

A HEALTHY KANSAS STARTS HERE

Female Athlete Triad

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Objectives

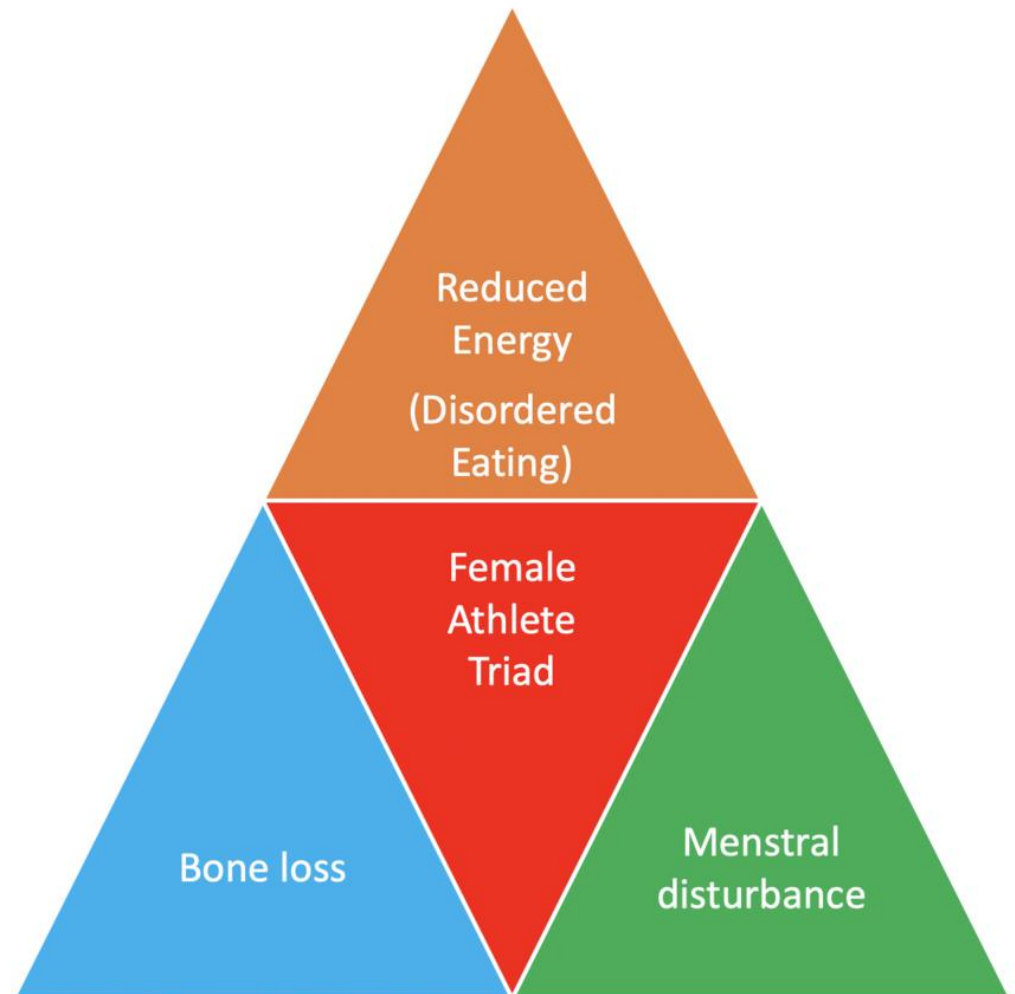
- Define the female athlete triad.
- Describe relative energy deficiency in sport.
- Describe the screening questions and clinical evaluation of an athlete with female athlete triad.
- Describe management and return-to-play guidelines for an athlete with female athlete triad.

Case

A 17-year-old distance runner presents with left lower leg pain x 2 weeks that she thinks are “shin splints.” She has not had a period for the past 3 months, which she is not worried about. She is watching her weight to improve her speed. The leg pain is getting worse, hurts when she walks, and is now preventing her from training.

How will you approach this patient?

