Review Article

Female Athlete Triad: Past, Present, and Future

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Abstract

After the passage of Title IX in 1972, female sports participation skyrocketed. In 1992, the female athlete triad was first defined; diagnosis required the presence of an eating disorder, amenorrhea, and osteoporosis. However, many athletes remained undiagnosed because they did not meet all three of these criteria. In 2007, the definition was modified to a spectrum disorder involving low energy availability (with or without disordered eating), menstrual dysfunction, and low bone mineral density. With the new definition, all three components need not be present for a diagnosis of female athlete triad. Studies using the 1992 definition of the disorder demonstrated a prevalence of 1% to 4% in athletes. However, in certain sports, many female athletes may meet at least one of these criteria. The actual prevalence of athletes who fall under the "umbrella" diagnosis of the female athlete triad remains unknown.

Over the past four decades, female participation in sports has increased significantly as a direct result of Title IX, the federal law enacted in 1972. Title IX was meant to eliminate discrimination based on sex with regard to participation in educational activities (not limited to sports) that receive federal financial support.[1] With increased participation in sports, there has been a similar increase in sports-related injuries and associated conditions.

The female athlete triad is a syndrome that has been observed in female athletes who present with three interrelated components: disordered eating, amenorrhea, and osteoporosis.[2-4] This condition is now considered a spectrum disorder characterized by relative dysfunction in energy availability (with or without disordered eating), menstrual function, and bone mineral density (BMD). Low energy stores increase an athlete's risk of developing the remaining components of the triad.[5,6] With the modified guidelines for diagnosis of this condition, more education is crucial for early diagnosis to prevent athletes from reaching more advanced stages of pathology. Although the triad poses a great health risk, the benefits of exercise outweigh the potential risks.

Historical Perspective

In 1971, before Title IX was passed, it was estimated that 310,000 females participated in sports; in 2010, there were approximately 3,373,000 female participants.[7] There has also been an increase in sports-related injuries, such as stress fractures. Lawrence Vincent noted the high incidence of amenorrhea among professional ballet dancers; many of these dancers also sustained a high number of stress fractures.[8] In response, he published a book of health tips for female dancers entitled *The Dancer's Book of*

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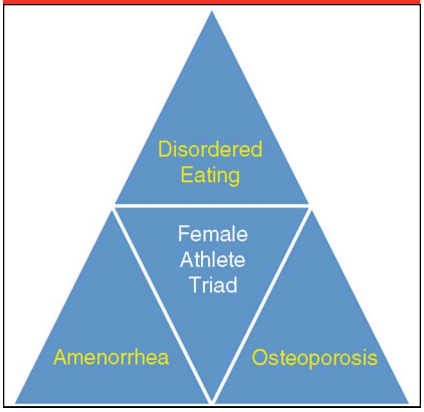
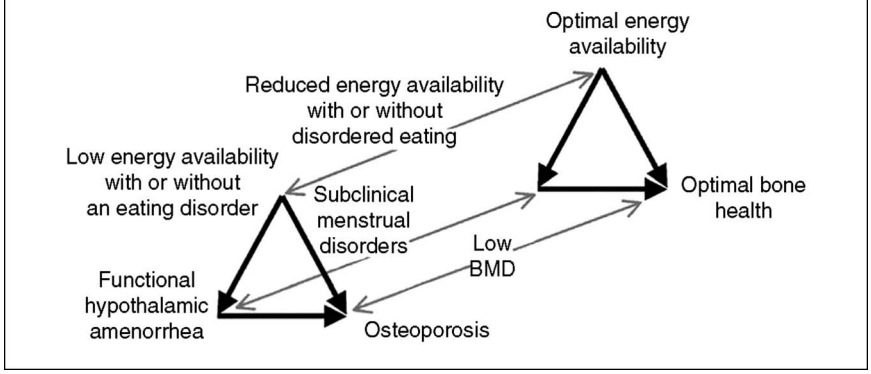
Figure 1



Schematic representing the initial definition of the female athlete triad. The condition was characterized as an interrelated disorder involving disordered eating, amenorrhea, and osteoporosis. All three components were required to be present for a diagnosis.

