Female Athlete Triad
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Female Athlete Triad

• I have no disclosures. I do not have any relevant financial relationships or any commercial interests.
Female Athlete Case

- 15 year old female cross country runner
- Complains of left lateral knee pain
- 6 weeks ago gradual onset with running when her season started
- Height 5 ft., 6 in, Weight 108 lbs., BMI is 17.5
- Prior bilateral knee pain, shin splints, Achilles pain in the past
- She doesn’t know how often she gets her menses but “not every month”
Female Athlete Case

- 18 year old female cross country runner, college freshman
- Complains of left thigh pain worsening over the last 8 weeks
- Height 5’6”, Weight 100 lbs, BMI 16
- Previously diagnosed with anorexia in high school
- Menarche age 14, menses 1-2 times per year, “maybe”
- Screening serum ferritin 15.
Female Athlete Triad Overview

- Benefits of exercise
- Components of triad
- Risk factors
- Prevalence
- Treatment
- Return to play
- Level of evidence
Benefits of Exercise

- Exercise has many physical and psychological health benefits.
- Female athletes do better in school and have a higher graduation rate.
- More likely to obtain advanced degrees.
- More likely to hold leadership roles.
- Decreased high risk behavior.
  - Less likely to smoke or use drugs
  - Less teen age pregnancies
- Sports are a great way for women to build healthy bodies, positive self esteem and a lifelong love of physical activity.
Female Athlete Triad

• For some exercise becomes pathologic and detrimental to a woman’s health.

• Female athlete triad is a serious health concern that has been identified among female athletes.
Female Athlete Triad Defined

• In the 90s:
  – disordered eating
  – amenorrhea
  – osteoporosis

• 2007 and today:
  – low energy availability (with or without eating disorder)
  – menstrual dysfunction
  – altered bone mineral density
Female Athlete Triad - Risk Factors

- Triad occurs more frequently in sports emphasizing thin build (A).
  - dance, runners, rowing, gymnastics, ice skating, beach volleyball
- Menstrual irregularity and low BMD increase risk of stress fractures (A).
- Restrictive dietary intake
- Exercise excessively
- Low self esteem
- Family dysfunction
- Abuse
Female Athlete Triad- Prevalence

• Studies have shown that prevalence of all three components of the triad is small – 1% to 4%.

• Athletes with one component should be assessed for the other 2 components (C).

• You do not need all 3 components to have adverse health effects.
The Female Athlete Triad Defined
Female Athlete Triad Defined

- Energy Availability
- Disordered Eating
- Menstrual Function
- Bone Mineral Density (BMD)
Female Athlete Triad- Energy Availability

• Defined as dietary energy intake minus exercise energy expenditure

• Energy availability is the amount of dietary energy remaining for other body functions after exercise.

• **Food In – Activity Out** = “left over” energy used for physiologic function
  – 1,800 kcal for females
  – 2,200 kcal for males
Female Athlete Triad- Energy Availability

• Athletes who are not aware of nutritional needs for their body
  – Intake is inadvertently restricted
  – Intake doesn’t match expenditure
  – Inadequate education regarding energy requirements

• Eating Disorders
  – Anorexia
  – Bulimia
  – Eating disorder NOS
  – Disordered Eating
Female Athlete Triad- Eating Disorders

- Bulimia- 4-6 out of 200 females
- Anorexia-1 out of 200 females
- 95% of people with an eating disorder are 12-25 years of age (90% female)
- Anorexia- majority are Caucasian, middle-class or upper-middle class families.
- Etiology is unknown and probably multifactorial
  - Environmental influences
  - Biologic risk factors
  - Anxiety, stress
  - Control by regulating what they eat and how they look
Female Athlete Triad- Eating Disorders

- Prevalence of low energy availability with or without eating disorders is unknown
- Disordered Eating NOS
  - 28-65% prevalence of dietary restriction, binge eating and/or purging behaviors among thin-build athletes
- Eating disorders
  - 25-31% prevalence among athletes in thin-build sports
  - 5-9% in the general population
Female Athlete Triad- Anorexia Nervosa