The Female Athlete Triad



The History of Female Athlete Triad¹

- 1972: Title IX of the Education Amendment Act
- 1992: The American College of Sports Medicine (ACSM) coined the term *Female Athlete Triad*
- 2007: The ACSM broadened the definition

The Female Athlete Triad Coalition Consensus Statement⁴

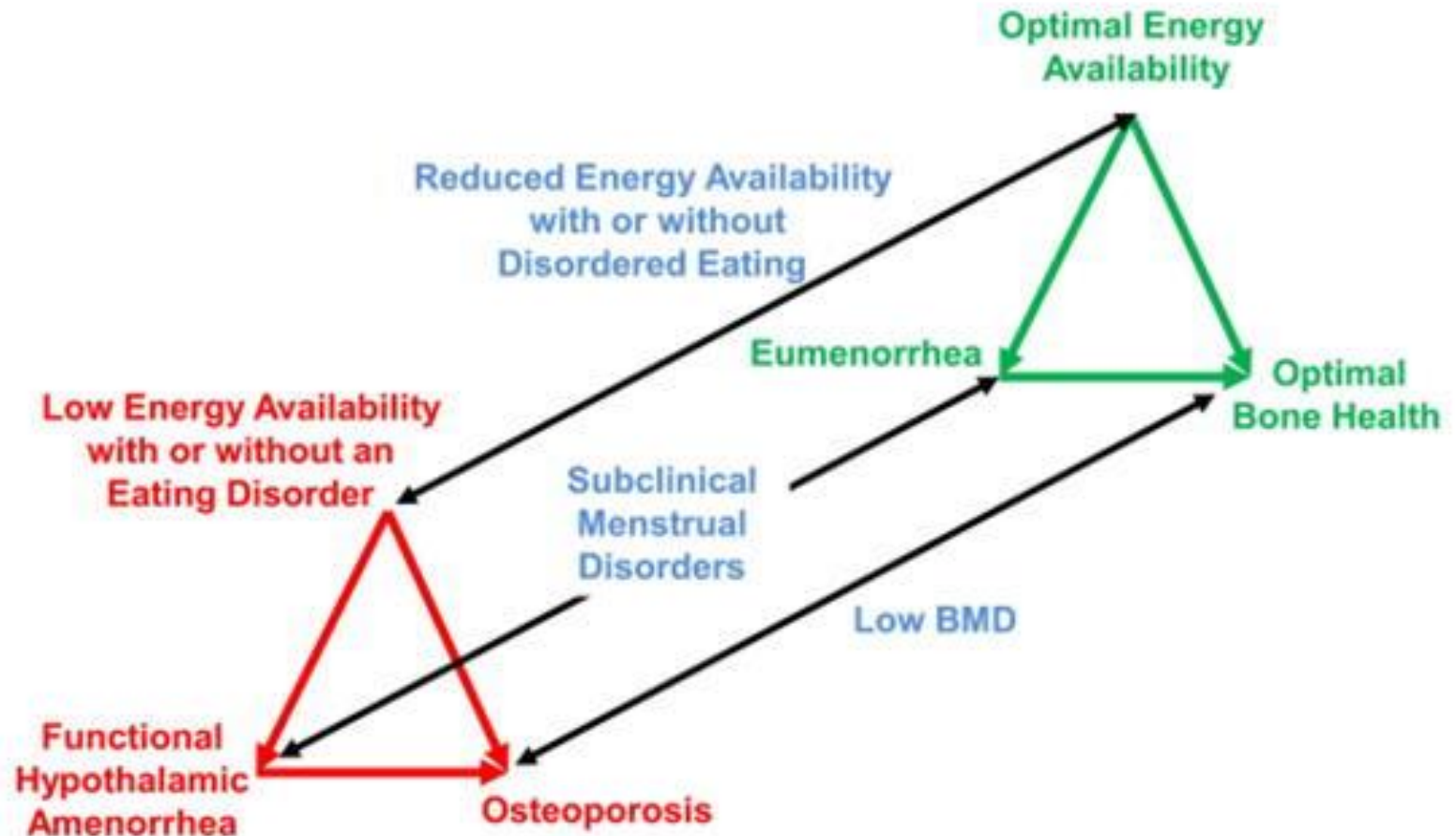


Image obtained from Stickler L, Hoogenboom 2014 female athlete triad coalition consensus statement on treatment and return to play of the female athlete triad. *Br J Sports Med.* 2014;48:289.