Figure 2



Schematic of the components of the female athlete triad, a spectrum disorder, based on the updated 2007 guidelines. The spectrum from normal to varying degrees of pathology is shown for each component of the triad. BMD = bone mineral density (Reproduced with permission from Nattiv A, Loucks AB, Manore MM; American College of Sports Medicine: American College of Sports Medicine position stand: The female athlete triad. *Med Sci Sports and Exerc* 2007;39[10]:1867-1882.)

Health. Researchers realized that the association between disordered eating, amenorrhea, and musculoskeletal injuries discovered among female athletes was not coincidence. In 1992, the Task Force on Women's Issues of the American College of Sports Medicine (ACSM) was assembled, and the term *female athlete triad* was created to define the three components that characterized the condition. All three components (ie, disordered eating, amenorrhea, osteoporosis) had to be present simultaneously for diagnosis[2,3,9] (Figure 1).

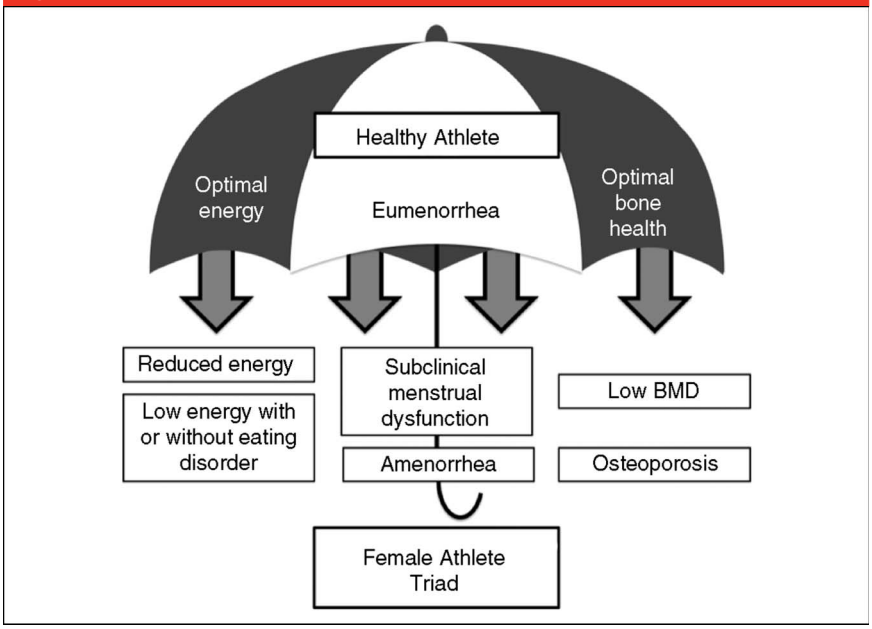
Female athletes involved in sports that require subjective judging (eg, gymnastics, figure skating) or endurance sports that emphasize low body mass/leanness are at increased risk of developing the triad. However, it should be noted that female athletes and nonathletes participating in any sport can develop triad symptoms.[4,5,9,10,11] Historically, the condition has been underreported because of a lack of education among healthcare professionals, coaches, and athletes; a failure to recognize certain components of the triad because of the variety of presentations; and a lack of athletes reporting symptoms (eg, musculoskeletal injuries, disordered eating behaviors) to their coaches.[2,4,12] In a study of 311 high school female athletes, musculoskeletal injury was found to affect 65.6% of the athletes.[4] Consistent with the suspected underreporting by athletes, 36% of the affected athletes did not report the injury to a coach, healthcare provider, or other supervisor.

For prevention, diagnosis, and treatment of symptoms of the triad, medical professionals, coaches, parents, teammates, and others involved with athletes must be aware of the condition and its components. Scientific studies on awareness of the condition have revealed that this typically is not the case. In a 2006 survey of Division I collegiate coaches, 64% of the 91 respondents were aware that the triad existed, but only 43% were able to appropriately identify the three components.[13] In a separate survey of physicians, physical therapists, coaches, and athletic trainers, less than half were able to name the three components of the triad, with only 48% of the 139 physicians surveyed able to identify the components.[10]

Change in Diagnostic Guidelines

Based on the original triad definition, many female athletes who present with only one or two of the components of the triad may be overlooked. In 2007, the ACSM updated the diagnostic guidelines, and the female athlete triad was defined as a spectrum of abnormalities in energy availability, menstrual function, and BMD (Figure 2). Each of the three components is part of a spectrum ranging from normal to varying degrees of pathology.[5] The female athlete no longer needs to demonstrate pathology in all three components of the triad to be diagnosed with the syndrome. The presence of one or two of the components on the pathologic side of the spectrum falls under the "umbrella" of the triad and may meet the criteria for diagnosis, prompting further assessment and evaluation for the other components[5] (Figure 3).

