12 Screening for Eating Disorders, Dysfunctional Exercise, and Menstrual Dysfunction in Female Athletes

Maria Fernandez-del-Valle, Danika A. Quesnel, Jennifer J. Mitchell, and Jacalyn J. Robert-McComb

Learning Objectives

Upon completion of reading this chapter, the reader will be able to:

- Become aware of the estimated prevalence of disordered eating (DE) and eating disorders (ED) in female athletes
- Understand reasons for and methods of screening for disordered eating and eating disorders in the female athlete in both informal and formal settings
- Understand reasons for and methods of screening for disordered eating and eating disorders in the female athlete in both informal and formal settings
- Become aware of screening tools that are utilized for disordered eating and eating disorders, in general, and specifically, in athletes
- Become aware of the estimated prevalence of dysfunctional exercise (DysEx) in female athletes
- Understand the different components of DysEx: Quantitative and Qualitative
- Become aware of the limitations associated with the "diagnosis" and assessment of DysEx
- Understand the methods for DysEx screening in the female athlete
- Understand the importance of screening for menstrual dysfunction in the active female
- Be able to list groups of athletes in whom screening for menstrual dysfunction is essential
- Have a resource of potential screening questions for menstrual dysfunction
- Understand the relationship of functional hypothalamic amenorrhea (FHA) with menstrual dysfunction
- Understand the relationship of low energy availability (EA) and FHA causing menstrual dysfunction and the need to improve overall EA as the first step in management

12.1 Introduction

Throughout the lifetime of a female athlete, many health concerns may arise. A few pertinent ones include disordered eating, eating disorders, dysfunctional exercise, and menstrual dysfunction. There are a number of ways to screen for these conditions in order to review risks with athletes and develop management plans.

Disordered eating (DE) may occur as a sole entity or associated with eating disorder-type behavior. Some athletes are unaware of their disordered eating, which may occur in the form of inadequate fueling after exertion, creating low energy availability. Other forms of disordered eating) may include restrictive eating, skipping meals, overexercising, and laxative abuse [1].

Eating disorders (ED) are diagnosed as mental health illnesses, meeting defined criteria per DSM-V, characterized by pathologic eating behaviors which adversely impact health [2, 3]. ED impacts female athletes more regularly than males, but recent results indicate the window between the two is becoming smaller. With that, the risk of ED in the general population compared to athletes is also narrowing [4]. There is no clearly defined standard for the methods or

M. Fernandez-del-Valle (✉)
Department of Functional Biology, School of Medicine and Health Sciences, University of Oviedo, Oviedo, Asturias, Spain

Health Research Institute of the Principality of Asturias (ISPA), Oviedo, Asturias, Spain
e-mail: dr.maria@fdelvalle.net

D. A. Quesnel
Department of Psychological Clinical Science, University of Toronto, Toronto, ON, Canada
e-mail: Danika.quesnel@mail.utoronto.ca

J. J. Mitchell
Health Sciences Center School of Medicine, Family and Community Medicine, Sports Medicine Fellowship, Texas Tech University, Lubbock, TX, USA
e-mail: jennifer.mitchell@ttuhsc.edu

J. J. Robert-McComb
Department of Kinesiology and Sport Management, Texas Tech University, Lubbock, TX, USA
e-mail: jacalyn.mccomb@ttu.edu

J. J. Robert-McComb et al. (eds.), *The Active Female*, https://doi.org/10.1007/978-3-031-15485-0_12

timing of screening female athletes for DE or ED. Several screening tools are available, but no consensus exists yet, concerning the optimal tool with athletes. Various opportunities present themselves for screening athletes for (DE/ED), but no single time has proven most advantageous. Screening may be performed in various ways, but it is optimal to gather as many objective pieces of evidence as possible, since denial by the athlete is often a large component of DE/ED. Ultimately, ideal screening is specific to each athletic level and entity, whether recreational or competitive. This chapter covers various methods and timing options for the most effective screening of female athletes for DE/ED.

Relative to DE/ED, the phenomenon of dysfunctional exercise (DysEx) can be a paradox with regard to healthful activity engagement. Physical activity and exercise are considered by scientists as a critical tool to prevent chronic physiological and psychological pathologies [5–8]. Maintaining adequate physical activity levels has positive effects on physical and mental health [9]. However, exercise, as many other behaviors, can become dysfunctional. Thus, this chapter also covers ways to recognize, screen, and manage dysfunctional exercise in female athletes.

In light of the relationship between DE/ED and DysEx, menstrual dysfunction cannot be ignored and deserves attention. Menstrual dysfunction is a condition that can appear in the female athlete's lifetime as a result of energy imbalance (either intentional or unintentional) and/or decreased energy availability. However, screening for menstrual disorders in athletes is more complicated than it might seem. Historically, the simple question was, do you have normal menstrual cycles or periods? If yes, then that was the end of the screening questionnaire. If no, the athlete was referred to the physician. With improved understanding of the female athlete triad and the components involved, screening has become more complex. In addition to menstrual status, those responsible for the health of the female athlete must also evaluate the other two components of the triad; bone health and optimal energy availability, or whether indications of DE/ED exist. Evaluation of one component of the female athlete triad should not occur in isolation from the other two components.

12.2 Definitions

12.2.1 Eating Disorders

Eating disorders, and disordered eating are similar phenomenon, but distinctly different. In athletes, DE encompasses various abnormal eating behaviors that can be inadvertent, such as inadequate refueling or they may be intentional. An ED is a clinical mental disorder, meeting diagnostic criteria as defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-V); specifically, Anorexia nervosa, Bulimia nervosa, binge-eating disorder, and other specific feeding and eating Disorders. DE is defined as having disordered attitudes or behaviors toward food and eating (body dissatisfaction, shape and weight concerns, self-induced vomiting, dieting, and skipping meals). However, these behaviors do not amount to an ED diagnosis as per the DSM-V diagnostic criteria [10].

12.2.2 Dysfunctional Exercise

More than 30 terms have been adopted by researchers and clinicians to try to describe problematic or DysEx in mental health disorders [11]. Historically, the concept of addiction has been associated with the qualities and subsequent terminology related to DysEx [12–18]. However, most of the research has focused solely on populations having both DysEx and mental disorders. Therefore, insufficient research exists regarding DysEx in the general and physically active populations (recreational, amateur, or high-performance athletes). The most common terms found in the literature are exercise "addiction" [14], "dependence" [18], "abuse" [19], "obligatory" [20], "compulsive" [21], "morbid," and "driven" [22] exercise or excessive exercise [13]. As a result of the multitude of proposed terms, "dysfunctional exercise" will be used to encompass each term. This lack of consistency has limited our body understanding of negative versus positive exercise behavior and its role in the development of LEA (low energy availability), DE or ED, and poor bone health [23].

It was not until 2015, when Rizk et al. attempted to analyze the different components, quantitative and qualitative, of DysEx behaviors, that we gained a distinctive understanding of the concept [23]. The quantitative component involves factors such as time, duration, intensity, or volume and can be defined as the amount of programmed exercise performed beyond the physical healthy limits; previously known as "Excessive Exercise." The qualitative component of DysEx relates to mental health features such as compulsion, rigidity, and obsessiveness. Core features determining the quality of the exerciser's relationship with exercise can be to control weight or shape [23] or due to features of addiction. Ultimately, the quality of the relationship is negative, thus creating both mental and physical distress [24].

Coverley Veale et al. proposed a classification for DysEx depending on the role of the exercise [25]: primary and secondary DysEx. Primary DysEx is the exercise that is an end in itself (i.e., exercise is the objective); hence, practitioners are intrinsically motivated to exercise. Secondary DysEx co-occurs with an ED or other compulsive disorders, where individuals are extrinsically motivated to exercise according to their self-image [i.e., weight loss is the objective] (Table 12.1). According to this classification, it is important

Table 12.1 Primary and secondary dysfunctional exercise symptoms [25–27]

Primary dysfunctional exercise	Secondary dysfunctional exercise
Preoccupation with exercise routine	
Significant withdrawal symptoms if exercise ceases Relief of withdrawal symptoms if exercise is resumed	
Increased tolerance to exercise	
Significant distress or impairment in other areas of daily living resulting from engagement in exercise	
Exercise used to cope with emotions	
Secret or hidden exercise	
Exercise continues despite injuries or physical pain	
Preoccupation with exercise **cannot** be explained due to co-occurring with another mental disorder	Preoccupation with exercise **can** be explained due to co-occurring with another mental disorder
	Exercise as permission to eat

to determine whether DysEx is primarily affecting the practitioner's life or whether it emerges as a derived problem from another psychological disorder [25, 26].

12.2.3 Menstrual Dysfunction

Terms used when discussing menstrual screening include the following: primary amenorrhea, secondary amenorrhea, and functional hypothalamic amenorrhea (FHA). Although these terms have been described in previous chapters, a brief review provides a fuller understanding regarding screening and management recommendations. Amenorrhea is the absence of menstruation or a woman's monthly period.

- Primary amenorrhea occurs when a female has not yet started her monthly periods by age 15 but has gone through other normal changes that occur during puberty.
- Secondary amenorrhea occurs when a woman who has been having normal menstrual cycles stops having her periods for 6 or more months (some sources state 3 months, although 6 months is more common). Note, however, this does not apply to women who are pregnant, breastfeeding, or in menopause.
- Functional hypothalamic amenorrhea (FHA) is a reversible form of gonadotropin-releasing hormone (GnRH) deficiency, commonly triggered by stressors, such as excessive exercise, nutritional deficits, DE/ED, or psychological distress.

The Office on Women's Health, Department of Health and Human Services suggests the physical and behavioral/emotional characteristics to detect eating disorders should be examined during the routine screening of adolescent and preadolescent patients by their primary care provider for the detection of issues related to the female athlete triad.

There is not yet an agreed upon optimal timing or method of screening for female athlete triad disorders. An energy deficit in a female athlete may cause a spectrum of menstrual dysfunction, either subtle or obvious, which may then have an impact on bone health. This leads to the realization that a comprehensive menstrual history may be needed in all athletes.

12.3 Research Findings in Disordered Eating/Eating Disorders, Dysfunctional Exercise, and Menstrual Dysfunction

The American College of Sports Medicine Position Stand on the Female Athlete Triad describes the interrelationships among energy availability, menstrual function, and bone mineral density. As these three entities are interwoven, an alteration in one can impact the others. Energy availability is the amount of energy remaining once exercise energy expenditure (EEE) is subtracted from energy intake (EI): (EA = EI-EEE). DysEx is a component of EEE and thus can impact EA which then can impair menstrual function and ultimately bone density. These are complicated relationships, but each entity is distinctly different, and in athletes, abnormalities can present alone or in combination. The longer these disorders go untreated, the greater the long-term consequences [28]. Thus, prevention and early detection of female athlete triad disorders are of utmost importance for the health of young female athletes [29, 30]. The following section will review the prevalence, current research, and screening procedures for each DE/ED, DysEx, and menstrual dysfunction.

12.3.1 Prevalence

12.3.1.1 Prevalence of Disordered Eating/Eating Disorders in Active Females

It is difficult to know the exact prevalence of DE/ED in female athletes as the majority of studies have various methodological flaws including the use of nonstandard diagnostic procedures, small sample sizes, lack of or inadequate control group(s), inadequate statistics, and/or heterogeneous athlete population [31, 32].

There have only been two, well-controlled studies utilizing DSM-IV criteria for diagnosis of EDs. These were conducted with elite athletes and demonstrated 31% prevalence in athletes compared to 5.5% in the control population for the first study and 25 versus 9% in the second study. Other studies have shown secondary amenorrhea to be as high as 69% in dancers and 65% in long distance runners versus 2–5% in the general population [31].

The first study to look at the combined prevalence of DE, menstrual dysfunction, and low bone mineral density in college females demonstrated that the number of athletes suffering from all three disorders of the triad was small (1–3 athletes out of 112). However, a significant number suffer from the individual disorders of the female athlete triad [3].

A more recent systematic review of 65 studies evaluating the prevalence of the individual and combined components of the triad verified that initial study. It showed a relatively small percentage of athletes (0–15.9%) exhibited all three components of the triad. The prevalence of any two triad conditions ranged from 2.7 to 27%. The prevalence of any one condition was the highest, from 16 to 60%. The recommendation from that review is that additional research on the prevalence of the triad using objective and/or self-report/field measures is necessary to more accurately describe the extent of the problem [28].

12.3.1.2 Prevalence of Dysfunctional Exercise in Active Females

The prevalence of DysEx, more specifically the addiction feature, is variable and uncertain due to the lack of comparable methodology in research of clinical cases, i.e., heterogeneity of the instruments used to assess addiction (qualitative component), insufficient sample size, and heterogeneity of the population studied. The most recent observational data available suggest a prevalence of 0.3–0.5% of the general population and 1.9–3.2% of individuals who are regular exercisers [26]. In this sense, Lejoyeux and colleagues analyzed exercise behaviors on 300 practitioners from a fitness room [18 years and older]. A total of 125 (42%) presented risk factors of primary DysEx. These participants spent more hours (h) each day in the fitness center compared with participants who had no risk [2.1 h/day vs. 1.5 h/day], and they went more often each week [3.5 vs. 2.9 days/week]. Moreover, those that presented addictive features smoked less and were significantly more compulsive buyers (63% vs. 38%) [33].

Prevalence of secondary DysEx is much higher. Typically, although not exclusively, DysEx is secondary to an ED. DysEx in those with EDs ranges from about 26.8–80% of clients [21]. In one study of 366 participants, researchers found that DysEx rates were 45.5% among 165 inpatients and 26.8% in 355 outpatients. The large range in prevalence rates can be a result of the presence of exercise dependence within each type of ED, with anorexia nervosa restrictive or purging subtype presenting with DysEx most commonly and eating and disorders not otherwise specified the least common.

12.3.1.3 Prevalence of Menstrual Dysfunctional in Female Athletes

In athletes, amenorrhea is much more common than in non-exercising controls with prevalence reported from 3 to 69% compared to 2–5% in the general population [3, 30, 34]. Prevalence is typically an estimate as it is difficult to gain accuracy due to inconsistencies in studies, including various definitions of amenorrhea, selection bias, underreporting, lack of education on what is normal versus abnormal, various competition levels, sports disciplines with varied intensity, and frequency of training [30, 35]. Despite this, research has shown that in adolescents, the current prevalence of the female athlete triad is 0–1.2% of athletes. When two factors of the triad are present, the prevalence of the triad is between 2.7 and 27% [28, 36].

