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The Female Athlete Triad

JULIE A. HOBART, M.D., and
DOUGLAS R. SMUCKER, M.D., M.P.H.
University of Cincinnati College of Medicine,
Cincinnati, Ohio

[▶ A patient information
handout on the female
athlete triad, written by
the authors of this article,
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The female athlete triad is defined as the combination of disordered eating, amenorrhea and osteoporosis. This disorder often goes unrecognized. The consequences of lost bone mineral density can be devastating for the female athlete. Premature osteoporotic fractures can occur, and lost bone mineral density may never be regained. Early recognition of the female athlete triad can be accomplished by the family physician through risk factor assessment and screening questions. Instituting an appropriate diet and moderating the frequency of exercise may result in the natural return of menses. Hormone replacement therapy should be considered early to prevent the loss of bone density. A collaborative effort among coaches, athletic trainers, parents, athletes and physicians is optimal for the recognition and prevention of the triad. Increased education of parents, coaches and athletes in the health risks of the female athlete triad can prevent a potentially life-threatening illness. (Am Fam Physician 2000;61:3357-64,3367.)

According to Title IX of the Educational Assistance Act, any college that accepts federal funding must provide equal opportunities for women and men to participate in athletic programs. Last year marked the 25th anniversary of the passage of Title IX legislation, which dramatically increased the number of women who participate in sports at all competitive levels. Increased participation in exercise can result in a myriad of proven short- and long-term benefits. However, potential adverse health consequences are associated specifically with the overzealous female athlete. The family physician, who may recognize pathologic conditions that are related to exercise, usually has multiple opportunities to intervene.

Definitions and Prevalence

The female athlete triad is a combination of three interrelated conditions that are associated with athletic training: disordered eating, amenorrhea and osteoporosis. Patients with disordered eating may engage in a wide range of harmful behaviors, from food restriction to bingeing and purging, to lose weight or maintain a thin physique. Many athletes do not meet the strict criteria for anorexia nervosa or bulimia nervosa that are listed in the *Diagnostic and Statistical Manual of Mental Disorders*, 4th ed. (Table 1), but will manifest similar disordered eating behaviors as part of the triad syndrome.¹

TABLE 1
Criteria for Eating Disorders

Anorexia nervosa

- A. Refusal to maintain body weight at or above a minimally normal weight for age and height (e.g., weight loss leading to maintenance of body weight less than 85 percent of that expected; or failure to make expected weight gain during period of growth, leading to body weight less than 85 percent of that expected).
- B. Intense fear of gaining weight or becoming fat, even though underweight.
- C. 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 denial of the seriousness of the current low body weight.
- D. In postmenarcheal females, amenorrhea, i.e., the absence of at least three consecutive menstrual cycles. (A woman is considered to have amenorrhea if her periods occur only following hormone, e.g., estrogen, administration.)

Specify type:

Restricting type: during the current episode of anorexia nervosa, the person has not regularly engaged in binge-eating or purging behavior (i.e., self-induced vomiting or the misuse of laxatives, diuretics or enemas)

Binge-eating/purging type: during the current episode of anorexia nervosa, the person has regularly engaged in binge-eating or purging behavior (i.e., self-induced vomiting or the misuse of laxatives, diuretics or enemas)

Bulimia nervosa

- A. Recurrent episodes of binge eating. An episode of binge eating is characterized by both of the following:
 1. Eating, in a discrete period of time (e.g., within any 2-hour period), an amount of food that is definitely larger than most people would eat during a similar period of time and under similar circumstances
 2. A sense of lack of control over eating during the episode (e.g., a feeling that one cannot stop eating or control what or how much one is eating)
- B. Recurrent inappropriate compensatory behavior in order to prevent weight gain, such as self-induced vomiting; misuse of laxatives, diuretics, enemas or other medications; fasting; or excessive exercise.
- C. The binge eating and inappropriate compensatory behaviors both occur, on average, at least twice a week for three months.
- D. Self-evaluation is unduly influenced by body shape and weight.
- E. The disturbance does not occur exclusively during episodes of anorexia

nervosa.