2014 International Olympic Committee Consensus Statement Relative Energy Deficiency in Sport (RED-S)²

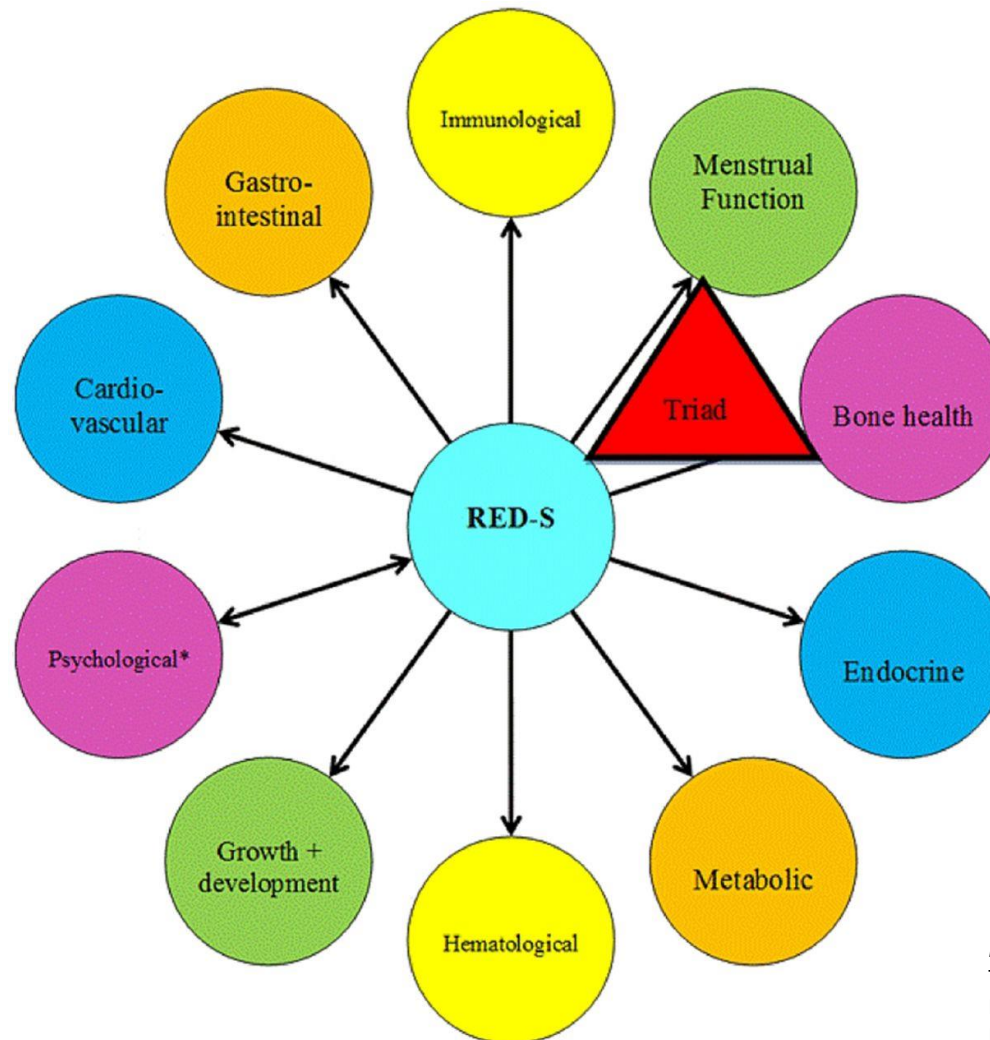


Image obtained from Mountjoy M, et al. The IOC consensus statement: beyond the Female Athlete Triad--Relative Energy Deficiency in Sport (RED-S). Br J Sports Med. 2014 Apr;48(7):491-7.

Who is at Risk?¹

- High school, college, and elite female athletes.
- More common in sports with *subjective judgment* (ice skating, gymnastics) or sports that *emphasize leanness* (running) due to their role in performance.
- A review of 65 studies found the prevalence of any one of the triad conditions in female athletes ranged from 16% to 60%.