Figure 3



The female athlete triad umbrella. The updated 2007 guidelines indicate that far more athletes can fall under the triad umbrella because all three components are not required to be present for a diagnosis. BMD = bone mineral density (Reproduced with permission from Matzkin E, Paci GM: The female athlete triad, in Mody E, Matzkin E, eds: *Musculoskeletal Health in Women*. London, UK, Springer-Verlag, 2014, pp 1-13.)

With this modification of the guidelines, the overall prevalence of triad components on their respective spectrums has increased, although the total prevalence of athletes with this condition is unknown. Table 1 compares the prevalence of the female athlete triad based on the 1992 and 2007 diagnostic guidelines. Prior to the updated 2007 definition, 1% to 4% of the patients presented with all three components of the triad according to self-reported questionnaires and dual-energy x-ray absorptiometry (DEXA) measurements of high school and elite athletes.[11,14] Because all three interrelated components no longer have to be present concomitantly, the overall prevalence of the condition has increased. In a prospective study of high school athletes and sedentary students, Hoch et al[15] found that the prevalence of sedentary students who had at least one component of the triad was 65%, whereas 78% of female athletes had one or more of the pathologic constituents. In a prospective study of women and girls who exercise, Barrack et al[6] found that the risk of developing a bone stress injury among active females increased from 15% to 21% in the presence of one risk factor (eg, disordered eating, menstrual dysfunction, weight-controlling behavior) but increased to 21% to 30% with two risk factors and 29% to 50% with three risk factors.

When assessing the specific components of the triad, the prevalence of menstrual irregularities among high school female athletes ranged from 18.8% to 54% based on data collected from self-reported questionnaires.[4,15] Martinsen and colleagues[12,21] conducted two studies to observe the prevalence of disordered eating and eating disorders in elite female high school athletes. In one study,[12] 11% to 25% of female athletes had pathogenic eating behaviors or were considered at risk of having an eating disorder as characterized by criteria described in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV). In a second study,[21] a clinical interview was conducted after the athlete completed the questionnaire and was deemed to be at risk of developing an eating disorder. The results of the interviews demonstrated that 14% of the female athletes had a true eating disorder compared with 5% of the controls. The most common eating disorder encountered in both studies was eating disorder not otherwise specified (EDNOS).[12,21] EDNOS is an eating disorder that does not meet the specific criteria of bulimia nervosa or anorexia nervosa.[22] Persons with EDNOS may display some of the attributes required for diagnosis of a specific eating disorder, yet not enough for an official diagnosis (eg, a female who meets the criteria for anorexia nervosa but menstruates regularly).[22] Given that disordered eating no longer has to be present for diagnosis of the triad and is now more broadly defined as energy availability, it is likely that the prevalence of the decreased energy availability component of the new triad definition is higher than what is reported here. However, current studies include only the old definition relating to energy availability, which specifically requires that disordered eating be present.

In 2012 and 2013, the Female Athlete Triad Coalition convened to develop a consensus statement for triad screening, treatment, and return to play.[23] The document lists 11 risk factors that should be screened, including a history of menstrual irregularity, stress fracture, dieting, and overtraining as well as personality factors such as perfectionism and obsessiveness. In addition, the