Specify type:

Purging type: during the current episode of bulimia nervosa, the person has regularly engaged in self-induced vomiting or the misuse of laxatives, diuretics or enemas

Nonpurging type: during the current episode of bulimia nervosa, the person has used other inappropriate compensatory behaviors, such as fasting or excessive exercise, but has not regularly engaged in self-induced vomiting or the misuse of laxatives, diuretics or enemas

Eating disorder not otherwise specified

The eating disorder not otherwise specified category is for disorders of eating that do not meet the criteria for any specific eating disorder.

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Amenorrhea that is related to athletic training and weight fluctuation is caused by changes in the hypothalamus. These changes result in decreased levels of estrogen. Amenorrhea in the female athlete triad may be classified as primary or secondary. In patients with primary amenorrhea, there is no spontaneous uterine bleeding in the following situations: (1) by the age of 14 years without the development of secondary sexual characteristics, or (2) by the age of 16 years with otherwise normal development. Secondary amenorrhea is defined as the six-month absence of menstrual bleeding in a woman with primary regular menses or a 12-month absence with previous oligomenorrhea.

Osteoporosis is defined as the loss of bone mineral density and the inadequate formation of bone, which can lead to increased bone fragility and risk of fracture. Premature osteoporosis puts the athlete at risk for stress fractures as well as more devastating fractures of the hip or vertebral column. The morbidity associated with osteoporosis is significant, and lost bone density may be irreplaceable.

Although the exact prevalence of the female athlete triad is unknown, studies have reported disordered eating behavior in 15 to 62 percent of female college athletes. Amenorrhea occurs in 3.4 to 66 percent of female athletes, compared with only 2 to 5 percent of women in the general population.²⁻⁷ Some components of the female athlete triad are often undetected because of the secretive nature of disordered eating behavior and the commonly held belief that amenorrhea is a normal consequence of training.

Recognition of Risk Factors

The development of poor self-image and pathogenic weight control behaviors in the female athlete may be caused by many factors. Frequent weigh-ins, punitive

Athletic pursuits that emphasize low body weight and a lean

consequences for weight gain, pressure to "win at all costs," an overly controlling parent or coach, and social isolation caused by intensive involvement in sports may increase an athlete's risk. Societal perpetuation of the ideal body image may intensify the endeavor for a thin physique.

physique include gymnastics, figure skating, ballet, distance running, diving and swimming.

Athletic endeavors such as gymnastics, figure skating, ballet, distance running, diving and swimming that emphasize low body weight and a lean physique can also increase the risk of developing the female athlete triad.^{2,4}

Prevention

Prevention of the female athlete triad through education is crucial. Coaches, parents and teachers are often unaware of the impact they have on athletes.

During adolescence and young adulthood, these athletes may receive comments or instructions that seem to encourage or demand maladaptive patterns of diet and exercise.

According to one small study,² 75 percent of female college gymnasts who were told by their coaches that they were overweight used pathogenic behaviors to control their weight. The physician may recognize such patterns and be able to intervene before the development of the female athlete triad.

Screening

The optimal time to screen athletes for the female athlete triad is during the preparticipation sports physical examination. The physician might also screen for the triad during acute visits for fractures, weight change, disordered eating, amenorrhea, bradycardia, arrhythmia and depression, and also during visits for routine Papanicolaou smears.⁸

A history of amenorrhea is one of the easiest ways to detect the female athlete triad in its earliest stages.

Evidence suggests that menstrual history may predict current bone density in female athletes.⁹ In a study of young female athletes, longer, more consistent patterns of amenorrhea were found to have a linear correlation with measures of bone density. Amenorrhea should not be

TABLE 2
Screening History for the Female Athlete Triad

Menstrual history

Age at menarche
Frequency and duration of menstrual cycles
Longest period of time without menstruation
Last menstrual period
Physical signs of ovulation, such as cervical mucus change or menstrual cramps
Hormonal therapy taken previously and currently

Diet history

What was eaten in the past 24 hours
List of any forbidden foods
Highest/lowest weight since menarche
Happiness with current weight
Ideal weight according to the patient
Disordered eating practices: bingeing and purging
Use of laxatives, diuretics or diet pills