12.3.2 Current Research in Disorder Eating/Eating Disorders, Dysfunctional Exercise, and Menstrual Dysfunction: Screening Tools

When choosing an appropriate screening tool, things to consider include the specificity of the tool, the feasibility of using one tool or another, and strengths and weaknesses of the instruments for measuring each of the components (DE/ED, DysEx, and menstrual dysfunction). Further considerations for choosing an appropriate screening tool include the following:

- *Applicability*: It should be easy to apply and interpret.
- *Validity*: The instrument should be capable of measuring what it was created for. Those instruments that have not been validated might not be the best. Those whose validation analysis is inconclusive should be avoided.
- *Reliability*: If used for clinical practice, it is important that the instrument is reliable (precise) when measuring the same subject (intra-subject). In the case, if it is used for research, it is important to have both precision (intra-subject) and accuracy (inter-subject), so the changes detected are attributable to the intervention or the situation tested and not to the lack of reliability of the instrument.
- *Cost–benefits*: For example, the sample size could reduce or increase the chance of using one or another instrument.
- *Objectivity*: The most objective instrument has to be used. For example, if physical activity levels are assessed and both accelerometers and questionnaires are available, the most objective instrument will be the accelerometer.
- *Reactivity*: Be aware that participants tend to change behaviors when being evaluated. Some instruments may be more sensitive to reactivity than others.

12.3.2.1 Current Research in Disorder Eating/Eating Disorders

There are multiple risk factors, which predispose an athlete to DE or ED. This list includes four major groups of factors as shown in Table 12.2.

Table 12.2 Risk factors for disordered eating/eating disorders [37, 38]

I. Non-sport-related factors	II. Sport-specific factors
A. Biological factors	A. Sports that emphasize
1. Pubertal status	1. Appearance
2. Pubertal timing	2. Thin body build
3. Body mass index	3. Low body weight
B. Psychosocial factors	B. Sports that require weight classifications
1. Body image dissatisfaction	C. Early sport-specific training
2. Mood disorders	
3. Low self-esteem	
4. Perfectionism	
5. Family dysfunction	
C. Sociocultural factors	
1. Perceived pressure to conform to an unrealistic standard of thinness	

Further evaluation of the sport-specific factors seems warranted given conflicting data. A review from 2001 [32] and a 2004 study [39] indicate that EDs are more likely to occur in athletes in aesthetic or leanness sports such as gymnastics, cross-country, and figure skating compared with athletes in non-leanness sports and controls. This was again verified in 2008 by Torstveit, Rosenvinge, and Sundgot-Borgen in a study with 186 athletes compared to 145 controls. EDs were more common in athletes in leanness sports (46.7%) compared to non-leanness sports (19.8%) and controls (21.4%) [29].

However, Beals provides evidence to question the long-held belief that EDs are more common in athletes in leanness sports in the small study of 112 athletes. She specifically notes that the percentages of individuals with DE and bone mineral density disorders, individually or in combination, were similar between lean build and non-lean build sports. The implication from this is that all female athletes, regardless of sport, should be screened for components of the female athlete triad and intervention should begin early to prevent development of the full triad [40, 41]. In any event, avoiding external pressure on the athlete to lose weight is essential to avert preoccupation with dieting, as it is considered to be the number one trigger for EDs [30, 31].

Screening for Disordered Eating/Eating Disorders and Pre-Participation Examinations

Screening recommendations for the female athlete triad or its components are based mostly on consensus, usual practice, or opinion. The most common times recommended are during pre-participation physical examinations (PPEs), during routine health visits, or if an athlete presents with a component of the triad [1, 30, 31, 42].

Screening can not only occur at a common entry point to athletic participation such as during pre-participation physical examinations (PPEs), but should also be an ongoing process throughout the span of an athlete's participation. This ongoing process is particularly applicable to recreational athletes who participate in exercise clubs, individual activities, and "weekend warrior" activities. The screening process should be viewed as a two-step process [43, 44]. Once an athlete screens positively or if a concern exists, the athlete should be referred for further medical and psychological or psychiatric evaluation.

The main benefit of screening during PPEs is that medical personnel are able to quickly review the responses to the tool utilized, and potentially, they can immediately refer the athlete who screens positively. All new athletes are required to have a PPE, so all would at least be screened in this format. The disadvantage of screenings during PPEs is that they often occur in a station-centered setting, such as in an athletic training room. This provides minimal privacy and confidentiality in completion of questionnaires and in further discussions with the individual athlete. Although, in order to enhance confidentiality and improve efficiency, some universities are shifting to having athletes complete health histories either before arrival on campus or on web-based sites [40]. As technology and the patient-centered medical home (PCMH) advance, a web-based data center in an electronic health record may become the standard. The PCMH promotes organizing care around patients, working in teams, and coordinating and tracking care over time [45].

Another negative aspect of screening at PPEs is that there are typically multiple other forms to complete. The athlete may then rush through the DE/ED screening tool, not taking the time to answer accurately [34, 46]. Female athletes often feel uncomfortable discussing ED during PPEs and are more likely to withhold information [46]. This is another reason why screening females with a supplemental form within the first few weeks of arrival on campus may be a better method.

An additional concern arises in settings where PPEs are only required at entry and not yearly. In a study of the National Collegiate Athletic Association (NCAA) Division I universities, of the 257 (74%) schools that participated, only 32% require an annual PPE. In this case, if the athlete develops risk factors for DE/ED after her freshman year PPE, it may go undetected until a significant health event occurs, if at all [34].

When any of the informal signs and symptoms of DE/ED found at Table 12.3 are noticed among female athletes, areas of discussion that could be explored include: (1) eating behaviors such as binging, purging, eating in secret, recurrent dieting; (2) a history of or current mood disorder to include sadness, depression, or anger; and (3) the use of extreme weight control measure to manage weight or shape including starvation, diuretics, laxative, or saunas [30, 31, 47, 48].

Table 12.3 Informal signs and symptoms of disordered eating/eating disorders in athletes [30, 31, 47, 48])

Physical symptoms
Poor exercise tolerance including dehydration, cramping, pre-syncope, and bradycardia
Gastrointestinal upset, including bloating, diarrhea, or constipation, and abdominal discomfort
Hair, skin, or teeth changes including lanugo, alopecia, dry skin, callouses on hands and/or loss of tooth enamel from self-induced vomiting
Complaints of menstrual irregularities

Reasons to Screen for Disordered Eating or Eating Disorders and Screening Practices

Screening helps to identify athletes who may be having issues with eating pathology or low energy availability who require further assessment. Screening can be a complex and challenging task, but the sports medicine team must keep in mind the reasons why screening is important. These include [30, 31, 46]:

- Prevention of DE/ED; the most effective way to decrease the incidence of ED is to prevent them.
- Early intervention when DE/ED exists to minimize impacts on health and performance; the longer an ED is allowed to persist and progress without treatment, the greater the health and performance detriments.
- Athletes tend to deny or do not realize a problem exists.
- Athletes are unlikely to come forward on their own, so complications from low energy availability can go unrecognized until a major event such as a stress fracture occurs. There are several reasons why the athlete may not come forward including guilt, shame, fear of losing a scholarship, or fear of losing playing time [30].

With no clearly defined standard for screening athletes for DE/ED, practices fall across a wide spectrum that includes: no specific screening, a few general questions at the time of PPE, utilization of a self-report questionnaire screening tool (SRQST) at PPEs, or the use of a SRQST combined with an interview by a trained mental health provider.

A 2012 study evaluated PPE forms utilized at 257/347 NCAA Division I universities for efficacy in screening for the female athlete triad. It compared those forms to the 12 items recommended by the Female Athlete Triad Coalition for screening females for the triad [49]. Only 25 universities (9%) had nine or more of the 12 recommended items on their forms [34]. Another study has shown that only 60% of Division I schools, which responded to the study, screened for ED during PPEs. Of those that did screen, <6% used a standardized SRQST [3].

Because the goal of the PPE is to facilitate optimal performance for athletes while ensuring the best possible health for the athlete both today and in her future, it has been suggested to implement a separate supplemental health questionnaire specific to female athletes. It is felt that this method would allow health care providers to narrow in on female-specific issues. It might be implemented before, during, or shortly after PPEs on campus [50].

Table 12.4 Athletic personal and barriers to recognition

Personnel working with athletes	Potential barrier to recognition
Coaches	• Lack of knowledge, experience, or resources to address the problem • May not want to interfere with an athlete successfully training and performing, despite concerns about DE/ED • Fear of being accused of creating or contributing to the DE/ED behaviors
Teammates	• Fear of breaking the trust of a team member • May self-reflect upon her own DE, creating irrational fears that identifying a teammate's issue will expose her
Family/Parents	• Desire to see child succeed regardless of the consequences • Feel unsure how to approach disordered eating behaviors
Administrators	• May feel they lack knowledge, experience, or resources to address the problem • May fear feelings of inadequacy or challenges from others for not having been proactive in previously establishing resources or policies

Note: ED Eating disorder; DE Disordered eating; DE/ED Eating disorder/Disordered eating

An interesting innovation in screening female athletes for DE/ED is the physiologic screening test consisting of 18 items (4 measurements and 14 questions). It has been validated and has the potential to be combined with one of the athlete-specific questionnaires (see Table 12.4) to create a two-step screening process in an attempt to minimize false positives and false negatives prior to psychological referral [41].

Functionality of Screening Tools for Disordered Eating or Eating Disorders

What makes a screening tool useful is functionality as well as validity. SRQSTs seem more functional than interviewer applied tools. However, they are subject to report bias, as athletes tend to be not as forthright with these as in a one-on-one interview [3, 51]. The interview tools are more appropriate for an in-depth evaluation, in search of a specific diagnosis, but they are time intensive and require education on the part of the interviewer. They are most useful as the second step in evaluation, once an initial screening tool is positive or when there is reason to suspect DE/ED in an athlete [52].

In the athletic arena, time is frequently an issue. It is essential for a screening tool to be focused and time limited. Formal screening tools are ideally brief, self-report questionnaires with simple cut-off scores that indicate a level of dysfunction concerning for pathology in the athlete [51].

One must be assured that the tool utilized, when interpreted as positive, truly indicates an issue for which further evaluation and time requirements will be needed. Once a screening tool is positive, the athlete should then have a more formal evaluation to determine whether true pathology exists or risk factors for pathology are present. This includes a detailed medical, nutritional, and reproductive history and physical examination with lab evaluation by a physician and referral to a psychologist or psychiatrist [1, 47]. An ideal tool for further evaluation is a structured interview. Eating disorders exam (EDE) has been identified as the gold-standard tool for identification of ED in general [41, 51, 53]. During the one-on-one interview, the athlete must feel secure and not threatened [30].

In organized sports, the PPE is a common entry point for evaluation of athletes. Screening at that time is of utmost importance, but it is not the only opportunity to diagnose DE/ED. Screening female athletes for DE/ED needs to by a dynamic, ongoing process, throughout the span of recreational and competitive activity. It should not occur in a vacuum, only at the time of a PPE. Recreational athletes can also fall into low energy availability from DE/ED. A less formal approach to screening may be applicable in their case.

Screening Settings for Disordered Eating or Eating Disorders

Screening for or DE/ED in athletes generally) occurs in three settings: (1) informal settings, mostly by observation and interaction with athletic trainers and coaches; (2) formal settings, typically with a team physician or primary care provider or when referred to a psychologist or psychiatrist; and (3) clinical settings.

Informal Settings: The informal setting occurs in the athlete's day-to-day routine while interacting with athletic trainers, coaches, administrators, teammates, teachers, family, and friends. For recreational athletes, informal screening may occur with personal trainers, group exercise leaders, and gym personnel. The ideal is for all individuals interacting with athletes to be educated on recognizing concerning patterns of behavior and exercise (nutrition issues, overexercising, etc.). Once educated on what to look for, he/she can feel empowered to approach the athlete in an effort to assist her. Written policies on dealing with suspected ED are recommended and adequate resources to assist the athlete are ideal [54, 55]. Each individual interacting with the athlete has the opportunity to informally screen the athlete for DE/ED. Whether they actually do, often depends upon their level of education and whether they are alert to a potential issue with the athlete [30, 56]. Direct questioning can be utilized; however, the nature of ED tends to be secretive. It is likely that the individual will not readily disclose the embarrassing symptoms of an ED, such as vomiting or laxative use. The intensity of questioning has to be balanced between the relationship of the athlete with the person inquiring and the athlete's readiness to disclose her illness. Thus, the allied health professional sometimes must read between the lines and look for physical and behavioral characteristics that may signify an ED.

Formal Settings: The formal, structured setting occurs during pre-participation examinations and in the clinical setting. In the formal setting, SRQSTs are best utilized. A questionnaire tool is especially helpful as it can be difficult for the provider to remember the myriad of questions recommended for picking up on subtleties in order to discover DE or recognize an athlete attempting to hide an ED.

Clinical Settings: The other formal setting where the female athlete may be encountered is in the clinical setting when presenting for routine health care or for an acute illness or injury. The clinician then has the opportunity to screen for components of the female athlete triad, including those that set the athlete up for low energy availability (DE/ED). A full medical, reproductive, and skeletal health history should be taken as well as an appropriate physical examination looking for classic signs of ED [1, 47]. Questions to be asked during the history should also include nutrition questions incorporating weight and dieting history, current exercise regimen looking for any recent changes in intensity or amount, and mood-related questions. Physical complaints and findings such as amenorrhea, gastrointestinal disturbances, low body mass index, bradycardia, orthostatic hypotension, skin changes, and laboratory studies can help diagnose an ED [57]. However, during the early course of an ED, physical examination and laboratory findings may be normal. Again, there are time constraints in the clinical setting and the provider is likely to focus specifically on the illness, injury, or well woman examination at hand and not expand the history to include elements important in identifying ED/DE and female athlete triad disorders. Health providers (athletic trainers, team physicians, sports medicine fellows, physician assistants, and nurse practitioners) working with female athletes need to remember to focus on their medical roots to complete an entire history and physical examination looking for symptoms and signs of DE/ED and female athlete triad disorders.

Barriers to Recognition of Disordered Eating/Eating Disorders

Unfortunately, people close to the athlete can contribute barriers to recognition of the issue. This is often inadvertent but can also be intentional. These barriers are included in Table 12.4 [47].

In order to minimize barriers, it is critical to maintain an environment that promotes the clear expectation that DE/ED will be addressed with the intent to promote optimal health and performance for the entire team. This may minimize the concern for a "telltale" environment. It is a responsibility of

those who are close to the athlete to help recognize DE/ED and initiate further evaluation and assistance [46]. Once it is recognized that assistance is needed, screening becomes formalized in the clinical setting with the team physician or primary care provider.