Table 1

Prevalence of the Female Athlete Triad Based on the 1992 and 2007 Guidelines

Study	Patient Population (Cohort Size)	Definition (Components Assessed)	Prevalence (%)
Thein-Nissenbaum et al[4]	High school athletes (311)	2007 definition (individual components)	Disordered eating: 35.4 Menstrual dysfunction: 18.8 Sports-related musculoskeletal injury: 65.6
Torstveit and Sundgot-Borgen[11]	Elite athletes (186), controls (145)	1992 definition	Elite athletes: 4 Controls: 3.4
Nichols et al[14]	High school athletes (170)	1992 definition (individual components)	All three components: 1.2 Disordered eating: 18.2 Menstrual irregularity: 23.5 Low bone mass 21.8
Hoch et al[15]	High school athletes (80), sedentary high school students (80)	2007 definition (one or more pathologic constituents)	Athletes: 78 Sedentary: 65
Beals and Manore[16]	Collegiate athletes (425)	1992 definition (individual components)	Eating disorder: 5.6 Menstrual irregularity: 31 Bone injury during career: 34.3
Thompson[17]	Collegiate cross-country runners (300)	2007 definition (individual components)	Disordered eating: 19.4 Menstrual dysfunction: 23 Inadequate calcium intake: 29.1
Pollock et al[18]	Elite endurance runners (44)	2007 definition with all components present (menstrual dysfunction, disordered eating, low BMD)	15.9
Doyle-Lucas et al[19]	Elite ballet dancers (15), controls (15)	2007 definition with all components present (menstrual dysfunction, disordered eating, low BMD)	40
Schtscherbyna et al[20]	Athletes aged 11–19 yr (78)	2007 definition (one or more pathologic components)	47.4

BMD = bone mineral density

importance of early intervention was emphasized along with the need to revolutionize the currently unstandardized preparticipation examinations for female athletes. The coalition proposed the use of a point system to assess athletes with risk factors for the female athlete triad during the preparticipation examination and to determine when an athlete is able to return to play. Each risk factor is allocated a certain number of points based on history or current findings. For example, the risk factor of stress reaction/fracture ranges from 0 to 2 points based on the athletes' history. Two points are added to the magnitude of risk score if the patient has had more than two stress injuries, more than one high risk factor, or injury involving trabecular bone sites. An athlete with no history of stress injury is considered low risk, and zero points would be added. Athletes with a cumulative risk score of six or more points should be restricted from sport participation.[23]

Present Definition of the Female Athlete Triad

Energy Availability

Originally known as "disordered eating," this triad component is now termed "energy availability." The spectrum of energy availability ranges from optimal to low. An athlete does not have to be diagnosed with an eating disorder to have this component of the triad.[5] Low energy availability can result from inadequate caloric intake caused by pathologic caloric restriction (as in the setting of anorexia nervosa or bulimia nervosa) or by expending more energy than the body is designed for at a given time. To determine a patient's energy availability, the amount of energy that is expended is subtracted from the amount of caloric energy consumed from diet and is divided by lean body mass in kilograms. To begin the assessment of energy availability, body mass index (BMI) should be

Table 2

Prevalence of Energy Imbalance in Female Athletes

Study	Patient Population (cohort size)	Components Assessed	Prevalence (%)
Martinsen and Sundgot-Borgen[12]	Elite high school athletes (611); nonathletic high school students (421)	At risk of disordered eating, true eating disorder as diagnosed by DSM-IV criteria	Athletes: At risk: 25 True eating disorder: 13.5 Nonathletes: At risk: 51 True eating disorder: 5.1
Doyle-Lucas et al[19]	Elite ballet dancers (15); controls (15)	Energy imbalance; caloric intake	Not applicable 1
Martinsen et al[21]	Elite high school athletes (606)	At risk of disordered eating	11
Torres-McGehee et al[25]	College equestrian riders (138)	Eating disorder based on EAT	42
Beekley et al[26]	US Military Academy female cadets (1,872)	At risk of disordered eating (EAT>20)	19

DSM-IV = *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*, EAT = eating attitudes test
[a] This study compared the caloric intake in dancers and control subjects. Caloric intake in dancers was 1,577 kcal compared with 2,075 kcal in controls ($P < 0.01$).

calculated. If the BMI is <17.5 kg/m^2, it is likely that the athlete has low energy stores. In athletes with a normal BMI, it is more difficult to assess energy availability. To determine if energy availability is suboptimal, a detailed history, including diet and energy expenditure, must be elicited from the patient. Even with the most accurate history, determining availability of energy is not completely precise.[23] Low energy availability is determined to be <45 kcal/kg of lean-body mass per day; however, energy availability ≤30 kcal/kg of lean-body mass is associated with most of the negative effects.[5,15,23]

Adequate nutrition education among athletes is necessary for the prevention and treatment of low energy availability.[5] In underweight athletes (BMI <17.5 kg/m^2), increasing BMI to 18.5kg/m^2 may be enough to increase energy stores, but it is not typically that simple.[23] The management of low energy availability requires a multidisciplinary approach, especially in patients with an eating disorder. A registered dietician, a primary care physician with expertise in treating athletes with the triad, and a mental health provider are important members of the treatment team. In athletes diagnosed with an eating disorder (as characterized by DSM-IV criteria) or low self-esteem, a psychiatrist or primary care physician may opt to prescribe antidepressants.[5]