Exercise history

Exercise patterns/training intensity for the sport (hours per day, days per week)
Additional exercise outside of required training
History of previous fractures
History of overuse injuries

discounted by the family physician as a benign consequence of athletic training. During preparticipation physical examinations at the University of California, Los Angeles, most women whose menstruation had stopped for three months or more had been told by their family physicians that amenorrhea was normal in athletes.¹⁰

While taking a patient's history, especially when asking about disordered eating practices, the physician should focus initially on the past. The patient may feel less threatened when discussing past eating behaviors. Patients are more likely to confirm that they have previously induced vomiting or used laxatives than to admit to current disordered eating patterns. A screening history for the female athlete triad is outlined in *Table 2*.

Diagnosis

In the beginning, the symptoms of the female athlete triad may be subtle. On physical and laboratory examination, however, the presence of symptoms such as fatigue, anemia, electrolyte abnormalities or depression caused by dieting may alert the physician to the diagnosis.⁵ Some of the most common signs and symptoms of disordered eating in the female athlete triad are listed in *Table 3*.

Fatigue, anemia, electrolyte abnormalities and depression may alert physicians to the diagnosis of the female athlete triad.

Amenorrhea secondary to excessive exercise is not a clinical diagnosis, nor one that can be made by laboratory testing. It is a diagnosis of exclusion. A history and physical examination should be completed for every female athlete with amenorrhea to rule out other treatable causes. The differential diagnosis of amenorrhea is listed in *Table 4*. Recently published review articles discuss the differential diagnosis and evaluation of amenorrhea in further detail.¹¹

Fatigue, anemia, electrolyte abnormalities and depression may alert physicians to the diagnosis of the female athlete triad.

There is a lack of published evidence to guide the physician in the cost-effective use of bone density testing for female athletes who are at risk for osteoporosis. Osteoporosis is defined as bone density 2.5 standard deviations below normal for the patient's age.⁸ Early studies of osteoporosis in female athletes focused on the loss of

bone mineral density in the vertebral column.¹² In recent studies, prolonged amenorrhea was found to affect multiple axial and appendicular skeletal sites, including those that were subjected to impact loading during exercise.^{12,13} Because the risk of bone loss increases with the duration of amenorrhea, a dual energy x-ray absorptiometry (DEXA) scan or similar study should be considered in athletes with amenorrhea lasting at least six months.

A position paper published by the American College of Sports Medicine recommends that short-term amenorrhea be considered a warning symptom for the female athlete triad and suggests medical evaluation within the first three months.⁸ At the time of examination, the patient should be educated about the risks of irreplaceable bone loss that can occur after only three years of amenorrhea.

Documentation of the loss of bone density may enhance patient compliance with recommendations for changes in eating behaviors and training regimens, and may convince the patient to start estrogen replacement therapy.¹⁴

Prognosis

Preservation of bone mineral density is one of the many reasons to screen female athletes and diagnose the female athlete triad early in its course. Postmenopausal women lose most of their bone mass and density in the first four to six years after menopause. If this is also true of amenorrheic athletes, intervention is needed before bone mass is irreversibly lost.⁹

Recent studies indicate that peak bone mass occurs at a younger age than was previously believed. Several studies have shown that the average age of peak bone mass is closer to 18 to 25 years rather than the currently accepted age of 30 years.¹⁵⁻¹⁸ If this is true, efforts to affect females with delayed or interrupted menses should begin during adolescence.

One study evaluated previously amenorrheic women who had resumed normal menses. After the first 14 months, their bone mineral density increased by an average of 6 percent. However, this trend did not continue. The rate of increase slowed to 3 percent the following year and reached a plateau at a bone mineral density that was well below the normal level for their age.⁹ Again, this finding shows the paramount importance of early intervention in preventing irreversible loss of bone mineral density.

