



# Eating Disorders

9

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## Introduction

Eating disorders are devastating diseases that are experienced by athletes and nonathletes, all genders, children, adolescents, and adults. Among athletes, eating disorders have long been recognized in females who seek to optimize their performance by manipulating their dietary intake and in turn body size, shape, and weight. Taken to the extreme, this can have negative impacts on health and performance [1]. Increasingly, we are observing eating disorders in athletes across genders, and similar to females, as an attempt to improve sport performance [2].

Eating disorders often result in a state of “low energy availability” (low EA, to be described later), which in turn causes disruption of reproductive physiology. In females, low EA manifests in oligo- or amenorrhea, hypoenestrogenism, and low bone mineral density (BMD). Referred to as the Female Athlete Triad (Triad), this scenario increases the likelihood of sport-related bone stress injuries (BSIs) [3].

More recently, the Male Athlete Triad has been defined. Similar to what is observed in females who, through dietary restriction and/or excessive exercise, develop a state of low EA, males experience hypogonadotropic hypogonadism, resultant low bone mineral density, and an increase in the risk of sport-related BSIs [4].

While some may consider BSIs to be a minor inconvenience, they can be a season-ending, or worse yet, career-ending, life-altering injury. Imagine the scenario of the athlete with a tension side femoral neck stress fracture, who, despite pain, continues to train until she suffers a fatigue fracture resulting in the placement of a femoral rod or need for a hip replacement.

It is critically important that sports medicine providers (physicians, athletic trainers, physical therapists, sports dietitians) understand the athlete at risk for eating disorders,

recognize behaviors, symptoms, and signs of an eating disorder, and within their scope of practice, intervene as early as possible to prevent adverse consequences to health and performance.

## Epidemiology

Eating disorders are defined by the *Diagnostic and Statistical Manual of Mental Disorders 5th edition* (Table 9.1). While binge-eating disorder is most common in the general population (3.5% of women and 2.0% of men, or three times anorexia nervosa and bulimia nervosa combined) [6], the concern among athletes is typically for anorexia nervosa and bulimia nervosa. A study of US high school female athletes found that 41.5% reported disordered eating [7]. A survey of US college female athletes revealed that 25.5% reported sub-clinical eating disorder symptoms [8].

## Females

It is estimated that nearly 1 in 20 females are affected by an eating disorder (anorexia nervosa, bulimia nervosa, binge-eating disorder) [9]. The proportion of female athletes affected varies by several factors including age, sport, and level of competition. While any athlete may develop an eating disorder, athletes participating in sports where leanness confers a competitive advantage, aesthetic sports, and weight category sports are often affected at higher rates [10].

## Males

While females are more likely to be affected by eating disorders, increasingly, males are engaging in pathologic eating behaviors. In the United States, it is estimated that eating disorders (anorexia nervosa, bulimia nervosa, binge-eating disorder) affect 2.2% of males [9, 11]. The sports in which

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**Table 9.1** Eating disorders as defined in the *Diagnostic and Statistical Manual of Mental Disorders 5th edition (DSM-5)* [5]

Eating disorder	Diagnostic criteria	Types	Severity
Anorexia nervosa	• Restriction of dietary intake leading to low body weight for age, sex, growth, and health	• Restricting type—no binge eating; includes those who achieve weight loss through excessive exercise	Adults (for children and adolescents, corresponding BMI <i>percentiles</i> should be used):
	• Intense fear of weight gain or becoming fat, despite low body weight	• Binge-eating/purging type—includes those who engage in recurrent binge/purge behaviors	• Mild: BMI $\geq 17$ kg/m <sup>2</sup>
	• Disturbance in how body size, shape, and weight is experienced, and persistent lack of recognition of how low body weight is impacting health		• Moderate: 16–16.99 kg/m <sup>2</sup> • Severe: 15–15.99 kg/m <sup>2</sup> • Extreme: <15 kg/m <sup>2</sup>
Bulimia nervosa	• Recurrent binge eating, and a lack of control over eating		• Mild: 1–3 episodes of compensatory behaviors/week
	• Regular use of compensatory behaviors such as self-induced vomiting, use of laxatives, diuretics, fasting, and/or excessive exercise		• Moderate: 4–7 episodes/week • Severe: 8–13 episodes/week • Extreme: 14 or more episodes/week
Binge-eating disorder	• Recurrent binge eating, and a lack of control over eating		• Mild: 1–3 binge eating episodes/week
	• Eating more rapidly than normal, until uncomfortably full, consuming large amounts of food, eating alone (due to embarrassment over eating), feeling disgusted and shame after bingeing		• Moderate: 4–7 episodes/week
	• Binge eating occurs at least 1 time/week		• Severe: 8–13 episodes/week
	• Not associated with compensatory behaviors		• Extreme: 14 or more episodes/week
Avoidant/restrictive food intake disorder	• More often observed in children		
	• Results in eating/feeding avoidance as a result of apparent lack of interest in eating, of concern about a negative experience associated with eating, e.g., dysphagia, nausea, abdominal pain, or of avoidance based on the sensory characteristics of food		
	• Results in a failure to meet nutrition and energy needs in support of growth, function, and health		
Unspecified or other specified feeding or eating disorder	• These terms largely replace the former “Eating Disorder Not Otherwise Specified—EDNOS”		
	• Used when an individual presents with behaviors that do not meet the full diagnostic criteria of other defined eating disorders (e.g., an athlete with “atypical anorexia nervosa” who technically has a normal BMI—perhaps because of high muscle mass—but otherwise meets criteria for anorexia nervosa)		

BMI body mass index

males are most likely to be affected by eating disorders are similar to those in which females are most likely to be affected.

