The Female Athlete Triad
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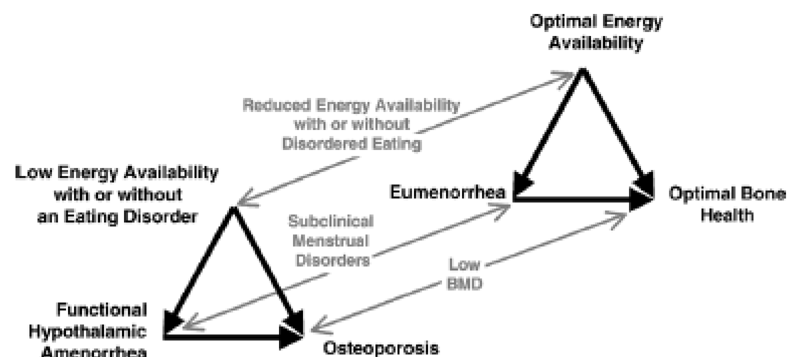
What is the female athlete triad?
The female athlete triad is described as an association of disordered eating, amenorrhea and osteoporosis observed in women participating in activities that emphasize leanness. Disordered eating is a clinical mental disorder defined by *The American Psychiatric Association*. It is characterized by abnormal eating behaviors, an irrational fear of gaining weight, and false beliefs about eating, weight and shape. **Disordered eating behaviors** include restrictive eating, fasting, frequently skipped meals, diet pills, laxatives, diuretics, enemas, overeating, binge-eating and then purging (vomiting). **Osteoporosis** is defined as a skeletal disorder characterized by compromised bone strength predisposing a person to an increased risk of fracture. Screening and diagnoses of osteoporosis is based on bone mineral density. **Amenorrhea** is defined as the absence of the menstrual cycle for more than 90 days.

How prevalent is the female athlete triad?
Few data exist concerning the incidence of full-blown female athlete triad. One study reported the incidence among high school athletes representing 8 sports in the Unites States. Of 170 athletes, 2 girls (1.2%) met the criteria for all 3 components of the triad. Another study investigated the female athlete triad in Norwegian elite athletes and controls. Among 186 athletes representing the national teams at junior and senior levels, 8 (4.3%) met the criteria for the female athlete triad, while 5 out of 145 (3.4%) controls met the same criteria. Six of the 8 athletes who met the criteria participated in leanness sports.

The results from the above studies indicate that the triad is not any more prevalent than it is among the non-athlete population and that the overall prevalence is relatively low. However, when you consider each of the 3 components on a spectrum (see figure below), there is likely a much greater prevalence of female athletes who meet the criteria for 1 or 2 of the components but not all 3, and many more may have some degree of bone loss, menstrual dysfunction and/or suboptimal energy availability.



An athlete may not meet the specific criteria for the female athlete triad, but could experience suboptimal bone health, energy availability and/or subclinical menstrual disorder. Along this spectrum an athlete is at greater risk of developing the female athlete triad. (diagram is from the American College of Sports Medicine's position stand: The female athlete triad. Med. Sci. Sports Exerc. 39, 2007.

Who is at risk of the female athlete triad?
The causes of athletic menstrual dysfunction are primarily negative energy balance, excessive exercise intensity or a combination of the two. Amenorrheic athletes tend to have greater negative energy balance than active controls and there is evidence that reversing negative energy balance can restore normal menstrual functioning. Some athletes are at greater risk of low energy availability and these are athletes who restrict dietary intake, exercise for prolonged periods, are vegetarian, or who limit the types of food consumed. Dieting is a common precursor for eating disorders, but several other factors can contribute to the risk including social and environmental factors, psychological predisposition, low self-esteem, family dysfunction, abuse, biological factors and genetics. Athletes who begin sport-specific training or dieting at an early age, have had injuries or who suddenly increase training volume are also at greater risk of an eating disorder. Athletes participating in sports that favor leanness show more negative eating attitude scores and disordered eating behaviors.

What are the health risks associated with the female athlete triad?
Health consequences from athletic menstrual dysfunction include poor nutritional status, infertility, risk of developing an eating disorder and poor bone health. Those athletes with inadequate energy intake and menstrual dysfunction more often complain of fatigue, frequent injuries, longer recovery time from injury, inability to concentrate, irritability and poor performance. These outcomes can lead to increased psychological stress which can further exacerbate the problems and lead to depression, obsession with food and body weight, increased incidence of binge-purge eating behaviors and risk of an eating disorder. The risk of stress fractures is higher and is associated with low bone mineral density, menstrual disturbances and insufficient dietary intake.