Prior to sport participation, a thorough history should be obtained, including the patient's dietary behaviors, menstrual pattern, training, and subjective weight (ie, how the athlete views her weight). A thorough physical examination is also important because certain findings should raise suspicion for low energy availability and a possible eating disorder. These findings include, but are not limited to, low body weight (BMI <17.5 kg/m^2), bradycardia, lanugo, orthostatic hypotension, poor dentition, chipmunk cheeks (caused by swollen parotid glands from vomiting), and the Russell sign (ie, a callus on the back of a finger caused by self-induced vomiting).[5,22-24] It should be noted that athletes who are overweight can also be energy deficient. The overall prevalence of energy imbalance and disordered eating among athletes varies based on the study evaluation criteria, as shown in Table 2.[12,19,21,25,26] Thus, the actual prevalence is unknown. However, prevention of decreased energy availability aids the prevention of other health risks, including amenorrhea, low BMD, and fractures. Female athletes who suffer from disordered eating have been found to have a twofold to fourfold increased risk of developing a sports-related injury.[4,27] Females who participate in a sport where being thin or lean is considered ideal are at increased risk of suboptimal energy availability or disordered eating, as defined by the original description of the female athlete triad.[2,4,5,9,11] Athlete education about proper nutrition and energy status is crucial to prevent the negative consequences associated with the triad, particularly those involving bone and reproductive health.[5]

Menstrual Function

The spectrum of menstrual function ranges from eumenorrhea to amenorrhea.[5] Eumenorrhea is defined as regular menstruation at approximately

Table 3

The Prevalence of Menstrual Irregularity in Female Athletes

Study	Patient Population (Cohort Size)	Component Assessed	Prevalence (%)
Thein-Nissenbaum et al[4]	High school athletes (311)	Menstrual dysfunction	18.8
Nichols et al[14]	High school athletes (170)	Menstrual irregularity	23.5
Hoch et al[15]	High school athletes (80), sedentary high school students (80)	Menstrual irregularity	Athletes: 54 Sedentary students: 21; $P < 0.001$
Beals and Manore[16]	Collegiate athletes (425)	Menstrual irregularity	31
Thompson[17]	Collegiate cross-country runners (300)	Menstrual dysfunction	23
Thein-Nissenbaum et al[34]	High school athletes (249)	Menstrual irregularity	19.7
Nattiv et al[35]	College track and field and cross-country runners (22)	Menstrual irregularity	23

every 28 days. Amenorrhea is divided into primary and secondary subsets; primary amenorrhea is the absence of menarche after age 15, and secondary amenorrhea is the cessation of menses for three consecutive cycles after menarche. Oligomenorrhea, menstruation every 35 days or fewer than nine menstrual cycles in 1 year, is considered abnormal. Subclinical menstrual irregularities, such as a luteal phase defect and anovulation, also fall along the spectrum and are important to rule out during the triad screening process.[5,23,28]

Functional hypothalamic amenorrhea (FHA) associated with the female athlete triad results from an unpredictable release of gonadotropin-releasing hormone (GnRH). Prolonged exertion and weight loss have been shown to influence GnRH release, although the pathophysiology is not entirely clear. GnRH directly affects the release of luteinizing hormone and follicle-stimulating hormone from the pituitary gland. When this pathway is disrupted, it directly affects the release of estrogen from the ovaries, causing FHA.[28,29] If an athlete has amenorrhea, regardless whether it is primary or secondary, it is prudent to exclude causes other than FHA, including thyroid abnormalities, structural anomalies, pregnancy, polycystic ovary syndrome, and pituitary tumor.[28]

Estrogen plays an important and complicated role in the physiology of BMD and bone formation. Estrogen inhibits bone remodeling and bone resorption, which then increases and enhances bone formation. In an estrogen-deficient state, BMD is decreased, thus leading to an increased risk of fragility fracture.[30] In a cross-sectional study of the possible risk factors that contribute to stress fractures in female endurance athletes, menstrual dysfunction was prevalent.[31] Nineteen athletes were diagnosed with a stress fracture; 15 had a history of amenorrhea and 13 reported current amenorrhea or oligomenorrhea at the time of the study. The high prevalence of menstrual dysfunction in athletes with a stress fracture is not surprising considering the direct effect of estrogen on BMD.

