

## Female athlete triad: Early recognition, intervention important

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The female athlete triad originally was considered an interrelationship of disordered eating, amenorrhea and osteoporosis. Our understanding has evolved to recognize that each of the components — now defined as energy availability (EA), menstrual function and bone health — exists on a spectrum from optimal health to disease. Athletes affected by the triad also may have risk factors for cardiovascular disease, and they may present with disease in one or any combination of the components.

Updated guidance on diagnosis and treatment of the triad conditions can be found in the new AAP clinical report *The Female Athlete Triad*, available at <http://dx.doi.org/10.1542/peds.2016-0922>. The report from the Council on Sports Medicine and Fitness will be published in the August issue of *Pediatrics*.

### Components of the triad

When exercise occurs without adequate compensation for exercise-related energy expenditure, adverse effects on reproductive, bone and cardiovascular health may occur.

EA is defined as daily dietary energy intake minus daily exercise energy expenditure corrected for fat-free mass (FFM). Optimal EA, where reproductive, bone and cardiovascular health are well-maintained, has been identified as 45 kilocalories per kilogram (kcal/kg) FFM per day in adults but may be higher in adolescents who are growing.

For many athletes affected by the triad, low EA is unintentional, and pathological eating behaviors are not present. An EA of less than 30 kcal/kg FFM per day has been associated with disruptions in menstrual function and bone mineralization.

The spectrum of menstrual disturbances related to the triad ranges from anovulation and luteal dysfunction to oligomenorrhea and amenorrhea (primary or secondary). As anovulation and luteal phase deficiency often are asymptomatic, they may be difficult to identify on history alone. After excluding other causes of amenorrhea, amenorrhea in the setting of low EA is defined as functional hypothalamic amenorrhea, indicating a suppression, attributable to lack of energy, of an otherwise intact reproductive endocrine axis.

Amenorrheic adolescent athletes have significantly lower bone mineral density (BMD) than eumenorrheic athletes and sedentary controls and may be up to three times more likely to sustain bone stress and other musculoskeletal injuries than eumenorrheic athletes.



The female athlete triad now is defined as energy availability (EA), menstrual function and bone health. The decreased rate of bone acquisition that can be associated with the triad in adolescent athletes is of particular concern since bone mass gains during childhood and adolescence are critical for the attainment of maximal peak bone mass and the prevention of osteoporosis in adulthood. By the end of adolescence, almost 90% of adult bone mass has been obtained. Genetics, participation in weight-bearing activities and diet all influence bone mass in children.

With improved EA and resumption of menses, some “catch-up” bone mass accrual may be possible in athletes with the triad, highlighting the importance of early recognition and intervention.

Adverse effects on endothelial function, total cholesterol levels and low-density lipoprotein levels have been identified in athletes with oligo- and amenorrhea, raising concerns that athletes with the triad could be at risk for developing cardiovascular disease. Endothelial dysfunction has been correlated with low BMD and low estrogen levels.

### **Guidance on screening, treatment**

Screening can be performed during the preparticipation evaluation (PPE) using the AAP-endorsed monograph, which contains eight questions for the triad (see sidebar, Resources). A complete nutritional, menstrual, fracture and exercise history should be obtained in athletes answering positively to any of the screening questions.

Physical examination often is normal but may reveal bradycardia, orthostatic hypotension, low body weight/body mass index (BMI) or signs of an eating disorder (cold/discolored hands and feet, hypercarotenemia, lanugo and parotid gland enlargement).

Laboratory assessment is aimed at evaluating for other causes of oligomenorrhea/amenorrhea and to identify metabolic disturbances associated with eating disorder. BMD testing by dual energy absorptiometry is indicated in athletes with eating disorder, low body weight/BMI, recent weight loss of 10% or more, menstrual dysfunction or low EA for six months or longer, and/or history of stress fracture.

Improving EA is the cornerstone of treatment of the triad disorders and has been associated with the return of normal menses and improvements in BMD.

Involvement of a multidisciplinary team that may include a physician, dietitian, certified athletic trainer, behavioral health clinician and, at times, an exercise physiologist is suggested. The goal is to improve EA to more than 45 kcal/kg FFM per day. If measurements of FFM cannot be made, a return to a body weight associated with normal menses or weight greater than 85% expected with a minimum daily energy intake of 2,000 kcal can be the goal.

Oral contraceptive pills and other forms of oral estrogen replacement have produced mixed results on BMD and can obscure the goal of returning menses to normal. Optimizing calcium and vitamin D to the AAP-recommended intake of 1,300 mg calcium and 600 IU vitamin D per day is important. Bisphosphonates, often used in postmenopausal osteoporosis, are not recommended for use in females of childbearing age.

### **Triad screening questions**

- Do you worry about your weight?
- Do you limit or carefully control the foods that you eat?
- Are you trying to lose/gain weight?
- Have you ever had an eating disorder?
- What age was your first menstrual period?
- Do you have monthly menstrual cycles?
- How many menstrual cycles have you had in the last year?
- Have you ever had a stress fracture?

*Dr. Weiss Kelly, a member of the AAP Council on Sports Medicine and Fitness Executive Committee, is a lead author of the clinical report.*

### **Resources**

- [Preparticipation Physical Evaluation, 4th edition](#)
- [Female Athlete Triad Coalition](#)

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