How is the female athlete triad prevented and treated?
Professionals working with athletes should be aware of the signs and symptoms for the female athlete triad and provide athletes information regarding the prevention of the triad (see table below). Prevention of the female athlete triad is through education, with emphasis placed on the optimization of energy availability and nutritional status. Women with menstrual dysfunctions or with low energy availability with or without an eating disorder should be made aware of the risk of bone mass loss, osteoporosis and stress fractures.

The treatment goal for disordered eating is to optimize nutritional status, normalize eating behaviors, modify unhealthy thought processes that maintain the disorder and treat possible emotional issues that may likely be the impetus for the disorder. Treatment requires a multi-disciplinary health care approach that may include a physician, nutritionist, and a mental health professional. Before treatment can begin, an eating disorder must be recognized and it is typically the professionals that work closely with athletes on a regular basis who will most likely pick up on the signs or symptoms, thus initiating the pre-treatment process. The younger the athlete is, the more involved the family should be in this process. Quite often, treatment may include family therapy.

Bone mineral density has been shown to increase with an increase in body weight among amenorrheic and anorexic athletes. Thus, to restore normal menstrual function and bone mass, the first line of treatment should include diet modification and changes in exercise behavior to increase energy availability either through an increase in energy intake, decrease in energy expenditure or a combination of the two. To restore menstrual cycles and bone mass, energy availability may need to increase well above 1000 calories per day. It is important that an athlete understand that an increase in body weight is a necessary step for increasing bone mass. Supplements for vitamin D, calcium and vitamin K, all important to bone health may be necessary as well.

Psychological and behavioral characteristics in an athlete with an eating disorder. These symptoms should also be recognized as subclinical precursors to a full blown eating disorder (from the National Athletic Trainers' Association position statement: Preventing, detecting, and managing disordered eating in athletes. *J. Athl. Train.* 43: 80-108, 2008).

Dieting (unnecessary for health, sports performance, or appearance)
Self-critical; especially concerning body weight, size and shape in addition to performance
Avoidance of eating and eating situations
Secretive eating
Ritualistic eating patterns
Claims of "feeling fat" despite being thin[b]
Resistance to weight gain or maintenance recommended by medical providers
Unusual weighing behavior (ie, excessive weighing, refusal to weigh for health or safety reasons, negative reaction to being weighed)
Compulsiveness and rigidity, especially regarding eating and exercising
Excessive or obligatory exercise beyond that recommended for training or performance
Exercising while injured despite medically prescribed activity restrictions
Restlessness; relaxing is difficult or impossible
Change in behavior from open, positive, and social to suspicious, untruthful, and sad
Social withdrawal
Depression and insomnia
Binge eating[c]
Agitation when binging is interrupted[c]
Evidence of vomiting unrelated to illness[c]
Excessive use of the restroom or "disappearing" after eating[c]
Use of laxatives or diuretics (or both) that is unsanctioned by medical providers[c]
Substance abuse, whether legal, illegal, prescribed, or over-the-counter drugs, medications, or other substances[c]

Nutritionally speaking, what is optimal for a female athlete?
Energy availability is important to the female athlete because of the health consequences associated with menstrual dysfunction and low bone mass. Additionally, maintaining energy balance will provide an adequate means to obtain the dietary requirements for each of the energy nutrients, vitamins and minerals. The RDA for average energy intake among healthy women who are slightly to moderately active and between the ages 18 and 50 yrs is about 2200 calories. A female endurance athlete can exceed this average requirement by several hundred calories. For instance, a 120-lb marathon runner can expend about 700 Calories 1 hour of training. Thus, her daily intake requirements could easily approach and go beyond 3000 calories

Daily carbohydrate intake, particularly for the endurance athlete should be 3-5 grams for every pound of body weight, on the higher end during periods of carbohydrate loading. For a 120-lb athlete, this would require a total of 360 to 600 grams of carbohydrate. In order to meet these requirements, it is essential that the athlete be in energy balance. Protein requirements for both endurance and strength trained athletes are higher than non-athletes. There is no reason to believe that the protein requirement for a female athlete is different from a male athlete, particularly if energy balance is achieved. It is recommended that the female endurance athlete consume .5 to .6 grams of protein for every pound of body weight. This is approximately 60 to 72 grams for a 120-lb athlete. For strength training, the requirements are slightly higher, about .75-.80 grams.

Calcium and vitamin D are especially important for bone health. Exercise can increase the loss of calcium through sweating, thus the RDA for calcium is likely to be higher for female athletes than mildly active women. Iron status in female athletes may be negatively affected. Thus, the female athlete should pay particular attention to her iron intake to ensure she is meeting the RDA. Supplementation may be warranted under certain circumstances such as low energy availability, pregnancy, menopause, or a risk of low bone mass. Otherwise, if the athlete is getting adequate energy in her diet, vitamin or mineral supplementation is likely not necessary.

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