### Para Athletes, Racial and Ethnic Minorities, LGTBQ Athletes

Less is known about the risk and prevalence of eating disorders (and the Female and Male Athlete Triads) in diverse populations of athletes. A study of US elite male and female para athletes ( $n = 260$ ) examined nutrition, menstrual function, bone health, and awareness of the Female Athlete Triad. Few respondents reported an eating disorder (3.1%), although 32.4% had elevated Eating Disorder Examination Questionnaire (EDE-Q) pathologic behavior subscale scores,

and a majority of respondents reported efforts to change their weight and body composition to improve performance. Over 9% reported BSIs, and 54% reported low BMD. Less than 10% were aware of the Triad [12].

While eating disorders have long been thought of as disorders affecting upper middle class white females, that is in fact far from the truth. Hispanic and Black teenagers are more likely to suffer from bulimia nervosa compared to white teens [13], and people of color with eating disorders are significantly less likely to receive help for their eating disorder [14]. There remains a significant gap in our understanding of eating disorders in racial and ethnic minority athletes.

Eating disorders are observed at higher rates among gay males [15, 16] and transgender college students [17]. Eating disorder rates among LGTBQ athletes are unknown.

## Health and Sport Consequences of Eating Disorders: A Systems Approach

Eating disorders can affect many aspects of human physiology. Among athletes, this can demonstrably impact performance due to acute injury, nonhealing injury, or as a result of other altered physiologic functions.

### Reproductive and Endocrine

Eating disorders result in hypogonadotropic hypogonadism in females and males. The relationship between low EA (from dietary restriction, excessive exercise, and/or other purging behaviors), menstrual dysfunction leading to hypoestrogenism, and low BMD is known as the Female Athlete Triad [3]. More recently, the relationship between low EA, hypogonadotropic hypogonadism, and low BMD in males has been referred to as the Male Athlete Triad [4].

In females, the Triad may result in reversible infertility. In males, the Triad may result in decreased libido and oligospermia. The degree of energy deficiency necessary to cause these reproductive/endocrine consequences appears to be greater among males compared to females.

Importantly, in the Female and Male Athlete Triads, low EA and its consequences may occur with or without an eating disorder. Although the exact prevalence of eating disorders as part of the Triads is unknown, clinical observation would suggest that it is a majority—meaning that low EA is a consequence of intentional dietary restriction, excessive exercise, purging behaviors, or some combination. EA is defined as the amount of energy (kilocalories) that remains after subtracting average daily exercise energy expenditure from average daily dietary energy intake, then normalizing (dividing) by the person's fat-free mass (FFM). The formula looks like this:

$$\text{Energy availability (kcal)} = \frac{\text{Avg Daily Energy Intake (kcal)} - \text{Avg Daily Exercise Energy Expenditure (kcal)}}{\text{Fat Free Mass (kg)}}$$

Components of the Female Athlete Triad vary depending on sport and competitive level. Rates of disordered eating are observed in as high as 70% of elite athletes. Likewise, the prevalence of menstrual dysfunction among athletes where leanness is emphasized can be as high as 69%. Finally, the prevalence of osteopenia among female athletes ranges between 22% and 50% [18]. An athlete with any one component of the Triad should be thoroughly evaluated for the other components.

Beyond abnormalities of reproductive physiology, a multitude of hormonal abnormalities result from eating disorders, especially anorexia nervosa [19]. In women with low weight from anorexia nervosa, total T3 tends to be low, and free T4 and TSH vary from normal to low normal. These changes are not reflective of thyroid disease but are an adaptive response to decreases in metabolic rate and energy expenditure. Cortisol levels are almost universally elevated in women with anorexia nervosa and can result in Cushing's-like symptoms (e.g., low bone mineral density, truncal fat accumulation with weight regain). Elevated antidiuretic hormone can result in hyponatremia. Interestingly, anorexia nervosa-related alterations in the levels of estrogen, androgens, and cortisol are associated with higher measures of anxiety and depression [19].

### Musculoskeletal

The combination of low bone mineral density and weight bearing or sport-related bone stress can lead to BSI—stress reactions or stress fractures. The mechanism for low bone mineral density is an imbalance between osteoblasts and osteoclasts brought on by decreased lean mass and hormonal alterations [20, 21]. Low bone density may result from inadequate acquisition of bone mineral density during periods of growth, the loss of bone mineral density, or both. Resultant BSIs are most commonly observed in weight bearing athletes such as runners, dancers, and soldiers. In decreasing order of frequency, BSIs occur in the metatarsals, tibia, tarsals, femur, fibula, and pelvis [22]. Upper extremity focused sports may develop BSIs of the ribs or humerus.

