

Female Athlete Triad

Kayla Daniel, MD, FAAP, Nationwide Children's Hospital

What is the Female Athlete Triad?

The Female Athlete Triad (FAT), as defined by the American College of Sports Medicine, is a medical condition in female athletes involving any one of three components: (1) Low Energy Availability (EA) with or without disordered eating, (2) Menstrual Dysfunction and (3) Low Bone Mineral Density (BMD). The prevalence of the FAT varies amongst high school, college, and professional athletes. Of note, 78% of high school athletes have at least one component of the triad. The most recent model of the triad is portrayed on a spectrum to highlight the importance of recognizing subclinical abnormalities and encouraging early intervention to avoid serious pathologic endpoints.

Low Energy Availability with or without Disordered Eating

EA is defined as the amount of dietary energy remaining after exercise for all other physiological functions. Low EA is often the consequence of lack of knowledge of proper nutrition, insufficient appetite for caloric needs, disordered eating, and not making time to appropriately fuel the body. Effects of low EA include disruption of the hypothalamic-pituitary-gonadal axis, alterations in thyroid function, changes in appetite regulation, decrease in insulin and IGF-1, increase in growth hormone resistance, lowered resting metabolic rate, endothelial dysfunction, lower IgA, increased susceptibility to URI and GI illnesses, and an overall negative impact on performance. Disordered eating is categorized into Anorexia nervosa, Bulimia nervosa or Disordered Eating NOS, which can have serious fluid and electrolyte disturbances leading to severe dehydration, acid-base issues, arrhythmias, and death.

Menstrual Dysfunction

Menstrual Dysfunction is defined as primary amenorrhea, secondary amenorrhea, or oligomenorrhea. Primary amenorrhea is delayed menarche until the age of 14 without the development of secondary sexual characteristics, or delayed menarche until age 15. Secondary Amenorrhea is the absence of menstruation for 3 consecutive months with previously regular cycles or the absence of menstruation for 6-12 months if previously oligomenorrheic. Oligomenorrhea is menstrual cycles occurring greater than 35 days apart. For athletes on hormonal contraceptives, these symptoms are under recognized and underreported. Consequences of menstrual dysfunction include decreased peak bone mass, increased risk of musculoskeletal injuries, increased injury recovery time, increased risk of stress fractures, endothelial dysfunction, and negative effects on fertility.

Low Bone Mineral Density

Low BMD is defined by the American College of Sports Medicine as a Z score less than or equal to -1.0 with a history of nutritional deficiencies, hypoestrogenism, and/or stress fracture. Alterations in BMD are diagnosed with DEXA scan, specifically looking at lumbar spine and total body minus head values in adolescents. Up to 60% of BMD is acquired during adolescence and peaks at the end of the second decade. Chronic hypoestrogenism, in the context of predicted menstrual dysfunction, is well-studied and has been accepted as the major cause of bone loss in adult women. Bone loss can also be a result of a chronic hypometabolic energy deficient state leading to a decrease in markers of bone formation and an increase in markers of bone resorption. The major consequences of low BMD are higher rates of stress injuries, fractures, and traumatic fractures.

Screening and Diagnosis

Early detection of at-risk athletes is essential to prevent consequences of the FAT. Screening for the FAT should occur during Pre-Participation Physical Exams (PPEs), well child visits, annual gynecologic exams, and applicable acute care visits. It is essential to screen for other components of the triad when one component is identified. Screening questions currently used on the PPE are shown below. Further evaluation and diagnosis of components of the FAT is best completed with a multidisciplinary team.

PPE questions from the OHSAA form 2020-2021

- 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?

Treatment Strategies

The goal in treating the spectrum of the FAT is to increase energy availability by increasing energy intake and/or decreasing energy expenditure. Energy availability can be recovered after days of increased energy intake/decreased energy expenditure, ultimately leading to appropriate weight gain. Recovery of menstrual function usually takes a couple months of consistently increased energy intake/decreased energy expenditure. Recovery of BMD may take years after recovery of menstrual status and energy availability has been achieved and maintained. At this time there is no evidence to unequivocally recommend pharmacologic therapy in athletes with FAT.

Return to Play

Currently there are no standardized guidelines for clearance and return to play for athletes with FAT. Ultimately this process includes a comprehensive evaluation of health status, participation risk, and unique decision modifiers.