- Restriction of energy intake relative to requirements, leading to a significantly low body weight.
- Intense fear of gaining weight or becoming fat, even though underweight.
- Disturbance in the way in which one’s body weight or shape is experienced, undue influence of body weight or shape on self evaluation, or persistent lack of recognition of the seriousness of the current low body weight.
- DSM-5- no longer requires amenorrhea
Female Athlete Triad- Anorexia Nervosa, DSM-5

- Specify whether:
  - Restrictive type
  - Binge-eating/purging type
- Specify if:
  - partial remission
  - full remission
- Specify current severity according to BMI:
  - Mild: BMI >17
  - Moderate: BMI 16-16.99
  - Severe: BMI 15-15.99
  - Extreme: BMI < 15
Female Athlete Triad
Exam Signs of Anorexia

- Amenorrhea - Hypothalamic dysfunction
- Arrhythmias - Electrolyte disorders, prolonged QT interval
- Bradycardia - Heart muscle wasting, sudden death
- Brittle hair and nails - Malnutrition
- Edema - Heart muscle wasting
- Hyperkeratosis - Malnutrition, vitamin and mineral deficiencies
- Hypotension - Malnutrition, dehydration
- Hypothermia - Thermoregulatory dysfunction, reduced fat
- Lanugo - Response to fat loss and hypothermia
- Hypothermia - Thermoregulatory dysfunction, reduced fat
- Marked weight loss - Self starvation
- Osteoporosis at a young age - Malnutrition
Female Athlete Triad- Anorexia Nervosa

- The mortality associated with anorexia has been reported to be as high as 9 percent
  - secondary to cardiac arrhythmia due to electrolyte abnormalities
  - and/or diminished heart muscle mass
- Suicide has also been more common (2 to 5%) in patients with anorexia nervosa.
Female Athlete Triad
Criteria for Bulimia Nervosa

- Recurrent episodes of binge eating- discrete time period, an amount of food definitely larger than most meals, lack of control.
- Recurrent inappropriate compensatory behaviors in order to prevent weight gain
  - Purging- self induced vomiting, misuse of laxatives, diuretics and medications
  - Non Purging- fasting, excessive exercise
- The binge eating and inappropriate compensatory behaviors both occur, on average, at least once a week for 3 months
- Self-evaluation is unduly influenced by body shape and weight
- The disturbance does not occur exclusively during episodes of Anorexia Nervosa
Female Athlete Triad
Criteria for Bulimia Nervosa, DSM-5

• Specify if:
  – partial remission
  – full remission

• Specify current severity:
  – Mild: 1-3 episodes of inappropriate compensatory behaviors per week
  – Moderate: 4-7 episodes per week
  – Severe: 8-13 episodes per week
  – Extreme: 14 or more episodes per week
# Female Athlete Triad

## Physical Exam Signs for Bulimia

<table>
<thead>
<tr>
<th>Physical Sign</th>
<th>Causes/Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental enamel erosions</td>
<td>- Recurrent vomiting,</td>
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<tr>
<td></td>
<td>- Mineral deficiencies</td>
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<tr>
<td>Edema</td>
<td>- Laxative abuse, hypoproteinuria</td>
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<tr>
<td></td>
<td>- Electrolyte imbalances</td>
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<tr>
<td>Parotid glad enlargement</td>
<td>- Gastric acid and enzymes from vomiting cause parotid inflammation</td>
</tr>
<tr>
<td>Scars/calluses on hands</td>
<td>- Self-induced vomiting</td>
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<tr>
<td>Weight fluctuations</td>
<td>- Alternating between binging and purging</td>
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</tbody>
</table>
Female Athlete Triad

Menstrual Disturbances/Amenorrhea

Bone Loss/Osteoporosis

Energy Deficit
Disordered Eating
Female Athlete Triad
Exercise Menstrual Dysfunction

• Menstrual dysfunction may be the first detectable problem
• Depending on the type of sport and competition level, the incidence varies
• Secondary Amenorrhea
  – 24% to 26% in female athletes
  – 2-5% in the general population
• Greatest incidence for sports that favor a low body weight physique
  – ballet (6-69%)
  – runners (24-65%)
Female Athlete Triad- Normal Menses
Female Athlete Triad- Menstrual Dysfunction

