

PediatricsⁱⁿReview[®]

The Female Athlete Triad

Sarah J. Lerand and Janet F. Williams

Pediatr. Rev. 2006;27:e12-e13

DOI: 10.1542/pir.27-1-e12

The online version of this article, along with updated information and services, is located on the World Wide Web at:

<http://pedsinreview.aappublications.org/cgi/content/full/27/1/e12>

Pediatrics in Review is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1979. Pediatrics in Review is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2006 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 0191-9601. Online ISSN: 1526-3347.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN[™]



In Brief

The Female Athlete Triad

Sarah J. Lerand, MD, MPH
University of Minnesota
Minneapolis, Minn.

Janet F. Williams, MD
University of Texas Health Science
Center
San Antonio, Tex.

Author Disclosure

Drs Lerand and Williams did not disclose any financial information regarding this In Brief.

The Female Athlete Triad: American College of Sports Medicine Position Stand. Otis CL, Drinkwater B, Johnson M, Loucks A, Wilmore J. *Med Sport Sci Exer.* 1997;29: i-ix

Bone Mineral Content of Amenorrheic and Eumenorrheic Athletes. Drinkwater BL, Nilson K, Chesnut CH 3rd, Bremner WJ, Shainholtz S, Southworth MB. *N Engl J Med.* 1984;311: 277-281

Bone Mineralization, Hypothalamic Amenorrhea and Sex Steroid Therapy in Female Adolescents and Young Adults. Hergenroeder AC. *J Pediatr.* 1995;126:683-689

Disordered Eating and the Female Athlete Triad. Sanborn CF, Horea M, Siemers BJ, Dieringer KI. *Clin Sports Med.* 2000;19:199-213

The female athlete triad is a phrase used to describe the constellation of disordered eating, amenorrhea, and osteoporosis that can develop in physically active girls and women. Although recently described in the medical literature as a clinical condition, this is not a new entity. The various components of the triad have been noted for years

by athletes, parents, coaches, trainers, and health-care personnel, particularly team physicians. This same team of individuals must work together to prevent, identify, and treat this condition, which can have significant morbidity and mortality.

Females participating in athletics are more likely to benefit from their sports participation than to be at risk for harmful effects. Early sports participation sets a precedent for lifelong cardiovascular fitness. In addition, girls who participate in sports are more likely than are nonparticipants to experience academic success and graduate from high school. Sports participation is associated with decreased initiation of high-risk health behaviors, such as using drug, alcohol, or tobacco and having sexual intercourse. Over recent years, as increasing numbers of girls and women participate in sports, the female athlete triad has become a more frequently recognized clinical entity. Risk for the triad is greatest in those endurance sports emphasizing leanness, requiring body contour-revealing clothing for competition, using weight categories for participation, or emphasizing a prepubertal body habitus for performance success and in those sports where performance is scored subjectively.

The disordered eating component of the female athlete triad encompasses the entire spectrum of abnormal eating patterns; it is not limited to anorexia nervosa or bulimia nervosa criteria. Disordered eating can include food restriction, fasting, or bingeing; purging by vomiting or using laxatives, diuretics, or diet pills; or preoccupation with food, exercise, or body image. Disordered eating affects up to 62% of female ath-

letes, depending on how broadly this eating component is defined. The potential complications of disordered eating include: depleted glycogen stores, decreased lean body mass, chronic fatigue, micronutrient deficiencies, dehydration, anemia, electrolyte and acid-base imbalance, and cardiac or gastrointestinal problems, which can impair athletic performance and increase the risk of injury and death.

The amenorrhea component of the female athlete triad ranges from oligomenorrhea to primary or secondary amenorrhea. The prevalence of secondary amenorrhea in the general population is 2% to 5% compared with 3% to 66% in adult female athletes, depending on the sport studied and the amenorrhea criteria used. The most frequent exercise-related menstrual and reproductive system problems in female athletes are delayed menarche, delayed thelarche, oligomenorrhea, amenorrhea, anovulatory cycles, and short luteal phase cycles.

Although the mechanism for exercise-related menstrual changes is unknown, it is considered to be energy-related, multifactorial, and hypothalamic in origin. Both amenorrheic and normally menstruating athletes have reduced luteinizing hormone pulse frequencies and low 24-hour mean leptin levels, but marked suppression is found in amenorrheic athletes. Failure to match the additional energy cost of exercise with caloric intake, also called "energy drain," is considered the major contributing factor to these hormonal changes. Other factors that affect menstruation in an athlete include body composition changes, reproductive immaturity, training factors, nutritional

quality, and hormonal stress responses to exercise.