Screening Tools for Disordered Eating/Eating Disorders

There are multiple screening tools for DE and ED in the literature (Appendix 1). Some are specific to athletes, while others are more general nutritional, DE/ED screening tools. Most of the general tools are validated, but few of the tools specific to athletes have been validated in female athletic populations [31, 58].

A screening tool may save time obtaining the athlete's history either before or as a part of a PPE or in the setting of a clinical visit with the physician. Questions may be incorporated into the PPE form or a supplemental screening tool. The American College of Sports Medicine Position Stand on the Female Athlete Triad and the National Athletic Trainers' Association Position Statement on Preventing, Detecting and Managing Disordered Eating in Athletes make the recommendation for screening during PPEs, but provides no guidance on any one particular tool [30, 31]. It is generally felt that a supplemental tool directed specifically at female athletes may ultimately be ideal.

The SRQST is utilized as a first step. These tools are not designed to diagnose an ED so athletes who screen positively, should then be further evaluated by a physician for medical evaluation and referred to a psychologist or psychiatrist. During that visit it is likely that one or more interview-based tools will be utilized to determine if the diagnosis of an ED is appropriate.

General Screening Tools for Disordered Eating/Eating Disorders and Diagnostic Screening Tools for Eating Disorders (Table 12.5)

The clinical interview is the assessment tool of choice when diagnosing ED as it allows for more detailed questioning. Disordered eating is not included here as it is not a clinical ED. Use of an interview-based tool is part of the second step in evaluation when a screening tool is positive (Table 12.6.) [51].

Table 12.5 General screening tools for disordered eating/eating disorders not athlete specific

Tool	Year	Key points	Validation
EAT-26 [51, 59]	1982	Most widely used standardized self-report measure of symptoms and concerns characteristic of EDs specifically Web-based; easily accessible; free	Score of 20 or more—interview by a qualified professional to evaluate for diagnostic criteria for ED; concurrent validity; good discriminate validity ChEAT-children's version
SCOFF [60, 61]	1999	5 questions; 1–2 min to complete	Two or more + responses, 100% sensitivity
EDE-Q [22, 61, 62]	1994	Self-completed, question form of EDE Widely used measure of eating disordered behavior 36 items; 15 min to complete Overestimates binge-eating frequency compared to EDE	Criterion validity
EDI-3 [52, 59, 63, 64]	2011	Developed from EDI (1983) and EDI-2 (1991) 91 questions; 12 subscales; 6 composite scores 20 min to complete Cost associated	Internal consistency satisfactory Discriminative Validity good
ESP [64]	2003	4 questions; 1–2 min to complete	As effective as SCOFF
BULIT-R [51, 65]	1991	Bulimia nervosa screening; 28 questions	Content construct criteria
NEDA screening program [65]	Yearly March	Evaluates resources of colleges and universities; online screen for students	No

Notes: EAT-26 Eating Attitude Test-26; *SCOFF* sick, control, one stone, fat, fear; *EDE-Q* eating disorder exam questionnaire; *EDI-3* eating disorder inventory 3; *ESP* eating disorder screen for primary care; *BULIT-R* bulimia test-revised; *NEDA* National Eating Disorder Association

Self-Report Questionnaire Screening Tools, Athlete Specific for Disordered Eating/Eating Disorders

There are a limited number of tools, which have been designed specifically for female athletes (Appendix 1). Some of the tools available screen both athletes and college students whether female or male. Another method of screening is through questions incorporated into a PPE form. In those, typically any nutrition questions will be directed at females and males. The following section of the form then has questions specific to females. Unless this is clearly delineated, this can be confusing for the athletes during completion of their history (Table 12.7).

Table 12.6 Interview-based tools—administered by qualified professional; second stage after screening

Tool	Year	Key points	Validation
EDE [51, 62, 66]	1987 revised 1993	Interview-based, semi-structured interview	Yes
		Gold standard of eating disorder assessment, specifically AN and BN	Good criterion validity
		28-d time frame, prior 4 weeks	Questionable construct validity
		62 items; 2 behavioral indices; 4 subscales	Not in athletic population
		30–60 min to administer	
IDED-IV [51, 52]	1990 revised 1998	Semi-structured interview	Not in athletic population
		Specifically, for diagnosing EDs, not DE; based on DSM-IV criteria	Good reliability and validity

Notes: EDE eating disorders exam; *IDED-IV* interview for diagnosis of an eating disorder; *AN* anorexia nervosa; *BN* bulimia nervosa; *ED* eating disorder; *DE* disordered eating

Table 12.7 Self-report questionnaire screening tools, female athlete specific

Tool	Year	Key points	Population
FAST [67]	2001	33 questions	F
		To identify disordered eating and atypical exercise and eating behaviors	
		Internal reliability; concurrent validity to EDI and BULIT-R	
HWDMHQ [58]	2002 updated 2006	First study to assess combined prevalence of all three components of female athlete triad	F
		Developed from:	
		EDI symptom checklist	
		EDE-Q	
PST [41]	2003	18 items:	F
		Four Physiologic measurements	
		14 Questions	
		15 min to complete	
		Validated; better than EDI-2 and BULIT-R	
Female Athlete Triad Coalition Screening Questionnaire [49]	2002	Internet accessible	F
		12 questions: nutrition, 8; menses, 3; bone health, 1	
		If positive, follow by in-depth evaluation with detailed	
		history of 19 questions and full medical evaluation	
AMDQ [59, 68]	2000	19 questions	F
		Designed to assess DE/ED	
		Compared to EDI-2 and BULIT-R, superior results on 7 of 9	
		Epidemiologic analyses	
		First instrument to operationalize the construct of DE	
		Not validated in a clinical population	
Athlete [69]	2005	Female athletes at three division I universities	F
		6 subscales from EDI, modified to athletes	
		Developed to assess psychological predictors of disordered eating in female athletes	
		Construct validity confirmed that the athlete questionnaire is a reliable and valid measure of the psychological factors associated with disordered eating in athletes	
LEAF [70]	2014	Females 25 questions across markers of energy availability Validated in the female population	F
BEDA-Q [71]	2014	The questionnaire has 9 items as answered in a "true or false" fashion or an on a 5-point Likert scale. Questions pertain to body satisfaction, drive for thinness, and perfectionism	F

Notes: FAST female athlete screening tool; *HWDMHQ* health, weight, dieting, and menstrual history questionnaire; *PST* physiologic screening test; *AMDQ* athletic milieu direct questionnaire; *EDI* eating disorder inventory; *BULIT-R* bulimia test-revised; *BEDA-Q* brief eating disorder in athletes questionnaire

Non-Gender-Specific Eating Disorder Tools (Table 12.8)

12.3.2.2 Current Research in Dysfunctional Exercise Etiology

Theories regarding the etiology of DysEx are diverse and multifactorial, based on physiological (endorphins hypothesis and sympathetic arousal hypothesis), psychological (general theory of addiction), or psychobiological (personality traits or the anorexia analogue hypothesis) issues.

Table 12.8 Self-report questionnaire screening tools, athlete specific

Tool	Year	Key points	Population
CHRIS [72]	2003	College student athletes	F, M
		Based on juvenile wellness and health survey (JWHS)	
		32 questions broken into four areas: mental health, 9; eating problems, 13; risk behaviors, 4; performance pressure, 6	
		Needs further validation	
SEDA [73]	1991	33 questions; self-reported eating pathology	F, M
		Athletic environment-related risk factors	
		Not validated in athletic population	
		Student athletes and students	
De Palma [38]	2001	ID pathologic eating in college students and athletes	
		16 questions; 8 from SEDA and 8 from DSED-diagnostic survey EDs	
PPE monograph [42]	2019	4 questions related to weight; 3 questions related to menses	F, M
International Olympics Committee Screening [74]		Athlete periodic health evaluation (PHE) form	F, M
		11 nutrition questions for both sexes	
		Female-specific questions: 6 menses, 2 bone health, 1 sexually transmittable infections	

Notes: CHRIS College Health-Related Information Survey; *SEDA* survey of eating disorders among athletes; *DSED* diagnostic survey for eating disorders; *PPE* pre-participation examination; *F* female; *M* male; *ED* eating disorder; *DE* disordered eating

Physiological Hypothesis

During the 1980s and 1990s, some authors had reported regarding the intense exercise effect in the endogenous opioid system, resulting in significant higher concentrations in bloodstream and spinal fluids: The Endorphins Hypothesis. β-endorphin and catecholamine form part of the brain reward system, and it was thought to be related to exercise addiction due to their capacity to regulate physiological responses to stress and intense exercise [24, 75].

Endorphins are endogenous opioids derived from pro-opiocortin polypeptides. Moreover, endorphins originate in the hypothalamus, and regulate pain perception, increasing pain threshold, and showing a greater effort perception in trained people. Exercise intensity (performed above 60% of the maximal oxygen uptake) and duration (sustained for at least 3 min) are related to increases in plasma β-endorphin concentrations. However, plasma endorphins cannot cross the blood–brain barrier (BBB), whereby there is no evidence that changes in plasma levels could lead to simultaneous brain changes. Notwithstanding, some authors believe that endogenous opiates in plasma also operate in central nervous system activity [26, 76]. In spite of the lack of sufficient direct evidence of an association between exercise addiction and the endogenous opioid system, and knowing that aerobic exercise stimulates the release of β-endorphin [77], an animal study with rats reported opioid tolerance and dependence in chronic exercisers [78]. Steinberg and colleagues established that chronic exercise practice [61]:

- provides an enjoyable effect that stimulates continuing practice;
- triggers an excessive and compulsive behavior;
- results in a reduced pain sensation dependent on the individual; and
- causes the emergence of a psychological and physiological withdrawal syndrome.

The Sympathetic Arousal Hypothesis was first proposed by Thompson and colleagues in 1987. This hypothesis is based on the idea that increased concentrations of catecholamine (adrenalin, noradrenalin, and dopamine) are induced by intense physiological or psychological stress (exercise or tasks). In addition, researchers have reported 1.5–20 times greater concentrations of catecholamine, depending on exercise type, duration, and intensity [79]. Catecholamine produces increases in heart rate, blood pressure, and a general reaction of the sympathetic nervous system known as "fight-or-flight response" [75, 79]. However, endorphin concentrations seem to be attenuated affecting the sympathetic nervous system regulation. On the one hand, habitual practitioners show a central effect of exercise that reduces the sensitivity to stress, producing lower concentrations of catecholamine and an increased efficiency of energy utilization [80]. On the other hand, research also has shown that greater physical fitness resulting in attenuated concentrations of these hormones and could promote negative feelings such as lethargy, fatigue, depression, and decreased arousal [53, 64]. These findings suggest a possible association between addiction and catecholamine behaviors, due to the fact that habitual exercisers are motivated to engage in increased levels of exercise in order to achieve the same arousal levels and suppress symptoms [75, 81].

Psychological Hypothesis

Szabo et al. proposed a general theory of addiction or Cognitive Appraisal Hypothesis to explain the etiology of exercise addiction. This theory means that habitual exercisers use exercise as a way to cope with stress, learning to need exercise for this purpose (coping mechanism). When the amounts are exaggerated, the exerciser explains and justifies the practice, and slowly takes a principal role instead of nor-

mal daily activities. Negative psychological feelings (irritability, guilt, anxiousness, etc.) appear when the person is required to reduce or stop exercising; feelings that are believed to represent the withdrawal symptoms. There is also a loss of the coping mechanism where the exerciser loses control over stressful situations and feels the need to exercise to manage the stress. Exercise is used as a way to manage their stress. However, as it begins to have a greater toll on the human body, it can ultimately amplify and increase vulnerability to stress. The dysfunctional exerciser is trapped in a vicious circle, exercising more to cope with daily stress that partly is caused by itself [76].

Psychobiological Hypothesis

Personality traits or Anorexia analogue hypothesis has been the most utilized to explain DysEx despite the limited research support. Individuals engaging in DysEx share common personality traits and behavioral dispositions with anorectic patients such as compulsiveness [82], neuroticism [83], low self-esteem [84], perfectionism [18, 81, 85, 86], high trait anxiety [87], high self-expectations, denial of potentially serious debility, and tendency toward depression [77]. These traits and dispositions seem to be more pathological in patients with anorexia nervosa than in dysfunctional exercisers [88]. The main effects of DysEx in female are concern about body image and appearance, development of anxiety and depression disorders, as well as the emergence of other behaviors as compulsive buying [33]. However, males often report having an uncertain identity, low self-esteem, and anxiety about physical ineffectiveness [85].

Dysfunctional Exercise in the Active Female

Gender incidence remains unclear, although some researchers reported equal prevalence in both males and females, while others have shown a higher prevalence of primary DysEx in males, compared with an increased secondary DysEx in females [89, 90].

Villella et al. reported DysEx behaviors in adolescents and young adults using the Exercise Addiction Inventory [91]. However, this inventory was validated for university students, not high school students [92, 93]. Participants with scores of 24 or more were identified as at risk for DysEx. From a total of 2, 853 high school students (1142 girls—40%) ranging between 13 and 20 years old, 8.5% were at risk of DysEx. Segregating the sample into adolescents and young adults, both groups showed similar percentages (8.7% and 8.3% respectively), and females' percentages were lower (6.3%) compared to males (10.1%) [91]. Exercise Addiction Inventory was used also by Griffiths et al. who identified 3% of the sample (n = 200) of adults between 18 and 40 years old at risk of DysEx scoring above 24, but no gender differences were reported [94].

Johnston et al. recruited 32 women (16–77 years old) from exercise facilities, weight-loss organizations, and school and university classes [13]. This study reported data of both quantitative and qualitative DysEx. Participants were engaged in a wide variety of activities (hockey, diving, exercise classes, running, weight training, etc.), where the weekly active time ranged from 1 to 16 h (mean of 5 h/week). A total of 18.75% scored above cut-off points of the Obligatory Exercise Questionnaire (OEQ), and half of them were defined as chronic dieters. They also showed that behavioral criteria such as frequency and amount of exercise (quantitative) are as important as psychological factors such as effort and enthusiasm (qualitative).