Treatment of FHA begins with increasing energy availability to an optimal state. In some athletes, this directly correlates to an increase in BMI by increasing caloric intake, reducing energy expenditure, or both. An increase in caloric intake has been shown to be directly related to weight gain and resumption of menses, as long as energy expenditure is controlled.[23,24,32] The mainstay and cornerstone of treatment of FHA is to increase energy availability through nutrition/caloric intake to normalize the secretions of luteinizing hormone and follicle-stimulating hormone.[23] Hormone replacement therapy and oral contraceptive pills (OCPs) have been used in the past as a first-line treatment for athletes with amenorrhea, but a significant benefit has not been demonstrated in this population. Oral contraceptive use was considered in the setting of a continued decrease in BMD in an athlete with persistent amenorrhea.[5] To date, data on the effects of OCPs on BMD remain inconclusive.[32] Recently, the use of OCPs in these athletes has fallen out of favor because data have suggested that OCP use causes further harm by reducing BMD if taken over a long period of time (ie, ≥2 years).[33]

A female athlete with menstrual dysfunction (eg, FHA, oligomenorrhea,

Table 4

Prevalence of Reduced Bone Mineral Density in Female Athletes[a]

Study	Patient Population (Cohort Size)	Components Assessed	Prevalence (%)
Thein-Nissenbaum et al[4]	High school athletes (311)	General musculoskeletal injury	Sports-related musculoskeletal injury: 65.6
Nichols et al[14]	High school athletes (170)	Low bone mass	21.8
Hoch et al[15]	High school athletes (80), sedentary high school students (80)	Low BMD	Athletes: 16 Sedentary students: 30
Beals and Manore[16]	Collegiate athletes (425)	Fracture during career	Bone injury during career: 34.3
Thompson[17]	Collegiate cross-country runners (300)	Calcium intake	Inadequate calcium intake: 29.1
Pollock et al[18]	Elite endurance runners (44)	Low BMD (lumbar)	34.2
Rauh et al[27]	Interscholastic athletes (163)	Musculoskeletal injury	37.4
Duckham et al[31]	Endurance athletes (70)	Prior history of stress fracture	27
Thein-Nissenbaum et al[34]	High school athletes (249)	Musculoskeletal injury	63.1
Nattiv et al[35]	College track and field and cross-country runners (22)	Bone stress injury over 5-year period	Not reported[b]

BMD = bone mineral density
[a] The overall prevalence of reduced bone mineral density is unknown and varies greatly based on the patient population and method of evaluation.
[b] Of the 211 male and female athletes in the study, 34 (12 males and 22 females) sustained a total of 61 bone stress injuries.

subclinical amenorrhea) should be assessed for other components of the triad. In a prospective study of high school athletes, Rauh et al[27] found that athletes who self-reported amenorrhea or oligomenorrhea had a nearly threefold greater risk of musculoskeletal injury (exact injury type was not recorded). However, the overall prevalence of menstrual dysfunction among the athletic population requires further study (Table 3). The importance of proper nutrition must be conveyed to athletes; proper nutrition leads to adequate energy availability and has a direct effect on reproductive health. With proper education at the beginning of an athlete's sports participation, menstrual irregularities may be prevented.

Bone Mineral Density

The spectrum of BMD includes osteoporosis but also encompasses reduced BMD because of its role in increased risk of injury in female athletes with the female athlete triad.[5] Younger female athletes must understand that, for most women, 90% of peak BMD is reached by age 18 years and that the greatest level of accrual is between the ages of 11 and 14 years.[36] To obtain optimal BMD, adequate nutrition (ie, protein, calcium, and vitamin D consumption; moderate physical activity with weight-bearing exercise) is required.[23,37] After the peak BMD has been reached, it may only be lost or maintained.[37] It is crucial that athletes possess this knowledge so that they can build and maintain BMD during these years to optimize bone health. The overall prevalence of low BMD among athletes is unknown and varies by study depending on the method of evaluation[4,14-18,27,31,34,35] (Table 4).