Severe disordered eating patterns may put the athlete at risk for more significant morbidity or even death. In nonathletes, the mortality rate in treated anorexia nervosa can range from 10 to 18 percent.⁷ Even though most women with the triad do not meet strict criteria for anorexia or bulimia, they still appear to have a greater risk of mortality than that of the general population.⁷

Treatment

In addition to having a fundamental role in the diagnosis of the female athlete triad, the family physician has an integral part in coordinating the management of this condition. While a multidisciplinary approach to

TABLE 3
Common Signs and Symptoms of Anorexia Nervosa and Bulimia Nervosa

Anorexia nervosa	Bulimia nervosa
Cachexia	Fatigue
Bradycardia	Abdominal pain
Hypotension	Chest pain
Lanugo	Swollen parotid glands
Hypothermia	Sore throat/esophagitis
Cold intolerance	Erosion of tooth enamel
Yellow skin (hypercarotenemia)	Knuckle scars/callus
Dry hair and skin	Constipation
Alopecia	Bloodshot eyes, petechiae of sclera (secondary to forceful vomiting)
Pruritus	

TABLE 4
Differential Diagnosis of

treatment has not been studied, many patients may benefit from a treatment plan that involves consultation with subspecialists. Involvement of a psychiatrist or psychologist and a dietician who specialize in the management of the female athlete triad may facilitate prompt improvement. Often, athletic trainers or coaches are the persons closest to the athlete. Their insights and support may be crucial to the success of any treatment plan.

Lifestyle Changes

Optimal treatment of the female athlete triad includes instruction from a dietician to educate and monitor the patient for adequate nutrition and to help the patient attain and maintain a goal weight. The patient, dietician and physician should agree on a goal weight, with consideration for the weight requirements for participation in the patient's chosen sport. A weight gain of 0.23 to 0.45 kg (0.5 to 1 lb) per week until the goal weight is achieved is a reasonable expectation. Helping the patient focus on optimal health and performance instead of weight is important. The patient need not stop exercising completely. Exercise activity should be decreased by 10 to 20 percent, and weight should be monitored closely for two to three months.⁵

Hormone Replacement Therapy

No published longitudinal studies are available on the long-term benefits of hormone replacement therapy (HRT) to slow or reverse the loss of bone mineral density in these young women. Most of the evidence for the use of HRT has been extrapolated from data that support its use in postmenopausal women. Both oral contraceptives and cyclic estrogen/progesterone have been used to treat amenorrhea of the triad. While hormonal therapy will treat the amenorrhea, the ultimate goal is the return of regular menses through proper nutrition, revised training regimens and maintenance of reasonable body weight.

One retrospective study of amenorrheic runners compared hormonal therapy with placebo over 24 to 30 months. The regimen included either conjugated estrogen in a dosage of 0.625 mg per day or an estradiol transdermal patch in a dosage of 50 µg per day. Both were given in combination with medroxyprogesterone in a

Amenorrhea

Pregnancy

Hypothalamic dysfunction

- Absence of gonadotropin-releasing hormone
- Psychologic or physical stress
- Anorexia nervosa
- Kallmann's syndrome
- Idiopathic
- Drugs

Pituitary dysfunction

- Prolactinoma or other pituitary neoplasm
- Sheehan's syndrome
- Granulomatous disease (sarcoidosis)
- Empty-sella syndrome

Ovarian dysfunction

- Menopause
- Premature ovarian failure
- Polycystic ovary syndrome
- Turner's syndrome (45, X)
- Gonadal dysgenesis
- Autoimmune disease
- Ovarian neoplasm

Uterine dysfunction

- Asherman's syndrome
- Absence of uterus

Endocrine disease

- Hypothyroidism
- Cushing's syndrome

dosage of 10 mg per day for 14 days per month. Patients receiving hormonal therapy showed a significant increase in bone mineral density, while those in the control group showed nonsignificant decreases of less than 2.5 percent.¹⁹ Small studies have also supported the use of oral contraceptives in persons with athletic amenorrhea.²⁰ Retrospective studies have shown that athletes with a history of oral contraceptive use may have a decreased risk of stress fracture.^{13,21}

While little direct evidence is available on the appropriate timing for initiation of HRT, considering hormone therapy after six months of amenorrhea seems prudent. Irreversible bone loss can occur after only three years of amenorrhea.⁶ Patients who already have evidence of early bone mineral density loss (osteopenia) on the basis of bone densitometry/DEXA scanning should be strongly encouraged to start hormonal therapy.