### Neuropsychiatric

A study of more than 2400 individuals hospitalized for an eating disorder found that 94% of the participants had a co-occurring mood disorder, with 92% of those in the sample struggling with a depressive disorder [23]. Also common are obsessive-compulsive disorder (OCD) [24] and post-

traumatic stress disorder (PTSD) [25]. Anorexia nervosa has a mortality rate of 10%, and it is estimated that one in five deaths is by suicide [26]. According to the National Center on Addiction and Substance Abuse, up to 50% of individuals with eating disorders misused alcohol or illicit drugs, a rate five times higher than in the general population [27]. In a study of women with bulimia nervosa, 31% had a history of alcohol abuse and 13% had a history of alcohol dependence (using prior DSM terminology) [28]. Less is understood about the risk of substance use disorders in athletes with concurrent eating disorders.

### **Cardiopulmonary [29]**

Cardiac consequences of anorexia nervosa and bulimia nervosa result from dietary restriction, fluid restriction, excessive exercise, weight loss, and electrolyte disturbances. Arrhythmias can include bradycardia and tachycardia. Electrocardiography abnormalities can include prolonged Q-T intervals and low voltage. Echocardiograms may show cardiac hypoplasia and mitral valve prolapse. Hemodynamic problems include hypotension, orthostasis, near syncope, and syncope.

Sports medicine physicians should consider a cardiology consultation for patients demonstrating resting heart rate <40 beats/min, prolongation of the Q-T interval, evidence of anatomical abnormalities (e.g., valvular heart disease, congestive heart failure), or syncope; during ongoing cardiology consultation, participation in training and competition should be prohibited.

### **Oropharyngeal**

Oropharyngeal manifestations of eating disorders are typically observed in those who engage in self-induced vomiting (SIV). Specifically, these manifestations include dental enamel erosion and recurrent sore throats. Efforts to reduce dental erosion include rinsing the oral cavity with a solution of baking soda and water immediately after vomiting to neutralize hydrochloric acid. Individuals actively engaged in SIV should be cautioned to NOT brush their teeth immediately after purging as this can further expose the teeth and gums to gastric acid.

Other oropharyngeal consequences include mouth sores, perleche, cracked lips, parotid gland enlargement, dental decay and loss of teeth, and bleeding gums.

### **Gastrointestinal [30]**

Gastrointestinal (GI) complications of eating disorder behaviors are quite common and can be very impactful. Constipation is the most frequent GI consequence among patients with either bulimia nervosa or anorexia nervosa. Recurrent SIV results in scarring and dysfunction of the gastroesophageal (GE) junction and subsequent GE reflux (GERD), regurgitation, and esophagitis. Forceful SIV can result in acute injury, tears, and bleeding at the GE junction, known as a Mallory–Weiss tear. Patients abusing laxatives will experience diarrhea and are at higher risk of hemorrhoids and rectal prolapse.

Chronic dietary restriction may result in paradoxical satiety as well as functional gastroparesis. Patients will complain of significant bloating, discomfort, and nausea with minimal oral intake, resulting in further dietary restriction. Significant weight loss resulting in decreased visceral fat can lead to superior mesenteric artery syndrome, and abdominal pain that worsens with eating.

### **Renal [31]**

Renal abnormalities may occur as a result of restriction or purging. Chronic hypokalemia can lead to irreversible chronic kidney disease. Restriction of fluid intake increases the risk of nephrolithiasis.

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## **Clinical Best Practice in Screening, Evaluation, Treatment, and Return to Sport**

All members of the athlete care team have a role in the identification, care, and safe return to sport for athletes affected by eating disorders.

### **Screening**

Although the US Preventive Services Task Force recently concluded that the current evidence is insufficient to assess the balance of benefits and harms of screening for eating disorders in adolescents and adults, providing an “I” statement, the task force did acknowledge the higher prevalence of eating disorders among athletes and other high-risk groups [32].

Recognizing the higher risk of eating disorders among athletes, screening for eating disorders in athletes has long

been recommended and is often initiated during the sports preparticipation evaluation. The *Preparticipation Physical Evaluation* (PPE) Monograph, now in its 5th edition [33], developed by six medical professional organizations in the United States, includes questions to screen for eating disorders and related consequences:

- Do you worry about your weight?
- Are you trying to or has anyone recommended that you gain or lose weight?
- Are you on a special diet or do you avoid certain types of foods or food groups?
- Have you ever had an eating disorder?

And for females:

- 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?

The International Olympic Committee (IOC) Periodic Health Examination includes the following relevant questions [34]:

Nutrition questions:

- Do you worry about your weight or body composition?
- Are you satisfied with your eating pattern?
- Are you a vegetarian?
- Do you lose weight to meet weight requirements for your sport?
- Does your weight affect the way that you feel about yourself?
- Do you worry that you have lost control over how much you eat?
- Do you make yourself sick when you are uncomfortably full?
- Do you ever eat in secret?
- Do you currently suffer, or have you ever suffered in the past with an eating disorder?

And for females:

- Have you ever had a menstrual period?
- What was your age at your first menstrual period?
- Do you have regular menstrual cycles?
- How many menstrual cycles did you have in the last year?
- When was your most recent menstrual period?
- Have you had a stress fracture in the past?
- Have you ever been identified as having a problem with your bones such as low bone density (osteopenia or osteoporosis)?

- Are you presently taking any female hormones (estrogen, progesterone, birth control pills)?

Once completed, the sport preparticipation history form is reviewed by the sports medicine physician and oftentimes the athlete care team to determine if further evaluation and treatment is necessary.

