Female Athlete Triad: Update and Management

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Disclosure

- I have no actual or potential conflict of interest in relation to this program/presentation.
Objectives:

- Review and Definitions
- Prevention
- Screening
- Non-pharmacological Management
- Pharmacological Interventions
Female Athlete Triad

- One or more of the following criteria:
  - Low energy availability with or without disordered eating
  - Menstrual cycle disturbances
  - Low bone mineral density (BMD)

- Sports that emphasize leanness, demand high energy expenditure and/or an aesthetic component (cross country running, gymnastics, figure skating, etc.)

- Prevalence of one component of the Triad ranged from 16 to 60% in female athletes.
Female Athlete Triad

Figure 1

Optimal Energy Availability

Reduced Energy Availability
with or without
Disordered Eating

Optimal Bone Health

Subclinical Menstrual Disorders

Low BMD

Eumenorrhea

Low Energy Availability
with or without
an Eating Disorder

Functional Hypothalamic Amenorrhea

Osteoporosis
Relative Energy Deficiency in Sports
Relative Energy Deficiency in Sports
Menstrual Function and Bone Health
Energy Availability (EA)

- Optimal EA for healthy physiological function is achieved at 45 kcal/kg ffm
- EA < 30 kcal/kg ffm has been shown to affect the hypothalamic-pituitary axis
  - Slowing of LH pulse frequency → menstrual disturbances
  - Reduced serum glucose, T3 iodothyronine, insulin, IGF-1
  - Decreased GH and cortisol
Measurement of EA

- How practical and reliable is it?
  - No standardized or reference protocol for undertaking an EA assessment.
  - Difficult and expensive to calculate
  - Will require a lot of equipment and precision to be a stand-alone diagnostic tool
  - Best surrogate measure is a biomarker.
# Measurement of EA

<table>
<thead>
<tr>
<th>Optimal Energy Availability with healthy Eating Habits</th>
<th>Reductions in Energy Availability with or without Disordered Eating</th>
<th>Chronic Energy Deficiency with or without Eating Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eumenorheic, Ovulatory Cycles</td>
<td>Low Bone Mineral Density</td>
<td>Functional Hypothalamic Amenorrhea Osteoporosis</td>
</tr>
<tr>
<td>Optimal Bone Status</td>
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</tbody>
</table>

**CHANGES IN METABOLIC HORMONE PROFILES ACROSS THE FEMALE ATHLETE TRIAD CONTINUUM**

- **REE**
  - ↓ REE
- **Total T₃**
  - ↓ Total T₃
- **Ghrelin**
  - ↓ Ghrelin
- **PYY**
  - ↓ PYY
- **Leptin**
  - ↓ Leptin
- **IGF-1**
  - ↓ IGF-1
- **Cortisol**
  - ↑ Cortisol

**CHANGES IN REPRODUCTIVE HORMONE PROFILES ACROSS THE FEMALE ATHLETE TRIAD CONTINUUM**

- **LH Pulsatility**
  - ↓ LH Pulsatility
- **FSH**
  - ↓ FSH
- **Estrogen**
  - ↓ Estrogen
- **Progesterone**
  - ↓ Progesterone

**CHANGES IN BMD AND BONE MARKERS ACROSS THE FEMALE ATHLETE TRIAD CONTINUUM**

- **Z-score ≥ -1.0**
  - ↓ P1NP
  - ↓ NTx
  - ↓ CTX
- **Z-score -1.0 to -2.0**
  - ↓ P1NP
  - ↓ NTx
  - ↓ CTX
- **Z-score ≤ -2.0**
  - ↓↓ P1NP
  - ↓↓ NTx
  - ↓↓ CTX
Objectives:

- Review and Definitions
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Prevention of Female Athlete Triad requires increased awareness

  - 33.3% of 103 adolescent female track athletes reported menstrual irregularity.
  - High mileage athletes and runners with greater tenure corresponded with more awareness.
  - Higher awareness levels associated with menstrual regularity.
Prevention of Female Athlete Triad requires increased awareness

- Pantano, K, “Current Knowledge, Perceptions and Interventions Used By Collegiate Coaches” (2006)
  - 64% of 91 NCAA D1 coaches have “heard about the triad”.
  - 43% were able to identify the three components of the triad.
  - College coaches with a high degree of knowledge had a statistically significant difference in their attitudes and skills.
  - Knowledge about the triad has no correlation with gender of the coach or years of experience.
Prevention of Female Athlete Triad requires increased awareness