DysEx in adult runners has been previously reported showing that the more they exercise the greater their DysEx pathologies with no gender differences. In addition, these results were constantly significant in health club exercisers [90]. Edgar et al. recruited a total of 102 female athletes where 47 were dancers, 39 runners, and 16 hockey players. DysEx was lower in women who participated in collaborative sports (hockey, or soccer), followed by endurance practitioners (marathon or ultra-marathon), with higher rates in women practicing activities such as ballet or modern dance. The higher prevalence of qualitative DysEx behaviors in dancers and ballerinas could be explained by the different expectations related to technical demand, and aerobic and anaerobic fitness, intensity, body image, and weight control requirements [95, 96].

The prevalence of DysEx has been estimated in athletes; however, these studies are partly limited by confounding factors and small samples sizes, however, they can give provide an information on baseline prevalence. Despite this a most recent study of 234 Australian athletes of different sports and found a prevalence of 34% [92]. DysEx has been measured in varies levels of athletic competition finding higher levels of DysEx in high performance and professional athletes (64.3%) compared to amateur athletes (43.3%). One study demonstrated that 34% of athletes had an ED, and of those 34%, 50% of females, and 27% of males were dysfunctionally exercising. In female athletes specifically, the Obligatory Exercise Scale (OES) was used to assess DysEx in a group of 183 women age 26–71 year and found a mean prevalence of 3.3% across all ages [93]. Hence, we could expect DysEx prevalence to be the same across lifespan in active women. Hence, we could expect DysEx prevalence to be the same across lifespan in active women.

Dysfunctional Exercise Components

If the quantity of exercise is exclusively the defining feature of DysEx, this could be unnecessarily labeling athletes or others as pathologic. Many Olympic or high-level athletes are able to engage in high levels of activity without experi-

encing symptoms of DysEx such as reduced quality of life or depressive symptoms. Research has proposed that characteristics of DysEx go beyond the frequency or intensity of the exercise itself [97]. In a study of college females, the duration and frequency of self-reported activity were unrelated to DysEx. Rather motivations for exercise such as engaging in exercise to change weight and shape or experiencing negative affect like feeling guilt about missing a session was indicative of excessive exercise [37].

Qualitative Component

The above findings prompt us to consider a secondary component of one's relationship with exercise: the "quality." The quality of exercise can be conceptualized by contexts which may influence an individual to exercise in an unhealthy way. The contexts of exercise help us define the meaning, nature, and purpose of exercise engagement. Together, these contexts shape the quality of one's relationship with exercise. Calogero and Pedrotty suggest several contexts which can shape our relationship with exercise, including, but not limited to exercise history, physical condition, emotional experiences, belief systems, social relationships, ecological factors, and sociocultural pressures [97]. For example, Claire is an 18-year old living in Los Angeles, USA. She feels compelled to run around the block four times before she has a snack for fear of gaining weight. Claire would be an example of the sociocultural context defining the quality of her relationship with exercise. This is because her motivation for activity is based on controlling her shape or weight which depicts the sociocultural pressure, she feels to be thin. This example helps illustrate that it is not simply the quantity of activity that characterizes DysEx. It may have only taken Claire 20 min to run around the block. However, the activity she engaged in was dysfunctional in nature due to the motivation underlying it. Together, we can conclude that it is quality and not simply the quantity of exercise that underlies DysEx. As such, it has been proposed that the quality of exercise mediates the relationship between healthful exercise and DysEx [95].

Interestingly, the origins of attempting to characterize and measure DysEx lie in understanding its quality. In fact, the first conceptualizations of DysEx were based upon the criteria for behavioral addiction, such as gambling [83, 98]. Many similarities exist between the two characterizations. Based on these characterizations, a number of scales were developed to assess DysEx. These assessment tools have, however, progressed with the evolving understanding of DysEx.

Quantitative Component

Since "health" is considered a state of complete physical, mental, and social well-being and not merely the absence of disease, physical activity levels could determine the health status of the population [99]. The benefits of moderate to vigorous physical activity (MVPA) and exercise have been well documented [100–102]. However, DysEx refers to negative effects of engaging in "too much" exercise. While sedentary lifestyle has been deeply researched using accelerometers, excess of physical activity has been poorly studied. In fact, there is substantial research that supports improvements of cardiovascular risk and reduction of all-cause mortality linked increased dose of exercise [98]. This generates two questions: the first, is DysEx determined by its quantity? The second, "how much is too much exercise?" The studies focused on finding a threshold to determine the limit for healthy versus DysEx have some limitations. For example, they generally chose a very conservative threshold based on the Metabolic Equivalent for Tasks (METS). So, more than 6 METS/day or more than 42 METS/week were found to be most protective or beneficial [103]. A study in 2001 reported a direct relationship between greater increases in physical health parameters and the number of weekly hours spent exercising (from 2 to 7 weekly hours). Lower cardiovascular risk of mortality was reported in those who practiced between 4 and 7 weekly hours of regular physical activity. However, some cardiovascular risks reported when more than 7 weekly hours where performed, may be due to undiagnosed cardiac conditions. By contrast, lower risk of cancer, respiratory disease, or other diseases were addressed when the practice was more than 7 h/week of MVPA [101]. Other authors show that physical activity benefits depend on the intensity of the practice, where greater benefits and lower mortality rates were associated with vigorous activity, not light activity [104, 105]. Based on this research, the Center for Disease Control and Prevention and American College of Sport Medicine recommended 30 or more min of MVPA almost every day [105, 106]. Currently, this recommendation has been increased, especially in children, where at least 60 min of MVPA should be performed 5 days a week and ideally every day. Another important limitation regarding to the quantitative component is that the definition of "How much exercise is too much?" is far below what many athletes perform. For example, endurance runner athletes and triathletes perform ~20 METS/session or ~20 h/week of exercise [107]. An athlete's training level is unique to his/her discipline and each type of exercise is accompanied by unique physiological adaptations. Therefore, every discipline could have different cut-off points and health benefits.

In addition to the problematic thresholds, there is also an often-forgotten perceived positive psycho-physiological effect of exercise when it is part of the daily routine of an individual (i.e., habit). Habit is defined as a recurrent, often unconscious, pattern of behavior that is acquired through frequent repetition. Whether this is a positive elevated exercise practice or not, should be analyzed based on the characteris-

tics (quantitative and qualitative) of the behavior. Remember that regular practice of exercise has been found to improve psycho-physiological parameters such as self-esteem, physical fitness, and social behavior, all of which contributes to maintain exercise behavior or habit [108]. But "what happens when you eliminate a habit from equation?" Researchers have reported that 1–2 weeks of practice deprivation can result in depression symptoms, negative mood states, or even fatigue [104–106, 109]. "Do these effects reflect that reduction of exercise levels is a positive decision?"

Thresholds for Dysfunctional Exercise: What We Know

Exercise thresholds (i.e., duration and intensity) have been primarily studied, but not validated, in populations with DysEx (i.e., Eds). Some authors suggest that engaging in more than 6 h of exercise per week during at least four consecutive weeks is an indicator of DysEx [19]. This threshold was proposed initially by Davis et al. in patients with Eds as a compensatory behavior; therefore, relating more to secondary DysEx [110]. This threshold (>6 h/week for at least 4 weeks) was further defined by Bratland-Sanda et al. in 2010 as MVPA. Therefore, performing more than 52 min/day of MVPA can be considered the threshold for secondary DysEx only in the context of those with an ED and not for the general population [111].

Due to a wide range of different characteristics of populations, establishing thresholds for healthy *versus* DysEx between the general population, those with Eds, and athletic populations may be unrealistic. A healthy population will be expected to perform at least 60 min of moderate to vigorous exercise every day for children and adolescents, and a minimum of 150 min/week for adults [112]. In this sense, there is a lack of knowledge and understanding about how to appropriately establish a threshold for each population. Research could help us understand how much activity should be performed by each group and set relevant thresholds for each. Establishing thresholds for each population is important, both for general knowledge and understanding, as well as to determine the most effective way to help an individual experiencing DysEx.

Screening Tools for Dysfunctional Exercise

Screening tools should be used to assess both quantitative and qualitative components of DysEx (Appendix 1). Quantitative features of the exercise behavior should assess duration (i.e., min, h), frequency (i.e., days/week, sessions/day), intensity (i.e., light, moderate or vigorous), or total volume. Therefore, qualitative features should be assessed through psychological measures such as mood state, depression, anxiety, compulsion, addiction, or eating disturbances. To further the complicate DysEx assessment, screening tools can be subjective or objective instruments. Daily logs, questionnaires, inventories, and observations are the most used subjective instruments due to their easy application and low cost. Nevertheless, there are important limitations associated to their validity and reliability [113]. When these screening tools are compared with gold-standard methods (i.e., accelerometry or GPS tracking devices) [114, 115], it results in either over-estimation in healthy populations [116], or under-estimate real levels in ED patients [117, 118]. Additionally, when the variables assessed are physiologic, it results in greater over-estimations, because the inability to analyze all dimensions of physical activity [116]. Regarding objective instruments, pedometers and accelerometers are the most common devices used to assess spontaneous activity during prolonged periods of time. Of these, the accelerometer is a practical, precise, and inexpensive device [119].

Classification of the Screening Tools for the Assessment of Dysfunctional Exercise

Choosing one screening tool over the other could give the researchers different validity levels of data from the most objective to the most subjective measurements. When is a screening tool considered objective or subjective? A screening tool is considered to be highly objective when it measures what it intends to, and when it approaches the fact. Subjective screening tools approximate the data by delayed information where the perception of researchers or participants could alienate results. Using objective or subjective screening tools depend on which characteristics of the excessive exercise are aimed to be analyzed: min per day, week or month, intensity of exercise, mood state, or eating disturbances. Researchers are more likely to use objective tools when the assessment does not need from the participation of individuals, or subjective tools when the participation of one or both researcher and individual is needed. Therefore, screening tools like mechanical devices are shown as objective tools, and inventories, questioners, self-report diaries, and interviews are shown as subjective tools [31, 120]. Both subjective and objective screening tools can be classified as qualitative (subjective instruments) and quantitative—including both subjective instruments and objective mechanical devices as accelerometers or pedometers, or other technologies such as mobile apps or sport-*GPS* tracking devices.

Qualitative Screening Tools for Dysfunctional Exercise

Qualitative screening tools report information about the characteristics of exercise related to psychological and physiological issues. The main characteristics of these instruments (QEQ, EDS-R, and EAI), as well as principal sources, can be found in the following Table 12.9.

Table 12.9 Screening tools for dysfunctional exercise

Tool	Year	Key points	Population
OEQ [12, 20]	1988 1991	Originated from the obligatory running questionnaire but designed to measure obligatory exercise and problems of over exercising. It was updated in 1991, and now consists of 20 items related to exercise habits.	Adolescents Adults
EAI [121]	2004	The goal of the EAI was to develop a short dysfunctional exercise questionnaire. The EAI was operationalized using the components of behavioral addiction proposed by Griffiths. It has good validity and reliability good internal reliability, content validity, concurrent validity, and construct validity.	Adults
CET [122]	2011	The Compulsive Exercise Test was developed to assess the factors operating in the maintenance of excessive exercise. The subscales of the CET are consistent with a cognitive-behavioral maintenance model of excessive exercise and support the multidimensionality of the excessive exercise construct.	Females with ED Adolescents
EDQ [120]	1997	EDQ is made up of 29 items and eight factors: interference with social/family/work life, positive reward, withdrawal symptoms, exercise for weight control, insight into problem, exercise for social reasons, exercise for health reasons and stereotyped behavior. These factors were shown to have good internal reliability.	Adults
CES [123]	1993	The eight-item questionnaire is designed to assess an individual's psychological commitment to exercise. Primarily it assesses how individual's well-being is impacted by exercising and the degree to which adherence to exercise maintained by the individual.	Adults Females with ED
EBQ [124	1998	The EBQ is a 21-item self-report scale, measuring the beliefs people have about not exercising regularly. It assesses assumptions in exercise via four factors: (1) social desirability; (2) physical appearance; (3) mental and emotional functioning; and (4) vulnerability to disease and aging. The scale has acceptable-to-good psychometric properties.	Adults Athletes
BDS [125]	1998	Reviews three aspects of bodybuilding behavior: (1) social dependence; (2) training dependence; and (3) mastery dependence. It has been deemed a reliable and valid measure of bodybuilding dependency.	Adults
EDS [18]	1997	This scale adapted the DSM-IV criteria for substance dependence and applied it to exercise criteria	Adults
EDS-R [126]	2004	In 2004, this scale was revised and reduced the items to 21 (3 items for each of the 7 subscales). The total score and subscale scores can be calculated for the EDS. The higher the score, the higher the risk for exercise addiction. The EDS has good psychometric properties.	
EIS [127]	1994	This 9-item scale measures the salience of an individual's identification with exercise as an integral part of the self-concept	Adults
ESS [128, 129]	1990, 1994	The 40-item scale was validated in college aged students and items are scored on a 5-point Likert scale. It aims to measure exercise dependence qualifications including, engaging in strenuous exercise, anxious when cannot exercise, places exercise above social life, hold irrational expectations, continues exercising beyond injury, and ruminates about effect of decreasing exercise.	Adults
EEDQ [130]	2012	This tool was uniquely created to measure exercise in ED populations. It arose from clinical need to assess client's attitudes and thoughts surrounding compulsive exercise in individuals with EDs. It is based on the EDE-Q and reviews client's thoughts regarding exercise in the last 28 d. There is a 7-point scale (0–6), with higher scores indicative of greater pathology.	Male and females with ED
EDAS [92]	2012	This tool was developed to measure dysfunctional exercise in competitive athletes. It uses five domains specific to athletic populations to assess factors of dysfunctional exercise.	Competitive athletes
ART [131]	2018	The ART has 15 items scored on a 5-point Likert scale examining: (a) Affect-Driven Training; (b) Training Amount; (c) Training Against Medical Advice; (d) Body Dissatisfaction and aims to examine dysfunctional exercise in athletes.	Athletes

Notes: *OEQ* obligatory exercise questionnaire; *EAI* exercise addiction inventory; *CET* compulsive exercise test; *EDQ* exercise dependence questionnaire; *CES* commitment to exercise scale; *EBQ* exercise belief questionnaire; *BDS* bodybuilding dependence scale; *EDS* exercise dependence scale; *EDS-R* exercise dependence scale revised; *EIS* exercise identity scale; *ESS* the exercise salience scale; *EEDQ* exercise and eating disorder questionnaire; *EDAS* exercise dependence assessment scale: *ART* athletes' relationships with training scale; *ED* eating disorders

Quantitative Screening Tools

Researchers have been using multiple movement devices successfully, including accelerometry, *GPS*-tracking devices, and pedometers to provide information about objective quantification of physical activity. Accelerometers and pedometers are the most popular and have been used not only in healthy children, adolescents, adults, and elders of both genders, but also in different pathologies, owing to their low cost, storage capacity (more than 20 days), programming, data download, validity, and reliability [132].