## Evaluation and Treatment

If an athlete is identified as at risk for an eating disorder, is demonstrating signs and symptoms of an eating disorder, or is active in their eating disorder, they should undergo evaluation and treatment by members of a multidisciplinary team. Athlete-centered care is the goal, leveraging both expertise and trusted relationships between the athlete and the care team. Figure 9.1 demonstrates the relationships between the athlete and their care team:

The bi-directional arrows in Fig. 9.1 represent the importance of information sharing between members of the multidisciplinary care team. This provides for comprehensive assessment and development of a collaborative, cohesive treatment plan.

Each member of the team has their domain of expertise, but there is cross-over between disciplines. For example, the *sports medicine physician* is not only managing health consequences of an eating disorder, but also assessing dietary intake and mental well-being. The *sports dietitian* is most effective as a “nutrition therapist,” understanding the emotional connections between food, eating, and body image, and applying evidence-based behavior change. The role of the *mental health professional* is critical, and expertise in eating disorder care is essential. Suicide is the second lead-

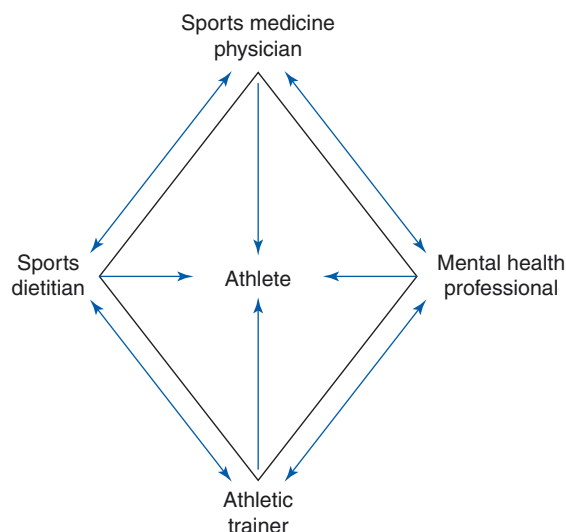


Fig. 9.1 Multidisciplinary care of athletes with eating disorders

**Table 9.2** Roles and responsibilities of the multidisciplinary athlete care team

Role	Screening/identification	Evaluation	Treatment
Sports medicine physician	<ul style="list-style-type: none"> <li>• During the preparticipation physical evaluation</li> <li>• Any time presenting with signs and symptoms</li> </ul>	<ul style="list-style-type: none"> <li>• History and physical examination, including detailed mental health assessment</li> <li>• Laboratory testing</li> </ul>	<ul style="list-style-type: none"> <li>• Refer to other members of multidisciplinary team</li> <li>• Prescribe pharmacotherapy when indicated</li> </ul>
	<ul style="list-style-type: none"> <li>• Referral from other members of athlete care team</li> </ul>	<ul style="list-style-type: none"> <li>• Other diagnostic testing as indicated (electrocardiogram, bone density testing)</li> </ul>	<ul style="list-style-type: none"> <li>• Treat associated conditions (e.g., mood and anxiety disorders) and injuries (e.g., bone stress injuries)</li> <li>• Responsible for clearance and return to play decision-making</li> </ul>
	<ul style="list-style-type: none"> <li>• Same as sports medicine physician (in some settings, athletes routinely undergo screening with a registered dietitian as part of the preparticipation physical evaluation)</li> </ul>	<ul style="list-style-type: none"> <li>• Detailed dietary history, including pathologic eating and exercise behaviors</li> </ul>	<ul style="list-style-type: none"> <li>• Provide medical nutrition therapy</li> </ul>
Mental health professional	<ul style="list-style-type: none"> <li>• Same as sports medicine physician (In some settings athletes routinely undergo screening with a mental health professional as part of the preparticipation physical evaluation)</li> </ul>	<ul style="list-style-type: none"> <li>• Detailed psychological and behavioral history with a focus on body image, psychosomatic reactions, physiology, past and ongoing physical and psychological trauma, assessing the current situation, taking a psychological approach for the assessment of comorbid conditions (e.g., mood and anxiety disorders)</li> </ul>	<ul style="list-style-type: none"> <li>• Provide psychotherapy (most often cognitive behavioral therapy)</li> <li>• Prescribe and monitor pharmacotherapy when indicated (in the case of psychiatry)</li> </ul>
Athletic trainer	<ul style="list-style-type: none"> <li>• The “eyes and ears” of the athlete care team</li> </ul>	<ul style="list-style-type: none"> <li>• Initial assessment of eating disorder-related conditions (e.g., bone stress injuries)</li> </ul>	<ul style="list-style-type: none"> <li>• Support the athlete in staying engaged in treatment</li> </ul>
	<ul style="list-style-type: none"> <li>• Often are the first to identify the athlete who is struggling from the effects of an eating disorder</li> </ul>		<ul style="list-style-type: none"> <li>• Perform physician directed biometric assessments (e.g., weight, heart rate, blood pressure)</li> </ul>
	<ul style="list-style-type: none"> <li>• May observe pathologic eating and exercise behaviors</li> </ul>		<ul style="list-style-type: none"> <li>• Assist in the rehabilitation of associated injuries</li> <li>• Help to keep the athlete engaged with the team if participation is restricted</li> <li>• Work with coaching staff to reengage the athlete with training when cleared by sports medicine physician</li> </ul>

ing cause of death for individuals with anorexia nervosa—a rate that is 18 times higher than age and gender matched comparison groups. Between a quarter and a third of those with anorexia nervosa or bulimia nervosa have considered suicide, and a quarter have attempted suicide [35]. Finally, the *athletic trainer* often is the “eyes and ears” of the athlete care team. They are the healthcare professionals who spend the most time with the athlete and are more likely to observe aberrant eating behaviors, excessive exercise, or hear from team members concerns about eating disorder behaviors at home and on the road.