Estrogen may be replaced in a variety of ways. Oral contraceptives are frequently used and are advantageous if birth control is also desired. Hormone replacement regimens as prescribed for postmenopausal women are also feasible options. No single treatment regimen has been proved to be the most beneficial for the female athlete triad. Some options for estrogen replacement therapy are listed in *Table 5*.^{5,22} Progesterone should be included in any treatment regimen to prevent the endometrial hyperplasia that can result from use of unopposed estrogen.

Additional Pharmacotherapy

Research has shown that athletes who had a higher incidence of stress fractures also had lower calcium intakes and less frequent use of oral contraceptives.¹¹ The recommended dietary allowance of calcium is 1,200 to 1,500 mg per day for females between 11 and 24 years of age.²³ Surveys of females between 12 and 19 years of age have shown an inadequate average daily calcium intake of less than 900 mg per day.²³ Additional daily supplementation of 400 to 800 IU of vitamin D will also facilitate the absorption of calcium. Treatments for osteoporosis, such as bisphosphonates and calcitonin, have not been tested specifically in younger patients with the female athlete triad. However, the physician should consider all available treatment options for athletes with frank osteoporosis on the basis of DEXA scanning (more than 2.5 standard

TABLE 5 Estrogen Replacement Therapy Dosing Regimens for Amenorrhea

Option 1

One of the following, daily or cyclically (days 1 to 25):

Conjugated estrogen, 0.625 mg
Ethinyl estradiol, 0.02 mg
Transdermal estradiol, 0.05 mg
Micronized estradiol, 1.0 mg

plus

Oral progestin, daily (2.5 to 5 mg medroxyprogesterone) or cyclically (5 to 10 mg for 10 to 14 days each month)

Option 2

Combination estrogen/progestin oral contraceptive

Information from Otis CL. Exercise-associated amenorrhea. *Clin Sports Med* 1992;11:351-62, and Fagan KM. Pharmacologic management of athletic amenorrhea. *Clin Sports Med* 1998;17:327-41.

deviations below age-specific norms). Options for the treatment of osteoporosis have been discussed in detail in a number of recent review articles.^{24,25}

Depending on the severity of the eating disorder, a selective serotonin reuptake inhibitor (SSRI) may be indicated for treatment of a specific disorder. Benzodiazepines have also been suggested by one author for the treatment of a patient with severe mealtime anxiety.²⁶ A psychiatric evaluation may help with the assessment of depression or eating disorders, and with the selection of medications.

Family Involvement

Involvement of the family is crucial to the success of treatment. Family members should be included in treatment plans from the beginning, particularly with adolescent patients. Although at first the physician's intervention may appear to be detrimental to the child's athletic career, education about the significance of the female athlete triad may motivate parents to participate in a treatment program.

The recommended dietary allowance of calcium is 1,200 to 1,500 mg per day for women between 11 and 24 years of age.

The Authors

JULIE A. HOBART, M.D.,

is residency faculty and assistant professor of family medicine at the University of Cincinnati/MercyFranciscan Hospitals Family Medicine Residency Program, Cincinnati, Ohio. Dr. Hobart received her medical degree from Ohio State University College of Medicine, Columbus, and completed a residency in family medicine and a faculty development fellowship at the University of Cincinnati/Franciscan Hospitals.

DOUGLAS R. SMUCKER, M.D., M.P.H.,

is assistant professor and codirector of research in the Department of Family Medicine at the University of Cincinnati College of Medicine. Dr. Smucker completed his medical degree and served a residency in family practice at the Medical College of Ohio in Toledo. He also completed a primary care research fellowship and a residency in preventive medicine at the University of North Carolina at Chapel Hill School of Medicine.

Address correspondence to Julie A. Hobart, M.D., University of Cincinnati, Family Medicine Residency Program, 2446 Kipling Ave., Cincinnati, OH 45239. Reprints are not available from the authors.

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