Subjective quantification of physical activity levels is also possible through self-administered questionnaires and interviews. For example, the International Physical Activity Questionnaire (IPAQ) is a free and self-administered questionnaire that has been validated and is used worldwide with adults from 18 years and older [133]. There are other questionnaires specially validated for children and adolescents, such as the Physical Activity Questionnaire for Children and Adolescents (PAC-C or PAC-A) [134]. When incorporated into clinical practice, the most appropriate self-administered questionnaires should be selected based on age, sex, and validation within the intended population group. However, we must keep in mind the over- or under-estimations associated to the instrument and the population group.

12.3.2.3 Current Research in Menstrual Dysfunction Types of Menstrual Dysfunction

Aside from pregnancy and menopause, causes of secondary amenorrhea are most likely due to the following:

- Thyroid dysfunction
- Elevated prolactin
- Ovarian failure
- Polycystic ovarian syndrome (PCOS)
- Hypothalamic amenorrhea

Thyroid dysfunction and elevated prolactin are easily sorted out by blood testing for thyroid-stimulating hormone (TSH) and prolactin (PRL) levels. An athlete with ovarian failure will have elevated follicle-stimulating hormone (FSH) levels and very low or absent estrogen. PCOS and hypothalamic amenorrhea are typically differentiated based on clinical presentation, as they both may have normal FSH levels. The athlete with PCOS will usually be at or above a normal body as index (BMI) and will likely be hirsute and may show signs of insulin resistance [1, 35].

Functional Hypothalamic Amenorrhea

Loucks provides convincing evidence for the energy availability hypothesis related to menstrual dysfunction in athletes. Additionally, she provides evidence against the original theories concerning body composition and exercise stress. It is important to remember a series of events appears to be related to a deficit in energy availability causing menstrual dysfunction and subsequent issues with skeletal health. Exercise does not have an impact on LH pulsatility beyond the impact of its energy cost on energy availability [32, 47].

The energy availability hypothesis states if the brain energy requirements are not met, an alteration in brain function occurs which disrupts the GnRH pulse generator [50]. Regulation of puberty and reproductive function depends on interactions at specific levels of the hypothalamic-pituitary-ovarian (HPO) axis. The GnRH "pulse generator" neurons in the hypothalamus secrete GnRH every 60–90 min. This hormone causes release of gonadotropins (luteinizing hormone [LH] and follicle-stimulating hormone [FSH]) from the pituitary gland. These, in turn, cause release of progesterone and estrogen from the ovaries. These two end hormones are key to regular, ovulatory menstrual cycles [1, 53, 54]. Deficiency in GnRH pulsatile secretion leads to hypothalamic amenorrhea. Since hypothalamic amenorrhea in the athlete becomes a diagnosis of exclusion, it is often termed functional hypothalamic amenorrhea (FHA), because it is a functional suppression of reproduction [1]. Because FHA is the typical menstrual abnormality seen in athletes, it will be the focus of discussion concerning treatment of menstrual disorders for this chapter.

Who Should Be Screened for Menstrual Dysfunction?

The main populations to screen for menstrual dysfunction include the following groups [41, 135]:

- Adolescents involved in vigorous exercise with primary amenorrhea
- No menarche within 5 years after breast development that occurred less than 10 years old
- Failure of the thelarche (breast development) by 13 years old
- Athletes with previously regular cycles, at any age, with secondary amenorrhea or the lack of menses for 3 continuous cycles after beginning menses
- Athletes with oligomenorrhea, less than 9 cycles per year
- An intensively exercising, reproductively mature woman interested in conception

When to Screen for Menstrual Dysfunction

The answers concerning when to screen athletes for menstrual disorders are similar for screening of DysEx and ED. Evaluation of one component of the female athlete triad should not occur in isolation from the other two components. There is not yet an agreed upon optimal timing or method of screening for any component of female athlete triad disorders [3, 58]. Screening should be economical and

time-efficient and should create an environment that will not cause an athlete to minimize or deny certain medical conditions [58].

Timing of screening can include 1) during pre-participation examinations (PPEs) for competitive athletes, 2) during clinical presentation of the athlete for routine health care (i.e., well woman examination) or for illness or injury, and 3) incidental observation by an athletic trainer, parent, friend, coach, or administrator [3, 29]. Since menstrual dysfunction is often seen as related to sexuality, it can be a very sensitive topic and is not as likely to be incidentally discussed as energy availability might be. This leaves incidental observation the least likely scenario. Because of this, it is probably best to have a short screening tool utilized by those who interact on a routine basis with the athletes, such as athletic trainers, personal trainers or other gym personnel, and coaches who do not have availability of athletic trainers. The questionnaire tool could be distributed to all female athletes at specific times during the athletic year and would act as a first step to identify a possible disorder in menstruation. It ideally would also contain questions concerning nutrition and bone health. It would be easy to score and if the athlete screens positively with the tool, she would then be referred to a team physician or other designated intervention team for the second stage of screening, an in-depth evaluation.

Screening Questions for Menstrual Dysfunction

No validated tools to screen for menstrual dysfunction exist. Several pre-participation examination forms have from one to six questions included on the form [42, 55]. Tools used to screen for DE and ED may include a few questions about menstrual health. It is likely best to have a supplemental form, apart from the PPE form, in order to effectively screen for menstrual dysfunction. Screening should also include questions related to energy availability and skeletal health. Appendix 1.1 provides examples of tools used to screen female athletes for various components of the female athlete triad. The ideal will be to develop a standardized form to screen for the female athlete triad that is then validated. Any athlete who screens positively would need further evaluation by a physician [48].

Evaluation of Menstrual Dysfunction Beyond Screening

The in-depth evaluation with the physician or intervention team should include a routine health history, a comprehensive menstrual and obstetrical and gynecologic history, an appropriate examination, and an evaluation of bone mineral density. The physician could obtain the sexual history, in order to avoid an uncomfortable setting for the athlete and her athletic trainer and/or coaches [3, 29, 34, 44, 46, 58]. Some screening tools and PPE forms currently in existence already have a variety of questions concerning menstrual history. However, this varies from one question to several, to an entirely separate form [42, 55, 57, 77].

The question still remains concerning what makes up an adequate screening tool compared to an extensive obstetrical and gynecologic history. None of the existing forms have been validated for menstrual dysfunction screening. In a study done of NCAA Division 1 schools in 2003, 138 of 170 schools responded and 79% stated they did screen for menstrual disorders (MD). Only 24% of those used a comprehensive menstrual history questionnaire. A menstrual disorder treatment protocol was used by 33%. Of the responding schools, 60% screened for ED. However, less than 6% used a structured interview or a validated questionnaire. The conclusion from this study was there exists a pressing need for more standardized ED and MD screening, prevention, and treatment programs among NCAA Division 1 schools. A further conclusion was, at the very least NCAA member institutions should implement mandatory ED and MD education for all athletes and athletic personnel [28].

A study performed in 2012, involving menstrual irregularity in high school athletes, showed a high incidence of menstrual irregularity and an increased number of musculoskeletal injuries than in athletes reporting normal menses. More than half of the athletes reported a change in menses during training or competition. The recommendation from this study was for improved education of high school athletes to improve caloric intake to better balance their energy availability to prevent or correct menstrual irregularity [68].

Management of Functional Hypothalamic Amenorrhea

Once an athlete is identified as having a menstrual disorder, management becomes the next issue. In functional hypothalamic amenorrhea, there is insufficient energy availability. This then alters GnRH pulsatility in the hypothalamus and LH and FSH release. With limited pituitary secretion of LH and abnormal pulsatility, there is a lack of ovarian stimulation and thus an estrogen deficiency which impacts skeletal health from low sex hormones. There is also altered neuroendocrine function with low levels of insulin, glucose, leptin, triiodothyronine, and insulin-like growth factor-1 and elevated growth hormone and cortisol [53].

In adolescent girls, about 90% of total body mineral content is accrued by 15.5–18 years of age. Delayed puberty can compromise bone mass accumulation and low bone mineral density is a common finding in athletes with functional hypothalamic amenorrhea [53]. Twenty-five percent of bone mass accrual occurs in the 2 years surrounding menarche [34]. Due to this, the athlete becomes at risk for stress fractures, failure to achieve optimal peak bone mass density, and is thus at risk later in life for osteoporosis or delayed stress

fractures [46]. Other risks from hypoestrogenism may include cardiovascular disease, dementia, depression, delayed post-exercise recovery, decreased immune function, and other neurodegenerative and psychiatric disorders [29, 47, 54, 126].

12.4 Contemporary Understanding of the Issues

Screening female athletes for disordered eating, eating disorders, DysEx, and menstrual dysfunction is a complex issue. Those involved with active females need to encourage screening on multiple levels, both formally and informally, utilizing a combination of timing and methods (observation, standardized questionnaires, interviews, etc.). Screening needs to occur as an ongoing process, not only occurring as an isolated event during pre-participation examinations. Education of those involved with female athletes, on all levels, will help in ongoing informal recognition of signs and symptoms of DE/ED, DysEx, and menstrual dysfunction. This is essential because the longer low energy availability is allowed to exist, the greater the health and performance impairments that occur and the more difficult they are to treat.

Screening for DysEx or menstrual dysfunction should not occur in isolation and need to include evaluation of total energy availability and bone health to be thorough in evaluating for the female athlete triad. Currently, there is no universally agreed upon timing or method to screen athletes for abnormal energy availability (DE/ED), DysEx, or menstrual dysfunction. Although, in association with PPE's and during routine healthcare visits, or clinical evaluation when one portion of the triad presents, are the most common cited times for screening. Additionally, there are not clear guidelines about what should happen when an athlete does screen positively for menstrual dysfunction. A complete physician evaluation is recommended, to include past medical history, past surgical history, current medications, social history, family history, and a comprehensive obstetrical and gynecologic history. Comprehensive history taking will then guide the physician concerning appropriate physical examination, laboratory testing, and radiology studies.

A national standard should be encouraged, with a supplemental questionnaire specific to females rather than questions incorporated into a standard PPE form. The athletic trainer or team physician or both should then review the tools. Physicians need to be reminded to screen female athletes for risk factors for low energy availability during routine health visits and visits for acute illness or injury. If for some reason a female athlete-specific questionnaire cannot be utilized, consideration should be given to use of a general population screening tool that is inexpensive and easily accessible. Please see Chap. 5 for more discussion surrounding management and education for MD management in athletes.

12.5 Future Directions

The sports medicine community can serve its female athletes well by developing a consensus guideline related specifically to screening for DE/ED, DysEx, and menstrual dysfunction. The challenge has been twofold: to agree on questions needing to be asked on a survey tool, and to achieve validation of any such tool. A method of rapid assessment of that tool would then allow the healthcare provider to determine whether further referral should be made the same day, or if ongoing monitoring may be needed. Incorporation of physiologic variables into a screening tool shows promise and should be further evaluated.

Simplified education programs for all people who interact with athletes should be developed based on prior efforts, distributed nationally, and assessed to evaluate their effectiveness in detection and/or prevention. Methods of screening for these conditions should be covered in these programs so that screening will become an ongoing process in both informal and formal settings where female athletes are encountered. Further, programs of education and screening should be expanded into junior high and high schools to identify issues of low energy availability as early as possible.

12.6 Concluding Remarks

Low energy availability, as a consequence of DE or ED or DysEx in female athletes, is a significant health concern. It is a key component of the female athlete triad and can lead to menstrual disorders and changes in bone health. The athletic health care community needs to address this health concern beginning in junior high school and high school and continuing through the lifetime of the active female. The best method of management is through a combined approach with screening both informally through observation and formally during pre-participation examinations and other interactions of female athletes with health care providers, in order to prevent the consequences of DE, ED, and DysEx. Pathologic eating disorders can lead to significant health complications, including death.

There is a fine line between regular and healthy exercise and excessive practice. There is not a clear relationship between high levels of exercise and other mental disorders. Although other mental illnesses may be the source, there are no studies to confirm or deny it. DysEx is more common in

high performance compared to recreational exercisers. When 15 years of experience are exceeded, the prevalence of DysEx decreases, likely because practice is highly integrated in daily life. When women display DysEx behaviors, the features are different compared to males. Features specific to women include weight preoccupation, appearance, body image, and body composition concerns. These features are closely related with DE and ED symptoms.

Menstrual dysfunction in athletes should be considered a medical issue needing further evaluation. Amenorrhea in the active female should no longer be viewed as a good thing. In addition to being a medical problem, it can be a symptom related to abnormal skeletal health. At one extreme, it may be the first warning sign of a potentially lethal ED. At the other extreme, it may be a sign of lack of proper nutritional education causing the athlete to exhibit DE, i.e., not taking in enough calories for the level of training. Prevention and early intervention are the key components to minimizing morbidity and mortality. The ideal method and timing for screening have yet to be determined. The best method is likely using a separate questionnaire-based screening tool during the preparticipation physical examination.

Screening for these disorders can be a sensitive issue. Initial screening by athletic trainers or coaches should include basic questions concerning menses, bone health, and energy availability. Once the athlete screens positively, she should be referred to medical personnel for a comprehensive evaluation. Screening tools need to be more specific and detailed, and validated for female population. Additionally, an in-depth analysis, using one or more screening tools, might be needed to prevent the female athlete triad and provide the best recommendations and/or treatment.

Appendix 1: Screening Tools

Appendix 1.1: Eating Disorders/Disordered Eating

1.1.1 General Screening Tools

EAT-26

This is the most widely used standardized self-report measure of symptoms and concerns characteristics of eating disorders specifically. It has three subscales: dieting, bulimia and food preoccupation, and oral control. EAT-26 is a refinement of the original EAT-40 that was first published in 1979. This tool is easily accessible as it is web-based and free. Scoring instructions are included on the website. It can be administered in group or individual settings and does not have to be administered by a mental health or medical professional. A score of 20 or more should prompt referral for interview by a qualified professional to determine whether diagnostic criteria for an ED exist. It is valid and reliable. Ch-EAT is the version used in children [52].

SCOFF Questionnaire

This was developed in 1999 in Great Britain as a quick and easy to remember screening tool for clinicians. The use of a mnemonic with yes/no responses, similar to the CAGE questions for alcoholism, is intended to simplify screening. There are five questions, which take between 1 and 2 min to administer. In the original study, two or more positive answers provided 100% sensitivity [60]. One question is written in Queen's English referring to weight in stones. An "Americanized" version, with the value in pounds, was developed for use in research comparing SCOFF to another screening tool [136].

