risk: caution yellow light</strong></th>
<th><strong>Low risk: green light</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Anorexia nervosa and other serious eating disorders</td>
<td>Prolonged abnormally low % body fat measured by DXA or anthropometry using The International Society for the Advancement of Kinanthropometry ISAK(^{141}) or non-ISAK approaches(^{142})</td>
<td>Healthy eating habits with appropriate energy availability</td>
</tr>
<tr>
<td>Other serious medical (psychological and physiological) conditions related to low energy availability</td>
<td>Substantial weight loss (5–10% body mass in 1 month)</td>
<td>Normal hormonal and metabolic function</td>
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<tr>
<td>Extreme weight loss techniques leading to dehydration induced haemodynamic instability and other life-threatening conditions</td>
<td>Attenuation of expected growth and development in adolescent athlete</td>
<td>Healthy BMD as expected for sport, age and ethnicity</td>
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<td></td>
<td>Abnormal menstrual cycle: FHA amenorrhoea &gt;6 months</td>
<td>Healthy musculoskeletal system</td>
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<tr>
<td></td>
<td>Menarche &gt;16 years</td>
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</tr>
<tr>
<td></td>
<td>Abnormal hormonal profile in men</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduced BMD (either from last measurement or Z-score &lt; −1 SD).</td>
<td></td>
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<tr>
<td></td>
<td>History of 1 or more stress fractures associated with hormonal/ menstrual dysfunction and/or low EA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Athletes with physical/psychological complications related to low EA/ disordered eating - ECG abnormalities- Laboratory abnormalities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prolonged relative energy deficiency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Disordered eating behaviour negatively affecting other team members</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lack of progress in treatment and/or non-compliance</td>
<td></td>
</tr>
</tbody>
</table>

BMD, bone mineral density; DXA, dual-energy X-ray absorptiometry; EA, energy availability; FHA, functional hypothalamic amenorrhoea; ISAK, International Society for the Advancement of Kinanthropometry

### Table 3  The Relative Energy Deficiency in Sport Return-to-Play Model (modified from Skårderud et al, 2012)\(^{140}\)

<table>
<thead>
<tr>
<th><strong>High risk red light</strong></th>
<th><strong>Moderate risk yellow light</strong></th>
<th><strong>Low risk: green light</strong></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 supplementary appendix 1)</td>
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<td></td>
</tr>
</tbody>
</table>

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Other Risk Factors

Important to consider age, eating disorder status
Contracts

The following items are mandatory and must be completed as prescribed. Failure to do so will result in the consequences listed below the requirements. All benefits and consequences are subject to change at any time and at the discretion of the Multidisciplinary Team. Multidisciplinary Team: 
_________________________ (Physician), ____________ (Psychotherapist), ____________ (Dietitian)

Requirements:
☐ Meet with __________________ (therapist) 1x per week, or as recommended by therapist.
☐ Meet with __________________ (dietitian) 1x per week, or as recommended by dietitian.
☐ Meet with Dr. ____________ 1-2x per month, or as recommended by Dr. ____________.
☐ Follow daily meal plan set forth by sports dietitian.
☐ Keep daily workout log updated with specific type, length, and effort.
☐ Weight gain of _______ lbs per week.
☐ Weekly weigh-in with _______ (name team member), or at time intervals of _____ weeks.
☐ Must achieve minimal acceptable body weight of _____ lbs by _____ (date).
☐ After this date, must maintain weight at or above minimal acceptable body weight.
☐ Limit of _____ workout sessions per week with no one session being more than _____ minutes in length.
All activity counts (e.g., biking, running, weight lifting, and swimming).

Benefits:
If ALL requirements are met then clearance to participate in team activities and use of athletic facilities will:
☐ be granted  ☐ continue.

Consequences:
If ANY requirement(s) are not met then clearance to participate in team activities and use of athletic facilities will be revoked, and re-instatement will be at the discretion of the team physician and multidisciplinary team.

I, __________________________ have read this contract and all of my questions were answered.

__________________________________  __________________________________________  ________________________
Athlete Name  Athlete Signature  Date

__________________________________  __________________________________________  ________________________
Team Physician Name  Team Physician Signature  Date

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Multidisciplinary team
An ounce of prevention is worth a pound of cure.

Benjamin Franklin