  - 28.4% of the 370 nurses had heard of the triad
  - 13.8% were able to identify the 3 components
  - 44.5% thought amenorrhea is not normal and requires a medical referral
  - 40.8% thought amenorrhea was normal but should be reassessed every 3-6 months
  - 10.8% of responders’ schools had policies in place to deal with disordered eating, 0.9% with menstrual irregularity and 4.3% with repeated stress fractures
Prevention of Female Athlete Triad requires increased awareness

  - 37% of the responding primary care physicians have heard of the Triad
  - 51% reported feeling comfortable treating or referring a patient with the Triad
  - 32% of attendings, 46% of fellows and 44% of resident physicians have heard of the Triad.
  - Residents and fellows were significantly better at identifying the components of the Triad.
  - Awareness rates were highest among orthopedists, ob/gyn and PM&R physicians
Objectives:

- Review and Definitions
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Screening for Female Athlete Triad

- Female Athlete Coalition Consensus Statement (2014)
  - Disordered eating
  - Clinical eating disorder
  - Intentional weight loss without disordered eating
  - Inadvertent undereating
Screening for Female Athlete Triad

- Several disordered eating/eating disorder screening tools for the general population
  - Eating Disorder Inventory-3
  - SCOFF
    - ≥2 positive answers
    - Sensitivity 84.6%-100%
    - Specificity 87.5%-89.6%

<table>
<thead>
<tr>
<th>S</th>
<th>Do you make yourself SICK (vomit) because you feel uncomfortably full?</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Do you worry that you have lost CONTROL over how much you eat?</td>
</tr>
<tr>
<td>O</td>
<td>Have you recently lost more than ONE stone (15 pounds) in a 3-month period?</td>
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<tr>
<td>F</td>
<td>Do you believe yourself to be FAT when others say you are thin?</td>
</tr>
<tr>
<td>F</td>
<td>Would you say that FOOD dominates your life?</td>
</tr>
</tbody>
</table>
Screening for Female Athlete Triad

- Validated screening tools for the detection of disordered eating behavior in athletes
  - Athletic Milieu Direct Questionnaire (AMdq)
  - Female Athlete Screening Tool (FAST)
  - American Physiological Screening Test for eating disorders among Female College Athletes.
Screening for Female Athlete Triad

- Low Energy Availability in Females Questionnaire (LEAF-Q)
  - Screening tool based on self-reported physiological symptoms
  - Self-reported physiological symptoms linked to persistent energy deficiency, with or without DE/ED
Screening for Female Athlete Triad

- Plateau, C. et al., “Female Athlete Experiences of Seeking and Receiving Treatment for an Eating Disorder”
  - 13 in-person interviews - preliminary study
  - Challenges to treatment include lack of eating disorder literacy among athletes and coaches
  - Feeling out of place
  - Coping with exercise transitions
Screening for Female Athlete Triad

- In-depth personal interview must be performed to make the diagnosis.
- Prevalence of energy deficiency is high without the presence of disordered eating.
- Coaches have difficulty identifying disordered eating and convincing athletes to seek treatment.
Objectives:
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Non-Pharmacological Management

- If low energy availability is due to unintentional under eating, nutritional education may suffice (eg, sports dietician).
- Increased food intake.
- Changes in food choices.
- Individualized changes based on athlete’s energy expenditure and exercise goals.
- May need reduction or cessation of exercise.
- Achieve level of 25-hydroxy vitamin D > 30 ng/mL
- Adequate consumption of Calcium
- Cognitive behavioral therapy
- Non-compliance with therapy may lead to removal of athlete from competition/training
Non-Pharmacological Management

Relative Energy Deficiency in Sport (RED-S) Treatment Contract

RED-S Treatment Contract for ____________________________

Multidisciplinary Team:
- (Physician) __________________________________________________________________________
- (Psychologist/Psychiatrist) _______________________________________________________________
- (Exercise physiologist) __________________________________________________________________
- (Dietitian) ____________________________________________________________________________
- (Other) _______________________________________________________________________________

Requirements
Meet with:
- The psychotherapist at intervals recommended by the health professional treatment team
- The dietitian at intervals recommended by the health professional treatment team
- The physician at intervals recommended by the health professional treatment team
- Follow the diet plan developed by the health professional treatment team
- Follow the adapted training plan developed by the health professional treatment team
- If underweight, weight gain expected to be __________ kg per week / weight stable within week ________
- If underweight, must achieve minimal acceptable body weight/ fat of _______________ kg/percent by ____________
- Regular weigh-in at the following time intervals of __________ week(s)
- After this date, ____________ (dd/mm/yyyy), must maintain weight and % fat at or above minimal acceptable body weight/fat mass of ____________ (kg/ %)
- Other ________________________________________________________________________________

If ALL requirements are met and the eating behavior (and other severe conditions) are normalized the Team Physician will decide if cleared for competition.