Eating Disorders Exam-Questionnaire (EDE-Q)

This tool was devised in 1994 and is a self-completed questionnaire form of the EDE, which is an interview-based tool administered by a qualified professional to diagnose eating disorders. It is a widely used measure of eating disordered behavior. The tool consists of 36 items and takes about 15 min to complete. It focuses on the past 28 days and is scored using a 7-point scale. The four subscales included are restraint, eating concern, weight concern, and shape concern. It has good criterion validity. Compared to the EDE, it does tend to overestimate binge-eating frequency [22, 62, 137].

Eating Disorder Inventory-3 (EDI-3)

This was developed in 2004 as an expansion and improvement upon Eating Disorder Inventory-2 (EDI-2) from 1991 and the original EDI in 1983. At the time, EDI-2 was already recognized as a standard self-report measure for ED assessment in the international health care community. EDI-3 evaluates for psychological traits and symptoms relevant to the development and maintenance of anorexia nervosa, bulimia nervosa, and eating disorder not otherwise specified. It consists of 91 items broken into 12 subscales (ED risk scales versus psychological scales) and provides 6 composite scores. On average, it takes about 20 min to complete. This tool can be accessed through the Internet, but it is cost associated. EDI-C is available for use with children [59, 63, 64, 68].

Eating Disorder Screen for Primary Care (ESP)

This was developed in 2003 in Great Britain in an attempt to generate a short screening tool that could both rule in and rule out EDs. It consists of four questions and takes 1–2 min to complete. It is not validated. One study compared it directly to SCOFF and it was found to be equally effective [64].

Bulimia Test-Revised (BULIT-R)

This is a 28-question tool that is easy to score and is well validated. It is a revision from the original BULIT. This instrument has been shown to be a reliable and valid measure for identifying individuals who may suffer from bulimia nervosa both in clinical and nonclinical populations [51, 65].

National Eating Disorders Association (NEDA) Screening Program

This is an online eating disorder screening. There are two separate questionnaires: one for college students and one for the general population. It provides a free, anonymous self-assessment to gauge one's risk of an eating disorder. It takes only a few min and consists of a series of questions designed to indicate whether clinical help may be needed. After completing a screening, if indicated, participants will receive referral information through NEDA's Helpline for personal evaluation by a medical professional and treatment. This is considered a good resource for people who may need help or know someone who may need help and do not know where to begin. NEDA also provides the annual Collegiate Survey Project, each year in March. This is a compilation of responses from 165 colleges and universities concerning on-campus resources for eating disorder-related programs [65].

1.1.2 Eating Disorders Diagnostic Tools

Eating Disorders Exam (EDE)

This semi-structured interview is recognized as the method of choice for diagnosing eating disorders, specifically anorexia nervosa and bulimia nervosa. It was developed in 1987 and revised in 1993. The interviewer, not the subject, rates the severity of symptoms. It focuses on a 28-day time frame over the previous weeks. There are 62 items, and it can take over an hour to administer. There are two behavioral indices (overeating and methods of extreme weight control) and four subscales (restraint, eating concern, shape concern, and weight concern). Administration is by a clinician with specific training in the use of this interview [22, 51, 62].

Interview for Diagnosis of Eating Disorders (IDED)-IV

This semi-structured interview was revised in 1998, after the original in 1990, for the purpose of discriminating between eating disorders and subthreshold syndromes, which it does. It has good reliability and validity. The rater uses severity scales on a diagnostic checklist that leads directly to the differential diagnosis using DSM-IV criteria. It is a reasonable alternative to EDE [51, 52].

If a generalized screening tool will be used, EAT-26 or EDE-Q are the most widely used self-report questionnaires. When time and resources are available or an athlete screens positively, the interview-based EDE is an ideal.

1.1.3 Athlete Specific Screening Tools

Female Athlete Screening Tool (FAST)

This tool was developed in 2001 to identify disordered eating and atypical exercise and eating behaviors among female athletes. It has 33 questions. It has internal reliability and concurrent validity to EDI and BULIT-R [67].

Health, Weight, Dieting, and Menstrual History Questionnaire (HWDMHQ)

This was the first study to assess the combined prevalence of all three components of the female athlete triad. The study showed that very few athletes demonstrate all three components, but a significant number suffer from the individual disorders of the triad. It was developed from the EDI symptom checklist and EDE-Q in 2002 and revised in 2006 [3].

Physiologic Screening Test

This tool was developed in 2003 to provide a physiologic screening test, specifically for collegiate female athletes competing at a high level, in order to detect DE/ED. It takes 15 min to complete and consists of 18 items: 14 questions and 4 physiologic measurements (percent body fat, waist:hip ratio, standing diastolic blood pressure, enlarged parotid glands). It outperformed the EDI-2 and BULIT-R on the false-negative rate, negative predictive value, yield, overall accuracy, and validity [41].

Female Athlete Triad Screening Questionnaire

This is a questionnaire available, free of charge, on the Internet. The Female Athlete Triad Coalition is sponsored by several sports medicine organizations and has existed since 2002. The initial screen has 12 questions: nutrition, 8; menses, 3; bone health, 1. If positive, an in-depth evaluation with a detailed history of 19 questions and a full medical evaluation are recommended [49].

Athletic Milieu Direct Questionnaire (AMDQ)

This was designed in 2000 to assess DE/ED in female athletes. It is the first instrument to operationalize the construct of DE. It consists of 19 questions evaluating behaviors relevant to weight management, diet, and exercise. It has not been clinically validated but compared to EDI-2 and

BULIT-R it has superior results on seven of the nine epidemiologic analyses [52, 69].

Athlete

This tool was developed in 2005 to be administered to female athletes at three Division 1 universities. It is used to recognize psychological predictors of DE. There are six subscales from EDI, which were modified to athletes [69].

Low Energy Availability in Females Questionnaire (LEAF-Q)

The LEAF questionnaire was developed to assess low energy availability in female athletes with or without eating disorders. This questionnaire comprises 25 questions across domains such as injuries, dizziness, cold sensitivity, gastrointestinal function, and menstrual dysfunction on a 5-point Likert scale. Overall, the LEAF-Q is reported to be brief and easy to administer, in a study of over 80 females the LEAF-Q had an internal consistency testing outcome of 0.86, suggesting relatively high homogeneity of the LEAF-Q. The test–retest reliability was 0.79 after a 2-week interval of retesting in this sample [70].

Brief Eating Disorder in Athletes Questionnaire (BEDA-Q)

The objective of this questionnaire is to discriminate between female elite athlete with and without eating disorders in a quick and effective way. The questionnaire has 9 items as answered in a "true or false" fashion or an on a 5-point Likert scale. Questions pertain to body satisfaction, drive for thinness, and perfectionism [71].

1.1.4 Non-Gender Specific Screening Tools

College Health-Related Informational Survey (CHRIS)

This was developed in 2003 as a new screening instrument for college student athletes. It was based on the Juvenile Wellness and Health Survey. There are 32 questions broken down into four areas: mental health, 9; eating problems, 12; risk behaviors, 4; performance pressure, 6 [72].

De Palma

This was devised in 2001 as a discriminate analysis tool to identify college students and student athletes at low, moderate, or high risk of pathologic eating. It was not given any specific title so is referred to here by the first authors last name. It has 16 questions, 8 each from two different previously used instruments, diagnostic survey of eating disorders (DSED) and survey of eating disorders among athletes (SEDA). It takes about 2 min to complete and 2 min to score. The items are short and relatively nonconfrontational [38].

Survey of Eating Disorders Among Athletes (SEDA)

This is a survey of collegiate females and males, who are both athletes and students. It consists of 33 questions related to self-reported eating pathology. It has not been validated in an athletic population [73].

Standardized Pre-Participation Examination (PPE) forms are directed at both female and male athletes. There is a myriad of those types of forms available. The following will discuss two of the more commonly used forms. Additionally, NCAA sponsored universities are required to perform PPEs on all athletes. There are several of those forms available online for the athlete to complete in advance of arrival for a PPE. There is no NCAA standard for those forms so many do not have specific DE/ED questions. Many universities use a separate form such as those previously discussed as part of their student athlete evaluations. Given the health care system is moving toward a Patient Centered Medical Home (PCMH), where patient information is stored electronically with ongoing updates, online storage of electronic data recorded in a PPE form may eventually be a recommended best practice. The National Committee for Quality Assurance is promoting the PCMH to allow for organizing care around the patient, working in health teams, and coordinating and tracking care over time [45]. The ability for health care providers to access the athlete's information electronically may improve the quality of care they receive and may make research related to athletes easier.

Pre-participation Physical Evaluation, Fifth Edition

The latest revision of this form occurred in 2019. It has four questions concerning weight issues that are directed at both females and males. There are three questions related to menses [42].

International Olympic Committee Periodic Health Evaluation of Elite Athletes

This form has 11 nutrition and weight-related questions for both females and males. There are nine questions directed at the female athlete's reproductive and/or skeletal health (6 menses, 2 bone health, 1 sexually transmitted infections) [74].

When a self-report screening tool is utilized, the timing and setting for its use must be considered. The tools that appear to be most useful are FAST, AMDQ, and HWDMHQ. The Physiologic Screening Test appears to have potential. However, ongoing validation of these tools must continue to occur. If screening occurs during PPEs the use of a supplemental tool for female athletes is optimal.

Appendix 1.2: Dysfunctional Exercise Questionnaires

Obligatory Exercise Questionnaire (OEQ)

The OEQ was originally developed from questionnaires about obligatory exercise tendencies in populations of runners. Over time, authors edited the questionnaire about runners to include a broader range of questions about exercise tendencies. Eventually, the OEQ was developed as a quick and simple questionnaire to administer, taking about 5 min to complete. There are 20 items which inquire on a range of exercise habits. The participant is meant to circle the frequency with which they engage in such a behavior or have thoughts surrounding aspects of dysfunctional exercise. In 2002, this measure was psychometrically validated and the internal consistency ratio was 0.96 and the test–retest reliability was also 0.96 [12, 20].

Exercise Addiction Inventory (EAI)

The EAI tool aims to identify those at risk for exercise addiction. Authors undertook the initiative to develop a quick and easy tool to administer as they did not feel one existed. The development of the EAI was based on the work of behavioral addiction. Authors adjusted the characterization of behavior addiction in the context of exercise. It can identify individuals who are at risk, those who exhibit some symptoms, and individuals who are at no risk of dysfunctional exercise. The scale is broken down into six items which inquire about attitudes and beliefs about exercise behavior, perceived importance of exercise along with its consequences, and frequency of exercise needed to achieve the anticipated benefit. Internal consistency has been demonstrated as very good (0.84). It also showed good concurrent reliability when compared to the obligatory exercise questionnaire and the exercise dependence scale [121].

Compulsive Exercise Test (CET)

The CET was developed in order to assess the primary factors functioning to maintain dysfunctional exercise. This scale is consistent with a cognitive behavior model of behavior maintenance. It was designed to be utilized in individuals with eating disorders. The scale consists of 31 items which relate to the compulsivity, affect regulation, weight control, and exercise factors of compulsive exercise maintenance. The items are scored on a 6-item Likert scale between 0 and 5. The internal consistency for this item is good (alpha = 0.85) [122].

Exercise Dependence Questionnaire (EDQ)

The EDQ consists of 29 items covering 8 subscales which inquire on the social affects and one's motivation to exercise. This scale was found to have good psychometric properties including internal reliability and discriminate validity. However, this scale does not uniquely assess exercise dependence; its items evaluate social practices and attitudes as well [120].

Commitment to Exercise Scale (CES)

The CES was designed to assess one's pathological commitment to exercise. This measure has often been used in eating disorder research [37]. The respondents have to answer on a scale of never to always by selecting a number listed on a horizontal line between 0 and 10. High scores indicate greater pathology. This measure is well validated and has a Cronbach's alpha of 0.85 [123].

Exercise Belief Questionnaire (EBQ)

The EBQ was developed specifically to measure maladaptive beliefs about the consequences of not exercising. The scale is a 21-item self-reported tool which measures the beliefs individuals have about not being able to exercise as they regularly do. It was developed with exercisers engaging in a large variety of intensities, modalities, and settings of activities. There are four subscales established which include social desirability, physical appearance, mental and emotional functioning, vulnerability to disease, and aging. The Cronbach alphas were calculated for each of the subscales and results are as follows: social desirability (a = 0.87); physical appearance (a = 0.83); mental and emotional functioning (a = 0.89); and vulnerability to disease and aging (a = 0.67) [124].

Bodybuilding Dependence Scale (BDS)

The BDS has 9 items falling within three subscales of bodybuilding dependence, which include social dependence, training dependence, and master dependence. The internal consistency was satisfactory for each scale with Cronbach's alpha = 0.76, 0.75, and 0.78. This scale is meant to uniquely assess dependence in individuals who engaging in body building or natural fitness competitions [125].

Exercise Dependence Scale (EDS) and Exercise Dependence Scale Revised (EDS-R)

The EDS and the EDS-R are both based on the DMS IV diagnostic criteria for substance dependence. The original scale (EDS) was developed and validated in 2002. This scale was used to determine the rates of primary exercise dependence. However, in 2004, this scale was amended, and thus came to be the exercise dependence scale revised. The new scale included 21 items within seven subscales. Cronbach's alphas were all above acceptable limits for each subscale as follows: Tolerance (alpha = 0.78); withdrawal (alpha = 0.90); continuance (alpha = 0.90); lack of control (alpha = 0.80); reduction in other activities (alpha = 0.70); and time (alpha = 0.86) [18, 131].

Exercise Identity Scale (EIS)

The EIS measures the salience of an individual's identification with exercise as a part of their overall self-concept. The EIS consists of nine items which ask about how the individuals views themselves in the context of activity, motivation for exercise, and other questions which pertain to how an individual describes his/her relationship with exercise. The Cronbach's alpha was 0.93 demonstrating good reliability [127].

The Exercise Salience Scale (ESS)

The ESS aimed to offer a set of diagnostic criteria by offering 30 questions based on the following: (1) engages in regular strenuous exercise; (2) experiences a dysphoric or anxious mood when unable to exercise; (3) alters priorities so that exercise is placed above social and occupational activities; (4) holds irrational expectations regarding the amount of exercise needed to maintain a desired body shape and fitness level; (5) persists in exercise behavior in the face of physical consequences, such as bad weather and physical injury; and (6) ruminates about the effects of any decrease in exercise level. The question are answered on a 5-point Likert scale, higher numerical scores indicated higher levels of pathology. Unfortunately, this scale concluded its validity and reliability tests by stating that unless an individual was previously diagnosed as exercise dependent in a clinical setting, the ESS was in need of additional testing to be a valuable tool to investigate exercise dependence, which may be the reason this scale is not often used in today's literature [128, 129].