The odds of developing an eating disorder after sexual violence are substantial; a history of rape increases the odds for lifetime incidence of eating disorder by nearly 22-fold. Similarly, among women with eating disorders, there is a much higher likelihood of experiencing sexual violence [36].

Given the relationship between sexual violence and eating disorders, it bears mention that sports medicine physicians and mental health professionals should ascertain whether an athlete with an eating disorder has experienced or is experiencing sexual violence.

Table 9.2 provides a summary of the roles and responsibilities of each member of the athlete care team when caring for an individual with an eating disorder.

Treatment of eating disorders exists on a continuum (outpatient to residential) based on severity of illness and involves each member of the multidisciplinary team. Ideally, patients/athletes are able to safely and adequately receive care in outpatient settings, where they are regularly seen by their physician, dietitian, and psychotherapist. The focus of treatment is psychotherapy and nutrition therapy. The goal of treatment is to address attitudes and beliefs about food,



weight, eating, and body image, improve behaviors (i.e., involving eating, exercise, weighing), and normalize weight. Among athletes, sport is often a strong motivator to engage in treatment and recover. It is important that members of the treatment team understand the physical/psychological demands of an athlete's sport to inform treatment goals and safe return to sport.

Although the primary treatment for eating disorders is nutrition therapy and psychotherapy, patients/athletes may benefit from pharmacotherapy for their eating disorder and/or related co-morbidities. Only two medications in the United States have a Food and Drug Administration (FDA) indication

for the treatment of eating disorders: fluoxetine for bulimia nervosa, and lisdexamfetamine for binge eating disorder [37]. Importantly, stimulants such as lisdexamfetamine are typically prohibited or tightly regulated in sport at the collegiate or higher levels and may require therapeutic use exemptions in order to be used. While other psychotropic medications are often prescribed, it is typically an off-label application, or alternatively to treat mental health co-morbidities and physical health consequences of an eating disorder. Table 9.3 is a non-exhaustive list of medications that may be used or should be avoided in the treatment of athletes affected by an eating disorder and related consequences.

**Table 9.3** Pharmacotherapy of eating disorders and related symptoms or disorders

Condition/medication	Notes
Eating disorder	
Fluoxetine	Indicated for the treatment of bulimia nervosa.
Vyvanse	Indicated for the treatment of binge eating disorder.
Depression, anxiety, and insomnia	
Selective serotonin reuptake inhibitors (SSRIs)	Often a first choice in the treatment of depression and anxiety.
Mirtazapine	Indicated for the treatment of depression. Associated with weight gain (which may or may not be desirable). Sedating.
Bupropion	<b>Avoid</b> in patients with a history of seizures. <b>Avoid</b> in patients with an eating disorder involving restricting or purging. In combination with electrolyte disturbances, it is more likely to lower seizure threshold.
Benzodiazepines	<b>Use with caution.</b> Can cause tolerance and dependence. Sedating. Do not use in close relationship to training or competition.
Trazodone	Sedating. Can cause orthostatic hypotension. <b>Avoid</b> in athletes who participate in sports with significant postural changes (e.g., gymnastics, diving).
Thought disturbance	
Atypical antipsychotics	There is some evidence of positive effects on depression, anxiety, and core eating disordered psychopathology in patients with anorexia nervosa [38]. Associated with weight gain (which may or may not be desirable). <b>Use with caution</b> in athletes where weight gain may adversely affect performance or safety (e.g., sports dependent on positive strength to weight ratios, sports where athletes must carry weight over distance, sports with weight class requirements).
Amenorrhea	
Estrogen patch + oral progesterone	<b>Preferred treatment</b> in athletes with low BMD, one or more low risk or one high risk stress fracture, and persistent amenorrhea despite 1 year of nonpharmacologic treatment [39].
Etonogestrel and ethinyl estradiol ring (NuvaRing)	Consider for hormone replacement therapy in athletes with a need for contraception [39].
Combined oral contraceptive pills	<b>Avoid</b> in athletes with hypothalamic hypogonadism, as first pass metabolism in the liver may adversely affect hormones in support of bone health [39].
Low bone mineral density	
Calcium	Ensure adequate dietary intake of calcium or supplement 1000–1300 mg daily.
Vitamin D	Supplement if indicated.
Bisphosphonates	Consider in athletes with nonhealing stress fracture.
Teriparatide	Consider in athletes with nonhealing stress fracture.
Gastrointestinal symptoms	
Proton pump inhibitors	Consider for athletes with symptoms of gastroesophageal reflux as a result of current or past self-induced vomiting.
H2 blockers	Consider for athletes with symptoms of gastroesophageal reflux as a result of current or past self-induced vomiting.
Erythromycin	Acts as a promotility agent. Consider in the athlete with constipation.
Metoclopramide	Promotility agent. Consider in the athlete with symptoms of gastroparesis. Has significant drug interactions. May be sedating.
Miralax	Osmotic-type laxative. Consider in the athlete with constipation.