Health Consequences of Female Athlete Triad³

Immediate:

- Increased musculoskeletal injuries (sprains, strains, tendonitis)
- Stress fractures
- Infertility
- Poor athletic performance
- Low energy availability

Long Term:

- Low bone mineral density
- Recurrent stress injuries
- Osteoporosis
- Infertility
- Chronic eating disorder or disordered eating
- Psychiatric disease

Low Energy Availability^{1,4}

- “Spectrum” from optimal energy availability (EA) to low EA, with or without an eating disorder.
- EA is the amount of energy remaining after exercise for all other metabolic processes.
- $EA = (\text{dietary energy intake}) - (\text{exercise energy expenditure})$

Positive energy balance is 45kcal/kg/day

Physiologic changes occur < 30kcal/kg/day

Low Energy Availability⁴

- Low EA is not always intentional.
- Athletes may have low EA with stable body weight.
- **Overt signs:**
 - Body Mass Index < 17.5
- **Risk factors for eating disorders:**
 - Body image dissatisfaction
 - Drive for thinness
 - Preoccupation with weight
 - Pressure from parents, coaches, peers
 - Participation in sports with aesthetic component
 - Depression or anxiety

The Menstrual Cycle as a *Vital Sign*⁵

- Evaluation of the menstrual cycle:
 - Reinforce its importance in assessing the overall health status of patients
 - May improve early identification of potential health concerns.
- **Normal menstrual cycles in adolescent girls:**
 - Menarche: 12-13 years old (98% by 15 years old)
 - Cycle interval: 21-45 days
 - Flow length: 2-7 days
 - Product use: 3-6 pads or tampons per day
 - Anovulation/immaturity: 3 years

Menstrual Dysfunction⁵

- **Amenorrhea:**
 - Primary - delayed menarche
 - Secondary - the absence of cycles for 90 days once normal menses established
 - Oligomenorrhea- irregular, 3-6 cycles/year
- The most common cause of amenorrhea in the adolescent age group is ***functional hypothalamic amenorrhea.***

Amenorrhea Differential Diagnosis⁴

- Functional hypothalamic amenorrhea
 - *Stress, exercise, and nutrition-related*
- Pregnancy
- Polycystic Ovarian Failure (PCOS)
- Thyroid disease
- Hyperprolactinemia
- Pituitary tumor
- Premature ovarian failure
- Congenital adrenal hyperplasia
- Outflow obstruction/anatomic abnormalities

Bone Loss¹

- 90% of peak bone mass is attained by age 18.
- Low EA and low estrogen alter the metabolic environment, and bone health is compromised.
- Estrogen promotes osteoblasts, which are cells that make new bone, and calcium retention.
- Estrogen deficiency leads to low bone mineral density.

Bone Loss¹

- Low EA also negatively impacts:
 - Growth hormone
 - IGF-1
 - Leptin
 - Cortisol
 - Thyroid hormone
 - Calcium
 - Vitamin D
 - Other influencers of bone health
- Bone stress injuries are more common with low EA, menstrual irregularities, and low bone mineral density.

Stress Fractures¹

- Repetitive strain leads to bone fatigue.
- In female athletes, menstrual history correlates with bone health.
- Lower extremity, pelvis, vertebrae.

Risk factors:

- Low BMI
- Disordered eating
- Excessive exercise
- Menstrual dysfunction
- Poor bone health
- Prior stress fracture

Screening for Female Athlete Triad¹

- Prevention & Education
- Primary care physicians can screen athletes during the pre-participation physical exam and routine visits
- The AAP, AAFP, and ACSM recommend 7 screening questions
 - Do you worry about your weight?
 - Do you limit the foods you eat?
 - Do you lose weight to meet the image requirements of sport?
 - Have you ever had an eating disorder?
 - How old were you when you had your first period?
 - How many menstrual cycles have you had in the past 12 months?
 - Have you ever had a stress fracture?