Exercise and Eating Disorder Questionnaire (EED-Q)

The aim of the EEDQ was to capture detailed information about exercise regimens and disturbances among clients with eating disorders. This scale includes 18 items across three subscales which include intentions to exercise, consequences of not exercising, and awareness of bodily signals. This instrument is considered easy to administer and complete. The EED-Q has been validated in both men and women with eating disorders. Cronbach's alpha was 0.92 which demonstrates satisfactory internal consistency [130].

The Exercise Dependence and Elite Athletes Scales (EDAS)

McNamara and McCabe (2013) authored the *Exercise Dependence and Elite Athletes Scale* for assessing dysfunctional exercise in elite athletes. This questionnaire was founded on characteristics identified by coaches from over 10 different sports (including endurance, ball, and aesthetic sports) as associated with DE. This self-reported tool has good validity with the athletic ED population measuring DysEx in elite athletes over a range of characterizations such as: 1) *Unhealthy Eating Behaviors*; 2) *Conflict and Dissatisfaction*; 3) *More Training*; 4) *Withdrawal;* 5) *Emotional Difficulties; and* 6) *Continuance Behaviors*. These six subscales are measured across 24 items scored on a 5-point Likert scale from 1 (Never) to 5 (Always) [92].

Athletes Relationship with Training Scale (ART)

The Athletes Relationship with Training Scale was developed in hope of creating a clinically useful, self-reported measure of unhealthy training behaviors and beliefs in athletes. The ART has a four-factor structure examining the following (a) Affect-Driven Training assessing negative affect associated with training or lack of training (b) Training Amount assessing training beyond scheduled practices and coach recommendations; (c) Training Against Medical Advice assesses training when injured or against medical recommendations; and (d) Body Dissatisfaction assesses training to acquire a certain body type. In a review of the tool in over 250 female athletes, and women with eating disorders and the ART predicted health care utilization and differences between athletes with and without eating disorders [131].

Chapter Review Questions

Eating Disorder/Disordered Eating Questions

1. The American College of Sports Medicine Position Stand on the Female Athlete Triad describes the interrelationships between:
   (a) Energy availability
   (b) Menstrual function
   (c) Bone mineral density
   (d) All of the above
2. Energy availability is the energy remaining for body functions after that used for exercise is added to total energy intake.
   (a) True
   (b) False
3. One way an athlete's available energy may be reduced is:
   (a) Decreased energy expenditure with reduced exercise
   (b) Increasing energy intake
   (c) Abnormal eating behaviors
   (d) None of the above
4. Screening for disordered eating and eating disorders can occur at a common entry point to athletic participation.
   (a) True
   (b) False
5. Once an athlete screens positively for possible low energy availability or if a concern exists, the athlete should:
   (a) Celebrate his/her positive screening
   (b) Continue his/her normal training routine

(c) Increase energy expenditure while decreasing energy intake
(d) Be referred for further medical and psychological or psychiatric evaluation

6. Properties that make a screening tool useful include:
   (a) Functionality
   (b) Validity
   (c) Reliability
   (d) All of the above
   (e) None of the above
7. A more formal screening evaluation for disordered eating/eating disorders should include:
   (a) Detailed medical, nutritional, and reproductive history
   (b) Physical examination with lab evaluation
   (c) Referral to a psychologist
   (d) All of the above
   (e) None of the above
8. The informal settings where athletes may be screened for disordered eating/eating disorders occur:
   (a) While interacting with personal trainers, family, and friends
   (b) When filling out Pre-participation Physical Exam forms
   (c) In clinical settings
   (d) None of the above
9. Physical complaints that can help diagnose an eating disorder include:
   (a) Amenorrhea
   (b) Bradycardia
   (c) Skin changes
   (d) Low body mass index
   (e) All of the above
10. The clinical tool that is recognized as the assessment of choice for diagnosing an eating disorder is:
   (a) Eating Disorders Interview (EDI)
   (b) EAT-26
   (c) Eating Disorders Exam (EDE)
   (d) Female Athlete Screening Tool (FAST)
   (e) SCOFF

Answers for ED/DE Questions

1. d
2. b
3. c
4. a
5. d
6. d
7. d
8. a
9. e
10. c

Dysfunctional Exercise Questions

1. What are the components that define dysfunctional exercise or problematic exercise?
   (a) Excessive exercise and intensity
   (b) Intensity and qualitative
   (c) Quantitative and qualitative
   (d) Quantitative and excessive exercise
2. Which is not a symptom for secondary dysfunctional exercise?
   (a) Preoccupation with exercise cannot be explained due to co-occurring with another mental disorder
   (b) Subjective awareness of a compulsion to exercise
   (c) Relief of withdrawal symptoms if exercise is restarted
   (d) Increased tolerance to exercise
3. The prevalence of Dysfunctional Exercise among those with an eating disorder range _____.
   (a) 10–30%
   (b) 15–50%
   (c) 25–60%
   (d) 26.8–80%
4. Dysfunctional exercise is less common in women who _____.
   (a) are dancers (i.e., ballet or modern dance)
   (b) participate in collaborative sports
   (c) are endurance exercise practitioners (i.e., marathon, ultra-marathon)
   (d) None of the above
5. Dysfunctional exercise is more prevalent in:
   (a) High-performance athletes
   (b) Amateur athletes
   (c) Individuals that engage in exercise with the objective to improve their health
   (d) There are no differences in dysfunctional exercise prevalence based on the level of performance
6. Quantitative component of dysfunctional exercise can be assessed using:
   (a) METs
   (b) MVPA
   (c) Frequency (per week or per day)
   (d) All the above are utilized to quantify exercise
7. The threshold for secondary dysfunctional exercise in the context of those with eating disorders (not athletes or general population) is:
   (a) >3 h/week for at least 4 weeks
   (b) >6 h/week for at least 4 weeks
   (c) >9 h/week for at least 4 weeks
   (d) >12 h/week for at least 4 weeks
8. What is screening tool is best to assess the quantitative component of dysfunctional exercise?
   (a) Accelerometry

(b) Self-report diary
(c) Observation
(d) Interview

9. Which of the following qualitative screening tools for dysfunctional exercise is only validated for adolescents and females with eating disorders?
   (a) OEQ—Obligatory Exercise Questionnaire
   (b) CES—Commitment to Exercise Scale
   (c) CET—Compulsive Exercise Test
   (d) EED—Exercise and Eating Disorders
10. Which of the following qualitative screening tools for dysfunctional exercise has been validated for males and females with eating disorders?
   (a) EIS—Exercise Identity Scale
   (b) ESS—The Exercise Salience Scale
   (c) EED—Exercise and Eating Disorders
   (d) EAI—Exercise Addiction Inventory

Answers for DysEx Questions

1. c
2. d
3. d
4. b
5. a
6. d
7. b
8. a
9. c
10. c

Menstrual Dysfunction Questions

1. Athletes who desire pregnancy, but are not ovulating can be treated with:
   (a) Clomiphene citrate for ovulation induction
   (b) Pulsatile GnRH or injected gonadotropins
   (c) Endogenous opiates
   (d) Both a and b can be used to induce ovulation
2. Which of the following statements is *false* about oral contraceptive pills (OCP)?
   (a) The use of OCPs will not normalize the metabolic factors impairing bone function, health and performance
   (b) OCP are unlikely to fully reverse low bone mineral density (BMD)
   (c) Estrogen replacement without nutritional rehabilitation will always reverse bone loss
   (d) All statements are true
3. Hormone therapy should not be used in amenorrheic adolescents younger than _____years old until after a thorough work-up has been completed.
   (a) 16
   (b) 17
   (c) 18
   (d) 21
4. Which of the following statements are true with regard to appetite in the female athlete?
   (a) Appetite is an unreliable indicator of energy requirements
   (b) Athletes should just eat when they are hungry and this will prevent low energy availability
   (c) Athletes should wait for hunger and then eat until satisfied in order to increase energy availability
   (d) All of the statements are true
5. Treating the cause of menstrual dysfunction can lead to ovulatory cycles within 12 months, but up to _____of athletes may have persistent amenorrhea.
   (a) 30%
   (b) 40%
   (c) 50%
   (d) 70%
6. _____percent of bone mass accrual occurs in the _____ years surrounding menarche.
   (a) 45%; 4
   (b) 35%; 3
   (c) 30%; 1
   (d) 25%; 2
7. In adolescent girls, about _____ of total body mineral content is accrued by 15½–18 years of age.
   (a) 60%
   (b) 70%
   (c) 80%
   (d) 90%
8. Target groups for menstrual screening should include which group(s) of women?
   (a) A normal secondary sexual development but no menarche by 15 years of age
   (b) Failure of the thelarche (breast development) by 13 years old
   (c) No menarche within 5 years after breast development that occurred less than 10 years old
   (d) All of the above-mentioned groups should be targeted
9. In 2006, National Collegiate Athletic Association Division 1 Schools adopted a standardized eating disorder and menstrual dysfunction screening tool to be used for all female athletes.
   (a) True
   (b) False
10. Which of the following characteristics is (are) true for an athlete with polycystic ovarian syndrome (PCOS)?
   (a) She will usually be at or above a normal body mass index (BMI)
   (b) She will likely be hirsute
   (c) She may show signs of insulin resistance
   (d) All of the above characteristics could be possible with PCOS

Answers for Menstrual Disorder Questions

1. d
2. c
3. b
4. a
5. a
6. d
7. d
8. d
9. b
10. d

References

1. Joy E, Kussman A, Nattiv A. 2016 update on eating disorders in athletes: a comprehensive narrative review with a focus on clinical assessment and management. Br J Sports Med. 2016;50:154–62. https://doi.org/10.1136/bjsports-2015-095735.
2. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders (DSM-5®). 5th ed. Arlington, VA; 2013.
3. Beals KA, Hill AK. The prevalence of disordered eating, menstrual dysfunction, and low bone mineral density among US collegiate athletes. Int J Sport Nutr Exerc Metab. 2006;16(1):1–23. https://doi.org/10.1123/ijsnem.16.1.1.
4. Pustivšek S, Hadžić V, Dervišević E, Carruthers J. Risk for eating disorders and body composition among adolescent female and male athletes and non-athlete controls. Int J Adolesc Med Health. 2019. https://doi.org/10.1515/ijamh-2017-0190.
5. Ness AR, Leary SD, Mattocks C, Blair SN, Reilly JJ, Wells J, et al. Objectively measured physical activity and fat mass in a large cohort of children. PLoS Med. 2007;4(3):476–84. https://doi.org/10.1371/journal.pmed.0040097.
6. Ekelund U, Brage S, Froberg K, Harro M, Anderssen SA, Sardinha LB, et al. TV viewing and physical activity are independently associated with metabolic risk in children: the European Youth Heart study. PLoS Med. 2006;3(12):2449–57. https://doi.org/10.1371/journal.pmed.0030488.
7. Landers DM. The influence of exercise on mental health. 1997. https://doi.org/10.1037/e606932007-001.
8. Ströhle A. Sports psychiatry: mental health and mental disorders in athletes and exercise treatment of mental disorders. Eur Arch Psychiatry Clin Neurosci. 2019;269(5):485–98. https://doi.org/10.1007/s00406-018-0891-5.
9. The World Health Organization. Rheumatic Fever and Rheumatic Heart Disease: Report of a WHO Expert ... - World Health Organization - Google Books; 2004.
10. Gowey MA, Lim CS, Clifford LM, Janicke DM. Disordered eating and health-related quality of life in overweight and obese children. J Pediatr Psychol. 2014;39(5). https://doi.org/10.1093/jpepsy/jsu012.
11. Allegre B, Souville M, Therme P, Griffiths M. Definitions and measures of exercise dependence. Addict Res Theory. 2006;14:631–46. https://doi.org/10.1080/16066350600903302.
12. Pasman L, Thompson JK. Body image and eating disturbance in obligatory runners, obligatory weightlifters, and sedentary individuals. Int J Eat Disord. 1988;7(6):759–69. https://doi.org/10.1002/1098-108X(198811)7:6%3C759::AID-EAT2260070605%3E3.0.CO;2-G.
13. Johnston O, Reilly J, Kremer J. Excessive exercise: from quantitative categorisation to a qualitative continuum approach. Eur Eat Disord Rev. 2011;19:237–48. https://doi.org/10.1002/erv.970.
14. Goodman A. Addiction: definition and implications. Br J Addict. 1990;85:1403–8. https://doi.org/10.1111/j.1360-0443.1990.tb01620.x.
15. Fairburn CG. Cognitive behavior therapy and eating disorders. First The Guilford Press; 2008. p. 324.
16. Davis C. Exercise abuse. Int J Sport Psychol. 2000;31(2):278–89.
17. Dalle Grave R, Calugi S, Marchesini G. Compulsive exercise to control shape or weight in eating disorders: prevalence, associated features, and treatment outcome. Compr Psychiatry. 2008;49(4):346–52. https://doi.org/10.1016/j.comppsych.2007.12.007.
18. Hausenblas HA, Downs DS. How much is too much? The development and validation of the exercise dependence scale. Psychol Health. 2002;17(4):387–404. https://doi.org/10.1080/08870440220000004894.
19. Davis C, Kennedy SH, Ravelski E, Dionne M. The role of physical activity in the development and maintenance of eating disorders. Psychol Med. 1994;24(4):957–67. https://doi.org/10.1017/s0033291700029044.
20. Thompson JK, Pasman L. The obligatory exercise questionnaire—the behavior therapist. Psychol Fac Publ. 1991;14:137.
21. Grave RD. Features and management of compulsive exercising in eating disorders. Phys Sportsmed. 2009;37(3):20–8. https://doi.org/10.3810/psm.2009.10.1725.
22. Fairburn CG, Beglin S. Eating Disorder examination questionnaire (EDE-Q 6.0). In: Fairburn CG, editor. Cognitive behavior therapy and eating disorders. Guilford Press; 2008. https://psycnet.apa.org/record/2008-07785-000.
23. Rizk M, Lalanne C, Berthoz S, Kern L, Godart N. Problematic exercise in anorexia nervosa: testing potential risk factors against different definitions. PLoS One. 2015;10(11). https://doi.org/10.1371/journal.pone.0143352.
24. Cockerill IM, Riddington ME. Exercise dependence and associated disorders: a review. Couns Psychol Q. 1996;9(2):119–29. https://doi.org/10.1080/09515079608256358.
25. de Coverley Veale DMW. Exercise dependence. Br J Addict. 1987;82:735–40. https://doi.org/10.1111/j.1360-0443.1987.tb01539.x.
26. Berczik K, Szabó A, Griffiths MD, Kurimay T, Kun B, Urbán R, et al. Exercise addiction: symptoms, diagnosis, epidemiology, and etiology. Subst Use Misuse. 2012;47:403–17. https://doi.org/10.3109/10826084.2011.639120.
27. Bamber DJ, Cockerill IM, Rodgers S, Carroll D. Diagnostic criteria for exercise dependence in women. Br J Sports Med. 2003;37(5):393–400. https://doi.org/10.1136/bjsm.37.5.393.
28. Gibbs JC, Williams NI, de Souza MJ. Prevalence of individual and combined components of the female athlete triad. Med Sci Sport Exerc. 2013;45(5):985–96. https://doi.org/10.1249/mss.0b013e31827e1bdc.
29. Torstveit MK, Rosenvinge JH, Sundgot-Borgen J. Prevalence of eating disorders and the predictive power of risk models in female elite athletes: a controlled study. Scand J Med Sci Sport. 2008;18(1):108–18. https://doi.org/10.1111/j.1600-0838.2007.00657.x.
30. Bonci CM, Bonci LJ, Granger LR, Johnson CL, Malina RM, Milne LW, et al. National Athletic Trainers' Association position statement: preventing, detecting, and managing disordered eating in athletes. J Athl Train. 2008;43(1):80. https://doi.org/10.4085/1062-6050-43.1.80.
31. Nattiv A, Loucks AB, Manore MM, Sanborn CF, Sundgot-Borgen J, Warren MP. The Female Athlete Triad. American College of Sports Medicine Position Stand. Med Sci Sport Exerc. 2007;39(10):1867–89. https://doi.org/10.1249/mss.0b013e318149f111.
32. Byrne S, McLean N. Eating disorders in athletes: a review of the literature. J Sci Med Sport. 2001;4:145–59. https://doi.org/10.1016/s1440-2440(01)80025-6.