BMD bone mineral density

## Recovery From Eating Disorders

A review of 119 studies, including nearly 6000 patients, found that approximately half of eating disorder survivors recovered, one-third improved, and 20% remained chronically ill. Predictors of recovery were younger age at onset and longer duration of follow-up [40]. A 22-year follow-up study of patients with anorexia nervosa or bulimia nervosa found that approximately two-thirds were recovered. Notably a third had persistent disease [41]. Few studies have examined eating disorder recovery in athletes. A 2014 study of 47 current and former US collegiate athletes who completed an online questionnaire examined factors associated with recovery. At the time of the study, 77% had fully recovered, and 33% had relapsed. A third of respondents indicated that their desire to recover was facilitated by a desire to regain their strength and ability to fully participate in their sport. Over a quarter of respondents reported that changing values and beliefs and support from others were key to their recovery [42].

## Return to Sport

Decisions regarding return to sport ultimately lie with the team physician, but it is often the collective assessment of the multidisciplinary team that determines the athlete's readiness to return to training and competition. One of the first guides for return to sport came from the Female Athlete Triad Coalition in their publication, *2014 Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013* [39]. This publication provides physicians with a Cumulative Risk Assessment tool for female athletes affected by the Triad, and Clearance and Return-to-Play (RTP) Guidelines based on their medical risk stratification. Notably, the guidelines state, "It is the recommendation of the Consensus Panel that athletes diagnosed with anorexia nervosa who have a body mass index (BMI) <16 kg/m<sup>2</sup> or with moderate-to-severe bulimia nervosa (purging >4 times/week) should be categorically restricted from training and competition. Future participation is dependent on treatment of their eating disorder, including ascertainment of BMI > 18.5 kg/m<sup>2</sup>, cessation of bingeing and purging and close interval follow-up with the multidisciplinary team."

While developed for females, a 2019 study examined the predictability of the Cumulative Risk Assessment tool in 156 male collegiate distance runners. Using the risk assessment categories of low energy availability, low BMI, BMD, and prior BSI, investigators found that prior BSI was associated with a 57% higher risk of prospective BSI, and every one-

point increase in the cumulative risk score was associated with a 37% increase in prospective BSI [43].

Athletes who are identified as being at moderate to high risk based on the Cumulative Risk Assessment tool should be provided with a written contract that clearly describes expectations of the treatment team, the responsibilities of the athlete in their recovery, and the criteria for safe return to training and competition.

Even upon return to sport, it is critical that the athlete have regular follow-up with members of the multidisciplinary team to ensure adherence to recommended guidelines for safe participation.

Some athletes will be unable to resolve their eating disorder sufficiently to safely return to sport, and some will require a higher level of care (e.g., intensive outpatient programs, partial hospitalization programs, hospitalization, or residential care) to recover. It is incumbent on the sports medicine physician to know when a higher level of care is necessary, and what resources for such care are available within the community to facilitate timely referrals to expert care. Beware of the athlete restricted from training and competition who isolates and restricts their dietary intake to such an extent that their life is at risk. Anorexia nervosa has the second highest mortality rate (opioid use disorder being first) of any mental health disorder [44]. Athletic trainers can play a key role in checking in with the restricted athlete and ensuring that they are actively participating in recommended treatment.

## Prevention of Eating Disorders

Recognizing the risks of developing an eating disorder inherent in sport (some sports more than others), it behooves all members of the athlete care team and sports administrators to engage in efforts to prevent eating disorders. This includes education of athletes, parents, and coaches, as well as ensuring members of the athlete care team have the necessary expertise. A 1-year school-based intervention within Norwegian Elite High Schools that aimed to decrease eating disorders and disordered eating behaviors in elite adolescent female and male athletes was successful in the prevention of eating disorders and a reduction in disordered eating behaviors [45].

Educational resources have been developed by the US National Collegiate Athletic Association (<https://www.ncaa.org/sports/2014/11/4/mind-body-and-sport-eating-disorders.aspx>), by the International Olympic Committee (<https://olympics.com/ioc/healthy-body-image>), and by the Female and Male Athlete Triad Coalition (<https://www.femaleandmaleathletriad.org/>). Sports medicine physicians, sports dietitians, and athletic trainers should all be trained to recognize the athlete who is either at risk for



development of an eating disorder or is early in their disease, to prevent worsening health consequences. Early intervention is associated with better outcomes [46].

## Summary

Athletes are at risk for the development of eating disorders due to pressures applied/perceived to optimize their body weight/composition to improve sport performance. Additionally, athletes face unique pressures due to sport, as a result of attempting to balance academic demands and sport, and like others, may experience traumatic events, all of which may trigger eating disordered behaviors. The consequences of eating disorders are extensive and affect nearly every system of the body. Resultant low energy availability adversely affects reproductive physiology across genders. In turn, hypogonadotropic hypogonadism may result in low bone mineral density, increasing the risk of BSI—a constellation of conditions referred to as either the Female Athlete Triad or Male Athlete Triad.