Evaluation of an Athlete with Female Athlete Triad

- Past medical history
- Menstrual history
- Exercise or sports history
- Nutritional assessment
- Psychological health
- Physical exam
- Consider labs and/or imaging

Diagnostic Tests

Diagnosing Low Energy Availability⁴

- Can be challenging!
- Goal BMI > 18.5 kg/m²
- Overt sign is BMI < 17.5 kg/m²
- Growth chart trends: normal BMI 5% - 85%
- Dietary logs
- # hours per week exercise
 - Should not be greater than # years old
- Energy intake (kcal) – exercise energy expenditure
- Positive energy balance 45 kcal/kg/day

Diagnostic Tests

Diagnosing Menstrual Dysfunction⁴

- *Functional Hypothalamic Amenorrhea*
- Rule out pregnancy and other causes of amenorrhea
- Tests to consider:
 - HCG, FSH, prolactin, TSH/T4
 - Testosterone, DHEAS, 17-OHP
 - CBC, CMP, ferritin
 - Pelvic or transvaginal ultrasound

Diagnostic Tests

Diagnosing Low Bone Mineral Density⁴

- *The American College of Sports Medicine recommends a DEXA scan for the following female athletes:*
 - Disordered eating or eating disorder for > 6 months
 - Oligomenorrhea or amenorrhea > 6 months
 - Stress fracture or other fracture from minimal trauma
- *ACSM defines low bone mineral density as a Z score < -1.0 in female athletes in weight-bearing sports.*
- *The International Society for Clinical Densitometry recommends low bone mineral density is a Z Score < -2.0.*
- If concerned about a stress fracture: X-Ray and MRI
- Check Vitamin D level: 25 (OH) Vit D (Goal 32-50 for athletes)

Management⁴

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

Return to Play⁴

- Multi-disciplinary team
- Individualized goals
- Risk assessment

Cleared: 0-1 points
 Provisional: 2-5 points
 Restrictions: > 6 points

Risk Factors	Magnitude of Risk		
	Low Risk = 0 points each	Moderate Risk = 1 point each	High Risk = 2 points each
<i>Low EA with or without DE/ED</i>	<input type="checkbox"/> No dietary restriction	<input type="checkbox"/> Some dietary restriction‡; current/past history of DE;	<input type="checkbox"/> Meets DSM V criteria for ED*
<i>Low BMI</i>	<input type="checkbox"/> BMI ≥ 18.5 or $\geq 90\%$ EW** or weight stable	<input type="checkbox"/> BMI $17.5 < 18.5$ or $< 90\%$ EW or 5 to $< 10\%$ weight loss/month	<input type="checkbox"/> BMI ≤ 17.5 or $< 85\%$ EW or $\geq 10\%$ weight loss/month
<i>Delayed Menarche</i>	<input type="checkbox"/> Menarche < 15 years	<input type="checkbox"/> Menarche 15 to < 16 years	<input type="checkbox"/> Menarche ≥ 16 years
<i>Oligomenorrhea and/or Amenorrhea</i>	<input type="checkbox"/> > 9 menses in 12 months*	<input type="checkbox"/> 6-9 menses in 12 months*	<input type="checkbox"/> < 6 menses in 12 months*
<i>Low BMD</i>	<input type="checkbox"/> Z-score ≥ -1.0	<input type="checkbox"/> Z-score $-1.0^{***} < -2.0$	<input type="checkbox"/> Z-score ≤ -2.0
<i>Stress Reaction/Fracture</i>	<input type="checkbox"/> None	<input type="checkbox"/> 1	<input type="checkbox"/> ≥ 2 ; ≥ 1 high risk or of trabecular bone sites†
Cumulative Risk (total each column, then add for total score)	_____ points +	_____ points +	_____ points = _____ Total Score

Table obtained from Joy E, et al. 2014 female athlete triad coalition consensus statement on treatment and return to play of the female athlete triad. *Br J Sports Med.* 2014;48:289.

Summary Points

- Low energy availability is the driving force of the female athlete triad.
- The triad is more commonly seen in athletes who partake in *lean sports* or sports with *subjective judgment*.
- Be aware that both women and men can suffer from energy deficiency, and it can affect more than the female reproductive system and skeleton.

Summary Points

- Screening for the triad is recommended during the pre-participation examination.
- Early recognition, intervention, and treatment can prevent serious health consequences of energy deficiency
 - Including amenorrhea, osteoporosis, fatigue, poor sports performance, and other comorbidities.
- Creating an energy-positive state by increasing intake and/or decreasing expenditure, will increase energy availability, normalize menses, and improve bone mineral density.

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