- Hypothalamus releases GnRH, GnRH pulse signals release of LH and FSH. LH and FSH act on ovaries to stimulate them and produce estrogen and progesterone.
- When you do not eat enough calories, hormones from the hypothalamus and pituitary will not be released.
- These hormones normally signal the ovaries to make estrogen and progesterone and menstrual cycles occur.
- Estrogen is necessary for strong bones:
  - Inhibits bone reabsorption, activates genes to protect and increase mineralization.
  - Regulates osteoclasts to prevent bone breakdown, increases calcium reabsorption from the gut, protects bone from reabsorption effects of PTH.
Female Athlete Triad
Menstrual Dysfunction Defined

- Amenorrhea- absence of menses > 3-6 months
  - Primary- delay in age of menarche
  - Secondary- occurs after onset of menarche
- Oligomenorrhea- cycles greater than 35 days
- Anovulation- absence of ovulation
- Luteal phase suppression
- Delayed menarche often occurs in athletes
- Cause of exercise induced menstrual dysfunction is due to decreased energy input
Female Athlete Triad
Work Up For Amenorrhea

1. Rule out pregnancy
2. TSH, Prolactin
3. Determine relative estrogen status with progesterone challenge test
4. + withdrawl bleeding- anovulation is dx
5. No withdrawl bleed- estrogen and progesterone challenge test
6. No withdrawl bleed- outflow tract obstruction
7. + withdrawl bleed- measure FSH and LH
8. If FSH and LH high- ovarian failure
9. Low or Normal FSH and LH and normal brain MRI (if clinically indicated)-
hypothalamic amenorrhea

Functional hypothalamic amenorrhea in Female Athlete Triad patients is a
diagnosis of exclusion (B).
Female Athlete Triad

Menstrual Disturbances/Amenorrhea

Bone Loss/Osteoporosis

Energy Deficit
Disordered Eating
Female Athlete Triad - Bone Mineral Density

- Bone is a living, dynamic tissue that is constantly remodeling
- Loaded bone remodels to become stronger
- Athletes in weight bearing sports usually have a 5-15% higher BMD than non-athletes
- Bone strength and fracture risk depend on density and quality of bone
Female Athlete Triad
Bone Mineral Density (BMD)

- BMD is measured by DEXA
  - T score
  - Z score
- Post menopausal women
  - Hip and lumbar spine measured
  - Use T scores
    - > -1 normal
    - -1 to -2.5 osteopenia
    - < - 2.5 osteoporosis
- Young athletes
  - Whole body scans
  - Use Z scores
Female Athlete Triad
Prevalence of Decreased Bone Mineral Density

• Osteopenia (T score -1 to 2.5)
  – 22-50% prevalence among female athletes
  – 12% in the general population

• Osteoporosis (T score less than -2.5)
  – 0-13% prevalence reported among female athletes
  – 2.3% in the general population

• Many studies have been using T score and not the recommended Z score

• Higher prevalence reported among athletes with disordered eating and/or amenorrhea
Female Athlete Triad
Determinants of Bone Mineral Density

- Genetics (60-80%)
- Exercise and physical activity
- Hormones
- Nutrition
- Smoking, drugs and alcohol
Female Athlete Triad - Bone Mineral Density

- Peak Bone Mass is achieved between 18-25 yrs
Female Athlete Triad
Bone Health Consequences

- After age 25 years, women lose bone mass at 0.3-0.5% annually.
- Lose approximately 2% of BMD per year of amenorrhea or oligomenorrhea instead of gaining the typical 2-4% of bone mass.
- Loss of BMD may not be reversible.
- Relative risk for stress fractures 2-4 x greater in amenorrheic than eumenorrheic athletes.
Female Athlete Triad

- Menstrual Disturbances/Amenorrhea
- Bone Loss/Osteoporosis
- Energy Deficit
- Disordered Eating
Female Athlete Triad-Treatment Team (C)