Each member of the athlete care team has a role in the prevention, screening, evaluation, and treatment of athletes affected by the Triad. The sports medicine physician is responsible for screening (during the preparticipation physical evaluation), evaluation, treatment, and return to sport decisions. Evidence-based guidance on clearance and return to play is available for female athletes and can inform decision-making for athletes across genders. The sports dietitian has a critical role in helping the athlete achieve adequate caloric and nutrient intake to restore normal physiology. Mental health professionals with experience in eating disorder care (and preferably athlete care) are essential in the treatment of an athlete with an eating disorder [47]. Finally, athletic trainers are often closest to the athlete and may observe concerning eating and exercise behaviors, overhear comments about body size, shape, or weight, and are often the first people to whom a concerned teammate or coach may reach out.

## References

1. El Ghoch M, Soave F, Calugi S, Dalle GR. Eating disorders, physical fitness and sport performance: a systematic review. *Nutrients*. 2013;5(12):5140–60.
2. Glazer JL. Eating disorders among male athletes. *Curr Sports Med Rep*. 2008;7(6):332–7.
3. Nattiv A, Loucks AB, Manore MM, Sanborn CF, Sundgot-Borgen J, Warren MP, American College of Sports Medicine. American College of Sports Medicine position stand. The female athlete triad. *Med Sci Sports Exerc*. 2007;39(10):1867–82.
4. Nattiv A, De Souza MJ, Koltun KJ, Misra M, Kussman A, Williams NI, Barrack MT, Kraus E, Joy E, Fredericson M. The male athlete triad—a consensus statement from the female and male athlete triad coalition part 1: definition and scientific basis. *Clin J Sport Med*. 2021;31(4):335–48.
5. American Psychiatric Association. Desk reference to the diagnostic criteria from DSM-5 (R). Washington, DC: American Psychiatric Association Publishing; 2013.
6. Hudson JL, Hiripi E, Pope HG Jr, Kessler RC. The prevalence and correlates of eating disorders in the National Comorbidity Survey Replication. *Biol Psychiatry*. 2007;61(3):348–58.
7. Jankowski C. Associations between disordered eating, menstrual dysfunction, and musculoskeletal injury among high school athletes. *Yearbook Sports Med*. 2012:394–5.
8. Greenleaf C, Petrie TA, Carter J, Reel JJ. Female collegiate athletes: prevalence of eating disorders and disordered eating behaviors. *J Am Coll Heal*. 2009;57(5):489–96.
9. Duncan AE, Ziobrowski HN, Nicol G. The prevalence of past 12-month and lifetime DSM-IV eating disorders by BMI category in US men and women. *Eur Eat Disord Rev*. 2017;25(3):165–71.
10. Martinsen M, Sundgot-Borgen J. Higher prevalence of eating disorders among adolescent elite athletes than controls. *Med Sci Sports Exerc*. 2013;45(6):1188–97.
11. Tenforde AS, Barrack MT, Nattiv A, Fredericson M. Parallels with the Female Athlete Triad in Male Athletes. *Sports Med*. 2016;46(2):171–82.
12. Brook EM, Tenforde AS, Broad EM, et al. Low energy availability, menstrual dysfunction, and impaired bone health: a survey of elite para athletes. *Scand J Med Sci Sports*. 2019;29:678–85.
13. Swanson SA, Crow SJ, Le Grange D, Swendsen J, Merikangas KR. Prevalence and correlates of eating disorders in adolescents. Results from the national comorbidity survey replication adolescent supplement. *Arch Gen Psychiatry*. 2011;68(7):714–23.
14. Marques L, Alegria M, Becker AE, Chen C, Fang A, Chosak A, Diniz JB. Comparative prevalence, correlates of impairment, and service utilization for eating disorders across U.S. ethnic groups: implications for reducing ethnic disparities in health care access for eating disorders. *Int J Eat Disord*. 2011;44(5):412–20.
15. Strother E, Lemberg R, Stanford SC, Turberville D. Eating disorders in men: underdiagnosed, undertreated, and misunderstood. *Eat Disord*. 2012;20(5):346–55.
16. Feldman MB, Meyer IH. Eating disorders in diverse lesbian, gay, and bisexual populations. *Int J Eat Disord*. 2007;40:218–26.
17. Diemer EW, Grant JD, Munn-Chernoff MA, Patterson DA, Duncan AE. Gender identity, sexual orientation, and eating-related pathology in a national sample of college students. *J Adolesc Health*. 2015;57(2):144–9.
18. Nazem TG, Ackerman KE. The female athlete triad. *Sports Health*. 2012;4(4):302–11.
19. Schorr M, Miller KK. The endocrine manifestations of anorexia nervosa: mechanisms and management. *Nat Rev Endocrinol*. 2017;13(3):174–86.
20. Misra M, Klibanski A. Bone health in anorexia nervosa. *Curr Opin Endocrinol Diab Obes*. 2011;18(6):376–82.
21. Fazeli PK, Klibanski A. Effects of anorexia nervosa on bone metabolism. *Endocr Rev*. 2018;39(6):895–910.
22. May T, Marappa-Ganeshan R. Stress fractures. In: *StatPearls*. Treasure Island, FL: StatPearls Publishing; 2022. <https://www.ncbi.nlm.nih.gov/books/NBK554538/>. Accessed 27 Mar 2022.
23. Tagay S, Schlottbohm E, Reyes-Rodriguez ML, Repic N, Senf W. Eating disorders, trauma, PTSD, and psychosocial resources. *Eat Disord*. 2014;22(1):33–49.
24. Mandelli L, Draghetti S, Albert U, De Ronchi D, Atti AR. Rates of comorbid obsessive-compulsive disorder in eating disorders: a meta-analysis of the literature. *J Affect Disord*. 2020;277:927–39.
25. Rijkers C, Schoorl M, van Hoeken D, Hoek HW. Eating disorders and posttraumatic stress disorder. *Curr Opin Psychiatry*. 2019;32(6):510–7.