DEXA is the diagnostic modality of choice for evaluation of BMD. When interpreting BMD from a DEXA scan of a premenopausal female athlete aged ≥20 years, the Z-score of the hip and a PA radiographic view of the lumbar spine should be used. In adolescents and children, a PA radiographic view of the spine and total body less the head are the preferred methods for evaluating BMD.[38] The Z-score is used to compare the subject with a control of the same sex and age. The T-score, which is also used to evaluate BMD, can be used to compare the patient's BMD to that of an average adult at peak BMD and is used to evaluate BMD in postmenopausal women. BMD is considered low when the Z-score is <-2.0 standard deviations (compared with normal controls). In premenopausal female athletes, a score >-1.0 standard deviation is considered abnormal and requires further evaluation. If a female athlete has a history of stress fractures or stress reactions, further investigation of low BMD is required.[5,15]

Treatment of low BMD depends on the underlying cause. Exercise and adequate nutrition are important for treatment and prevention. Weight-bearing and dynamic exercises have a positive effect on bone formation and BMD, especially in

premenopausal females.[23] Calcium and vitamin D supplements may be desirable in some cases. The recommended amount of calcium and vitamin D intake for adults is 1,000 mg and 600 to 800 IU, respectively.[39] It is also prudent to screen for other factors that may accelerate bone loss, including corticosteroid use, regular alcohol consumption, cigarette smoking, protein deficiency, and hyperthyroidism.[40] In the female athlete, menstrual function should be evaluated and must be corrected if it is abnormal because estrogen plays a direct role in bone health and remodeling. Increasing energy availability is the mainstay of treatment for amenorrhea. OCPs should not be used as a first-line treatment to halt additional bone loss. Because an increase in weight has been shown to correlate with an increase in BMD, increasing weight should be the initial focus of treatment in these patients.[5,28] Education of athletes with regard to proper nutrition, menstrual function, and low BMD is needed to help prevent the manifestation of this component of the triad in female athletes.

Summary and Future Research

As female participation in sports continues to increase and become more competitive, it is important to prevent, diagnose, and manage the components of the female athlete triad in athletes. Educating the athlete about proper nutrition is an important part of preventing this condition. In the past, diagnosis of the triad based on its original definition was an easier task because all three components (disordered eating, amenorrhea, osteoporosis) had to be present simultaneously. Pharmacologic treatment was used to restore menses and was believed to halt loss of BMD. However, the use of pharmacologic therapy has fallen out of favor, and the current mainstay of treatment is to increase energy availability, which leads to the resumption of menses and halts additional bone loss. Because the definition of the triad has been modified to that of a spectrum disorder, index of suspicion plays an important role in diagnosis during the assessment of a female athlete. Although the female athlete triad poses a great health risk, the benefits of participation in sports significantly outweigh the risks.[15]

Any athlete who falls under the so-called umbrella of the triad should be questioned and educated regarding all of the components and potential health risks of this condition. By preventing premature bone loss in young female athletes, we can prevent future fragility fractures. Education of athletes is crucial to prevention. If athletes can understand the importance of optimal energy availability and how it directly affects bone and reproductive health, the pathology associated with the components of the triad may be avoided.

Coaches, athletic trainers, and healthcare providers should also be educated about the female athlete triad to detect and recognize its components before athletes reach the pathologic end of the spectrum. A thorough history and physical examination by a healthcare provider is also prudent in discovering if a female athlete is at risk for developing any of the pathologic entities of the triad. Treating this cohort of athletes is a multidisciplinary effort. First, educating the athlete must be an integral component of the treatment plan. Healthcare providers such as orthopaedists or primary care physicians should be involved. A mental health provider is essential for treating athletes with disordered eating. A registered dietician also plays an integral role in treatment given that most of the negative effects associated with the triad originate with low energy availability.

Further research is needed to determine the true prevalence of the triad and identify which females are at risk. Awareness levels among athletes, coaches, and healthcare professionals should be assessed to determine where education is needed most. A patient may present with any of the components of the triad; therefore, an awareness of these components among all involved in the care of female athletes is prudent.

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Evidence-based Medicine: Levels of evidence are described in the table of contents. In this article, references 4, 33, and 35 are level II studies. References 6, 11, 12, 15, 18, 19, 21, and 29 are level III studies. References 14, 16, 17, 20, 25-27, 31, 34, and 36 are level IV studies. References 3, 5, 23, 24, 28, 30, 32, 37, and 40 are level V expert opinion.

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