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

Athlete Name __________________________________________________________________________
Athlete Signature ____________________________ Date ____________
Team Physician Name _____________________________________________________________________
Team Physician Signature ____________________________ Date ____________

- 19 yo female with 11 months of amenorrhea.
- Menses resumed after 2.5 months of increased daily dietary intake by 500 kcal.
- Menses continued to be irregular for several cycles.
- Estrogen levels increased 64.3% compared to baseline.
- No increase in BMD in 12 months but there was an increase by 49.6% in P1NP, a marker of bone formation.

- 756 army recruits
- Median serum 25(OH)D of recruits with stress fractures was significantly lower than in the group without stress fracture.
- Recruits with serum concentration of 25(OH)D < 30 ng/mL had a significantly higher number of stress fractures.
Non-Pharmacological Management

- Michopoulos, V., “Neuroendocrine recovery initiated by cognitive behavioral therapy in women with functional hypothalamic amenorrhea: a randomized controlled trial” (2013).
  - Sample of 8 women in CBT.
  - 87.5% exhibited a decrease in cortisol levels vs 33% in control arm (9 women).
  - 75% of women in CBT resumed ovulation vs. 33% in the control arm.
  - BMI was not affected by CBT
  - Leptin levels were increased in women who underwent CBT, whereas leptin remained constant in women in the control arm
  - TSH levels in women who underwent CBT increased, but did not change in women in the control arm
## Future of Non-Pharmacological Management

### Changes in Metabolic Hormone Profiles Across the Female Athlete Triad Continuum

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<th>Pediatrics</th>
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<th>Adults</th>
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<td>REE</td>
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<td>Cortisol</td>
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### Changes in Reproductive Hormone Profiles Across the Female Athlete Triad Continuum

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</tr>
<tr>
<td>Progesterone</td>
<td>↓</td>
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### Changes in BMD and Bone Markers Across the Female Athlete Triad Continuum

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Objectives:

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Pharmacological Interventions

- Daily calcium (1,200-1,500 mg) and vitamin D (400-800 IU) will assist the bone with building materials.
- Combined oral contraceptives are NOT recommended for regaining menses or improving bone mineral density.
- Transdermal oestradiol (E2) therapy with cyclic oral progestin
  - Short-term use
  - If not responding to non-pharmacological management
- Recombinant parathyroid hormone 1–34 (rPTH)
  - Short-term use in setting of delayed fracture healing or very low bone mineral density
  - Contraindicated in adolescents with open growth plates
Pharmacological Interventions

  - Included 6 observational studies examining OCPs effect on risk of fracture in women.
  - Overall, no relationship between OCPs and risk of fracture.
  - One cohort study reported OC had increased risk for all fractures.
  - Another case-control study reported increased risk only for those who had 10 or more prescriptions.
  - Two other studies found little evidence of association between OC use and fracture risk.
Pharmacological Interventions

  - 121 young oligo-amenorrhoeic female athletes.
  - Compared transdermal birth control vs. OCP vs. no intervention over 12 months.
  - Transdermal estradiol plus cyclic oral progesterone showed improvement in bone mineral density over the OCPs and arm with no intervention
  - IGF-1 and P1NP decreased during the study in OCP compared with transdermal arm.
  - Great adjunct in treatment
Pharmacological Interventions

  - 21 adult women with anorexia nervosa received PTH for 6 months
  - Spine bone mineral density increased significantly with PTH (6-10% increase)
  - No changes in BMD of the hip and femoral neck
  - Serum P1NP increased after 3 months of PTH and remained the same at 6 months
  - IGF-1 levels were unchanged
  - PTH is a great adjunct in treatment
Treatment Strategies

- Multidisciplinary team approach
  - Physicians
  - Athletic trainers
  - Coaches
  - Sports dieticians
  - Mental health support

- Inpatient treatment for patients with
  - Bradycardia
  - Hypotension
  - Orthostasis
  - Electrolyte imbalance
Treatment Strategies

- Resistance to treatment increases with severity of problem
- Patients see disorders as purposeful and necessary
- Use sport participation as leverage
- Concurrent depression, anxiety and substance abuse has to be addressed
- Athletes with severe eating disorders, participation in competition is not recommended
References