26. Arcelus J, Mitchell AJ, Wales J, Nielsen S. Mortality rates in patients with Anorexia Nervosa and other eating disorders. *Arch Gen Psychiatry*. 2011;68(7):724–31.
27. The National Center on Addiction and Substance Abuse (CASA) at Columbia University. *Food for thought: substance abuse and eating disorders*. New York, NY: The National Center on Addiction and Substance Abuse (CASA), Columbia University; 2003.
28. Gregorowski C, Seedat S, Jordaan GP. A clinical approach to the assessment and management of co-morbid eating disorders and substance use disorders. *BMC Psychiatry*. 2013;13(1):289.
29. Casiero D, Frishman WH. Cardiovascular complications of eating disorders. *Cardiol Rev*. 2006;14(5):227–31.
30. Santonicola A, Gagliardi M, Pier Luca Guarino M, Siniscalchi M, Ciacci C, Iovino P. Eating disorders and gastrointestinal diseases. *Nutrients*. 2019;11:3038.
31. Li Cavoli G, Mulè G, Rotolo U. Renal Involvement in psychological eating disorders. *Nephron Clin Pract*. 2011;119:c338–41.
32. Screening for Eating Disorders in Adolescents and Adults. US Preventive Services Task Force recommendation statement, US Preventive Services Task Force. *JAMA*. 2022;327(11):1061–7.
33. American Academy of Pediatrics, American Academy of Family Physicians, American College of Sports Medicine, American Medical Society for Sports Medicine, American Medical Society for Sports Medicine, American Orthopaedic Society for Sports Medicine, and American Osteopathic Academy of Sports Medicine. *Preparticipation physical evaluation*. 5th ed. Itasca, IL: American Academy of Pediatrics; 2019.
34. Ljungqvist A, Jenoure PJ, Engebretsen L, Alonso JM, Bahr R, Clough AF, de Bondt G, Dvorak J, Maloley R, Matheson G, Meeuwisse W, Meijboom EJ, Mountjoy M, Pelliccia A, Schwellnus M, Sprumont D, Schamasch P, Gauthier JB, Dubi C. The International Olympic Committee (IOC) consensus statement on periodic health evaluation of elite athletes. *Clin J Sport Med*. 2009;19(5):347–65.
35. Smith AR, Zurowski KL, Dodd DR. Eating disorders and suicidality: what we know and what we don't know, and suggestions for future research. *Curr Opin Psychol*. 2018;22:63–7.
36. Hailes HP, Yu R, Danese A, Fazel S. Long-term outcomes of childhood sexual abuse: an umbrella review. *Lancet Psychiatry*. 2019;6(10):830–9.
37. Bello NT, Yeomans BL. Safety of pharmacotherapy options for bulimia nervosa and binge eating disorder. *Expert Opin Drug Saf*. 2018;17(1):17–23.
38. McKnight RF, Park RJ. Atypical antipsychotics and anorexia nervosa: a review. *Eur Eat Disord Rev*. 2010;18(1):10–21.
39. De Souza MJ, Nattiv A, Joy E, et al. Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013. *Br J Sports Med*. 2014;48:289.
40. Steinhausen HC. The outcome of anorexia nervosa in the 20th century. *Am J Psychiatry*. 2002;159(8):1284–93.
41. Eddy KT, Tabri N, Thomas JJ, et al. Recovery from anorexia nervosa and bulimia nervosa at 22-year follow-up. *J Clin Psychiatry*. 2017;78(2):184–9.
42. Arthur-Cameselle JN, Quatromoni PA. Eating disorders in collegiate female athletes: factors that assist recovery. *Eat Disord*. 2014;22(1):50–61.
43. Kraus E, Tenforde AS, Nattiv A, Sainani KL, Kussman A, Deakins-Roche M, Singh S, Kim BY, Barrack MT, Fredericson M. Bone stress injuries in male distance runners: higher modified Female Athlete Triad Cumulative Risk Assessment scores predict increased rates of injury. *Br J Sports Med*. 2019;53(4):237–42.
44. Chesney E, Goodwin GM, Fazel S. Risks of all-cause and suicide mortality in mental disorders: a meta-review. *World Psychiatry*. 2014;13(2):153–60.
45. Martinsen M, Bahr R, Børresen R, Holme I, Pensgaard AM, Sundgot-Borgen J. Preventing eating disorders among young elite athletes: a randomized controlled trial. *Med Sci Sports Exerc*. 2014;46(3):435–47.
46. Austin A, Flynn M, Shearer J, et al. The first episode rapid early intervention for eating disorders - upscaled study: clinical outcomes. *Early Interv Psychiatry*. 2022;16:97–105.
47. Rice SM, Purcell R, De Silva S, Mawren D, McGorry PD, Parker AG. The mental health of elite athletes: a narrative systematic review. *Sports Med*. 2016;46(9):1333–53.