Completing the triad is osteoporosis resulting from premature bone resorption, impaired bone formation, or both. Osteoporosis results in low bone mass, microarchitectural deterioration, and increased skeletal fragility and risk of fracture. In normal skeletal development, females gain more than 50% of their adult skeletal mass and 15% of their adult height during adolescence. Peak bone mass is reached between ages 18 and 25 years, after which both men and women lose bone mass at the annual rate of 0.3% to 0.5% until menopause accelerates bone loss for women.

If young women experience amenorrhea or oligomenorrhea during the critical years of bone growth, they are at risk for losing 2% of their bone mass annually instead of gaining the normal 2% to 4%. The osteopenia or osteoporosis noted in an oligomenorrheic or amenorrheic athlete is related to a low estrogen level, which leads to increased rate of bone loss very similar to that found in postmenopausal women or in women who have a pathologic hypoenestrogenic condition, such as premature ovarian failure, pituitary tumor, or anorexia nervosa. Determinant factors for the extent of bone loss include length and severity of menstrual irregularity, type of skeletal loading during activity, nutritional status, and genetics. If trabecular bone is lost during long-term amenorrhea, reversal of the resultant low bone mineral density may be impossible.

The sports preparticipation evalua-

tion is the ideal opportunity to screen for the risk or presence of the female athlete triad. Screening also should be incorporated into the clinical evaluation of girls who have changes in their menstrual cycles, disordered eating, significant weight change, depression, stress fractures, or cardiac arrhythmias, including bradycardia. Use of a standardized form as part of this screening could help to ensure detailed review of the menstrual, diet, exercise, and psychosocial histories. A comprehensive physical examination must be performed, and when indicated by history and physical findings, laboratory studies should be ordered.

Early recognition and treatment of the condition are essential. The patient must be counseled on how to match her increased energy expenditure from exercise with her energy intake. For some patients, explanation of the condition and how to correct the imbalance through diet and possibly exercise modification may be enough, but an individual and multidisciplinary approach is necessary for many patients. It should include medical management; nutrition and exercise counseling; psychotherapy; involvement of the coaches, trainers, and the family; and comprehensive patient follow-up.

Correction of the imbalance between energy intake and expenditure typically corrects the menstrual irregularities associated with the female athlete triad. Adolescent athletes need to be counseled about the need for increased intake of carbohydrates, protein, and calcium compared with their sedentary peers. It has been recom-

mended that amenorrheic adolescent athletes increase their calcium intake to at least 1,500 mg daily (compared with the 1,200 mg recommended dietary daily allowance for other adolescents). If dietary calcium intake is inadequate, calcium supplementation may be necessary. Use of estrogen-progesterone combinations may increase bone mineral density in some females. The American Academy of Pediatrics Committee on Sports Medicine recommends that hormonal therapy be reserved for the skeletally mature adolescent athlete. Measuring bone density by DEXA scan can assist in the decision to start or continue hormonal therapy.

Efforts to prevent the female triad include promoting a healthy, active lifestyle while discouraging potentially harmful behaviors. Prevention of the triad entails educating athletes, coaches, trainers, parents, and health-care professionals about proper nutrition, safe training practices, and the benefits of exercise, as well as the risks and warning signs of the triad. Pressuring athletes to diet and lose weight or to meet a single "ideal standard" for body weight or body fat should cease. Through educational efforts, effective screening, therapeutic measures, and dispelling of myths such as "thinner is better," health-care practitioners may be able to curtail the significant morbidity and mortality known to result from the female athlete triad.

(This In Brief was written while Dr Lerand was a pediatric resident at the University of Texas Health Science Center in San Antonio.)

The Female Athlete Triad
Sarah J. Lerand and Janet F. Williams
Pediatr. Rev. 2006;27:e12-e13
DOI: 10.1542/pir.27-1-e12

**Updated Information
& Services**

including high-resolution figures, can be found at:
<http://pedsinreview.aappublications.org/cgi/content/full/27/1/e12>

Permissions & Licensing

Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at:
<http://pedsinreview.aappublications.org/misc/Permissions.shtml>

Reprints

Information about ordering reprints can be found online:
<http://pedsinreview.aappublications.org/misc/reprints.shtml>

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