- Athlete and their Family
- Primary Care Physician
- Sports Medicine and/or Orthopedic Physician
- Sports Psychologist (Psychotherapist or Psychiatrist)
- Dietician
- School Personnel (Athletic Trainer, Coaches, Teachers)
Female Athlete Triad Screening, Diagnosis and Treatment

- Screening should occur at annual exam or pre participation exam (C).
- History - past medical/surgical, menstrual, psychological
- Exercise - exercise patterns, training intensity, additional exercise outside training, history of injuries
- Medications - anti convulsants, SSRI, Medroxyprogesterone, GnRH agonists, Aromatase inhibitors (decrease BMD, increase stress fracture risk)
Female Athlete Triad- Treatment

• Initial evaluation of patients with eating disorders requires assessing medical stability and whether hospitalization is required (C).
• In patients with eating disorders, assess for psychiatric comorbidities, including suicide risk, anxiety and substance abuse (C).
• Treatment for acute orthopedic and medical problems
Female Athlete Triad
Eating Disorder Treatment

- Blood work: electrolytes, complete blood count, ferritin, sed rate, liver function, TSH, FSH, LH.
- Urinalysis, pregnancy test
- EKG if resting heart rate is less than 50
Female Athlete Triad- Imaging Studies

• Evaluation for stress fractures
  – Plain radiographs (pain over 2 weeks)
  – 3-phase bone scan or MRI for stress fractures

• DEXA if stress fracture and 6 mo of menstrual dysfunction and disordered eating (C).
Female Athlete Triad - Treatment

- Athletes with disordered eating should be referred to mental health (C).
- Family-based treatment (the Maudsley method) is effective for treating anorexia nervosa in adolescents (B).
- Most patients with bulimia benefit from psychotherapy such as cognitive behavioral therapy and/or treatment with a SSRI (B).
- Antipsychotic medications are generally not effective in the treatment of eating disorders (B).
Female Athlete Triad- Treatment

- **CORRECT ENERGY DEFICIT!!**
- A minimum weight restoration target for patients with eating disorders is 90% of the average weight expected for the patients age, height and sex (C).
- In functional hypothalamic amenorrhea, BMD increases with weight gain more so than with OCP/HRT supplementation (C).
- Decreasing intensity of exercise and increasing nutritional intake.
  - Weight gain of 2.5 to 5 lbs
  - 10% decrease in exercise load (duration or intensity)
  - Increase BMI > 20 to restore normal menses
- Birth control pills are no longer first line treatment.
- Bisphosphonates not advised for young women.
Female Athlete Triad
Return to Play

• Can continue to play while in treatment
• Activity modifications with close monitoring
• Restrict private workouts
• Withdrawal from activity should not be used as a form of punishment for noncompliance
• Difficult cases, resumption of physical activity when the athlete is 10-15% of ideal body weight.
Case Revisited

- Left lateral knee pain- distal ITB syndrome
- She’s been told she is “too thin”
  - She has seen a gynecologist for irregular menses
  - She denies any abnormal eating behaviors
- Counseling and Education
- Physical therapy for ITB syndrome
- She gained 6 lbs in our 8 week f/u visit
Case Revisited

- Left femur stress fracture
- Aggressive multidisciplinary team treatment
- Decreased training time, careful monitoring of health status
- Counseling, education
Female Athlete Triad Summary

- Screen all female athletes
- Watch for components of the triad
- GYN- Menstrual dysfunction
- Ortho- Stress fracture
- Occurs across a spectrum
- Correcting energy deficit is key for restoring healthy body function
Female Athlete Triad Summary

- Early Intervention
- Treatment with a multidisciplinary team approach
- Comprehensive evaluation with close monitoring
- Education and Prevention
Female Athlete Triad- References


- Nutrition and Athletic Performance. MSSE; 2009. 41(3): pp 709-731


Online Resources - Female Athlete Triad

- [http://www.femaleathletetriad.org/](http://www.femaleathletetriad.org/) - International Consortium endorsed by the AMSSM, AOASM, ACSM.
- [http://www.nationaleatingdisorders.org](http://www.nationaleatingdisorders.org) - National Eating Disorders Association
Female Athlete Triad

Questions???

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