33. Lejoyeux M, Avril M, Richoux C, Embouazza H, Nivoli F. Prevalence of exercise dependence and other behavioral addictions among clients of a Parisian fitness room. Compr Psychiatry. 2008;49(4):353–8. https://doi.org/10.1016/j.comppsych.2007.12.005.
34. Mencias T, Noon M, Hoch AZ. Female Athlete Triad Screening in National Collegiate Athletic Association Division I Athletes. Clin J Sport Med. 2012;22(2):122–5. https://doi.org/10.1097/jsm.0b013e3182425aee.
35. Beals KA, Manore MM. Disorders of the Female Athlete Triad among Collegiate Athletes. Int J Sport Nutr Exerc Metab. 2002;12(3):281–93. https://doi.org/10.1123/ijsnem.12.3.281.
36. Thein-Nissenbaum J, Hammer E. Treatment strategies for the female athlete triad in the adolescent athlete: current perspectives. Open Access J Sport Med. 2017;8:85–95. https://doi.org/10.2147/oajsm.s100026.
37. Mond JM, Hay PJ, Rodgers B, Owen C. Eating Disorder Examination Questionnaire (EDE-Q): norms for young adult women. Behav Res Ther. 2006;44(1):53–62. https://doi.org/10.1016/j.brat.2004.12.003.
38. DePalma MT, Koszewski WM, Romani W, Case JG, Zuiderhof NJ, McCoy PM. Identifying college athletes at risk for pathogenic eating. Br J Sport Med. 2002;36(1):45–50. https://doi.org/10.1136/bjsm.36.1.45.
39. Sundgot-Borgen J, Torstveit MK. Prevalence of eating disorders in elite athletes is higher than in the general population. Clin J Sport Med. 2004;14(1):25–32. https://doi.org/10.1097/00042752-200401000-00005.
40. Beals KA. Subclinical Eating Disorders in Female Athletes. J Phys Educ Recreat Danc. 2000;71(7):23–9. https://doi.org/10.1080/07303084.2000.10605173.
41. Black DR, Larkin LJS, Coster DC, Leverenz LJ, Abood DA. Physiologic screening test for eating disorders/disordered eating among female collegiate athletes. J Athl Train. 2003;38(4):286.
42. Bernhardt D, Roberts W. PPE: preparticipation physical evaluation. 2019.
43. Garner A, Davis-Becker K, Fischer S. An exploration of the influence of thinness expectancies and eating pathology on compensatory exercise. Eat Behav. 2014;15(3):335–8. https://doi.org/10.1016/j.eatbeh.2014.04.017.
44. Garner DM, Rosen LW, Barry D. Eating disorders among athletes: research and recommendations. Child Adolesc Psychiatr Clin N Am. 1998;7(4):839–57.
45. National Committee for Quality Assurance (NCQA). Patient-Centered Medical Home (PCMH). 2021. https://www.ncqa.org/programs/health-care-providers-practices/patient-centered-medical-home-pcmh/.
46. Beals K. Disordered eating among athletes: a comprehensive guide for health professionals. Human Kinetics, IL; 2004. p. 117–30.
47. Lebrun CM. The female athlete triad: what's a doctor to do? Curr Sport Med Rep. 2007;6(6):397–404.
48. Beals KA, Meyer NL. Female athlete triad update. Clin Sports Med. 2007;26(1):69–89. https://doi.org/10.1016/j.csm.2006.11.002.
49. Mountjoy M, Hutchinson MR, Cruz-Hervert LP. Female athlete triad coalition position stand on female athlete triad pre participation evaluation. 2008;2013.
50. Rumball JS, Lebrun CM. Use of the preparticipation physical examination form to screen for the female athlete triad in Canadian Interuniversity Sport Universities. Clin J Sport Med. 2005;15(5):320–5. https://doi.org/10.1097/01.jsm.0000179136.69598.37.
51. Anderson DA, Lundgren JD, Shapiro JR, Paulosky CA. Assessment of eating disorders: review and recommendations for clinical use. Behav Modif. 2004;28:763–82. https://doi.org/10.1177/0145445503259851.
52. Garner D. EAT-26: eating attitudes test—eating disorder testing. 2020. https://www.eat-26.com/.
53. Fairburn CG, Beglin SJ. Assessment of eating disorders: interview or self-report questionnaire? Int J Eat Disord. 1994;16(4):363–70.
54. Kakaiya D. Eating disorders among athletes. IDEA Health & Fitness J. 2008. https://www.ideafit.com/personal-training/eating-disorders-among-athletes/.
55. Vaughan JL, King KA, Cottrell RR. Collegiate Athletic Trainers' confidence in helping female athletes with eating disorders. J Athl Train. 2004;39(1):71–6.
56. Sherman RT, Thompson RA, Dehass D, Wilfert M. NCAA coaches survey: the role of the coach in identifying and managing athletes with disordered eating. Eat Disord. 2005;13(5):447–66. https://doi.org/10.1080/10640260500296707.
57. Pritts SD, Susman J. Diagnosis of eating disorders in primary care. Am Fam Physician. 2003;67(2):297–304, 311.
58. Beals KA. Eating disorder and menstrual dysfunction screening, education, and treatment programs: survey results from NCAA Division I Schools. Phys Sport Med. 2003;31(7):33–8. https://doi.org/10.3810/psm.2003.07.434.
59. Cumella EJ. Review of the eating disorder inventory-3. J Pers Assess. 2006;87:116–7. https://doi.org/10.1207/s15327752jpa8701_11.
60. Morgan JF, Reid F, Lacey JH. The SCOFF questionnaire: assessment of a new screening tool for eating disorders. Br Med J. 1999;319(7223):1467–8. https://doi.org/10.1136/bmj.319.7223.1467.
61. Steinberg H, Sykes E, LeBoutillier N. Exercise addiction: indirect measures of "endorphins". In: Annett J, Cripps B, Steinberg H, editors. Exerise addiction: motivation for participation in sport and exercise. Leicester, UK: British Psychological Society; 1995. p. 6–14.
62. Berg KC, Peterson CB, Frazier P, Crow SJ. Psychometric evaluation of the eating disorder examination and eating disorder examination-questionnaire: a systematic review of the literature. Int J Eat Disord. 2012;45(3):428–38. https://doi.org/10.1002/eat.20931.
63. Garner D. This week's citation classic: self-report measures for eating disorders. Curr Contents. 1993;8.
64. Cotton MA, Ball C, Robinson P. Four simple questions can help screen for eating disorders. J Gen Intern Med. 2003;18(1):53–6. https://doi.org/10.1046/j.1525-1497.2003.20374.x.
65. National Eating Disorders Association (NEDA). Eating disorders screening tool. 2021. https://www.nationaleatingdisorders.org/screening-tool.
66. Clausen L, Rosenvinge JH, Friborg O, Rokkedal K. Validating the eating disorder inventory-3 (EDI-3): a comparison between 561 female eating disorders patients and 878 females from the general population. J Psychopathol Behav Assess. 2011;33(1):101–10. https://doi.org/10.1007/s10862-010-9207-4.
67. McNulty KY, Adams CH, Anderson JM, Affenito SG. Development and validation of a screening tool to identify eating disorders in female athletes. J Am Diet Assoc. 2001;101(8):886–92. https://doi.org/10.1016/s0002-8223(01)00218-8.
68. Garner DM, Olmstead MP, Polivy J. Development and validation of a multidimensional eating disorder inventory for anorexia nervosa and bulimia. Int J Eat Disord. 1983;2(2):15–34. https://doi.org/10.1002/1098-108X%28198321%292%3A2%3C15%3A%3AAID-EAT2260020203%3E3.0.CO%3B2-6.
69. Hinton PS, Kubas KL. Psychosocial correlates of disordered eating in female collegiate athletes: validation of the ATHLETE questionnaire. J Am Coll Heal. 2005;54(3):149–56. https://doi.org/10.3200/jach.54.3.149-156.
70. Melin A, Tornberg ÅB, Skouby S, Faber J, Ritz C, Sjödin A, et al. The LEAF questionnaire: a screening tool for the identification of female athletes at risk for the female athlete triad. Br J Sports Med. 2014;48(7):540–5. https://doi.org/10.1136/bjsports-2013-093240.
71. Martinsen M, Holme I, Pensgaard AM, Torstveit MK, Sundgot-Borgen J. The development of the brief eating disorder in athletes questionnaire. Med Sci Sports Exerc. 2014;46(8):1666–75. https://doi.org/10.1249/mss.0000000000000276.

72. Steiner H, Pyle RP, Brassington GS, Matheson G, King M. The College Health Related Information Survey (CHRIS-73): a screen for college student athletes. Child Psychiatry Hum Dev. 2003;34(2):97–109. https://doi.org/10.1023/a:1027389923666.
73. Guthrie S. Prevalence of eating disorders among intercollegiate athletes: contributing factors and preventive measures. In: Black D, editor. Eating disorders among athletes: theory, issues, and research. Association for the Advancement of Health Education and National Association for Girls and Women in Sport, Associations of the American Alliance for Health, Physical Education, Recreation, and Dance: Reston, VA; 1991. p. 43–66.
74. Ljungqvist A, Jenoure P, Engebretsen L, Alonso JM, Bahr R, Clough A, et al. The International Olympic Committee (IOC) Consensus Statement on periodic health evaluation of elite athletes. Br J Sport Med. 2009;43(9):631–43. https://doi.org/10.1136/bjsm.2009.064394.
75. Glass JM, Lyden AK, Petzke F, Stein P, Whalen G, Ambrose K, et al. The effect of brief exercise cessation on pain, fatigue, and mood symptom development in healthy, fit individuals. J Psychosom Res. 2004;57(4):391–8. https://doi.org/10.1016/j.jpsychores.2004.04.002.
76. Szabo P, Tury F. [Prevalence of clinical and subclinical forms of anorexia and bulimia nervosa among working females and males]. Orv Hetil. 1995;136(34):1829–35.
77. Hamer M, Karageorghis CI. Psychobiological mechanisms of exercise dependence. Sports Med. 2007;37:477–84. https://doi.org/10.2165/00007256-200737060-00002.
78. Smith MA, Yancey DL. Sensitivity to the effects of opioids in rats with free access to exercise wheels: μ-opioid tolerance and physical dependence. Psychopharmacology. 2003;168(4):426–34. https://doi.org/10.1007/s00213-003-1471-5.
79. Zouhal H, Jacob C, Delamarche P, Gratas-Delamarche A. Catecholamines and the effects of exercise, training and gender. Sports Med. 2008;38:401–23. https://doi.org/10.2165/00007256-200838050-00004.
80. Tsatsoulis A, Fountoulakis S. The protective role of exercise on stress system dysregulation and comorbidities. In: Annals of the New York Academy of Sciences. Blackwell Publishing Inc.; 2006. p. 196–213.
81. Hausenblas HA, Downs DS. Relationship among sex, imagery, and exercise dependence symptoms. Psychol Addict Behav. 2002;16(2):169–72. https://doi.org/10.1037/0893-164X.16.2.169.
82. Thome JL, Espelage DL. Obligatory exercise and eating pathology in college females: replication and development of a structural model. Eat Behav. 2007;8(3):334–49. https://doi.org/10.1016/j.eatbeh.2006.11.009.
83. Carron A, Hausenblas H, Estabrooks P. The psychology of physical activity. New York: McGraw-Hill; 2003.
84. Hall HK, Hill AP, Appleton PR, Kozub SA. The mediating influence of unconditional self-acceptance and labile self-esteem on the relationship between multidimensional perfectionism and exercise dependence. Psychol Sport Exerc. 2009;10(1):35–44. https://doi.org/10.1016/j.psychsport.2008.05.003.
85. Yates A, Leehey K, Shisslak CM. Running—an analogue of anorexia? N Engl J Med. 1983;308(5):251–5. https://doi.org/10.1056/NEJM198302033080504.
86. Blaydon MJ, Lindner KJ. Eating disorders and exercise dependence in triathletes. Eat Disord. 2002;10(1):49–60. https://doi.org/10.1080/106402602753573559.
87. Spano L. The relationship between exercise and anxiety, obsessive-compulsiveness, and narcissism. Pers Individ Dif. 2001;30(1):87–93. https://doi.org/10.1016/S0191-8869(00)00012-X.
88. Blumenthal JA, O'Toole LC, Chang JL. Is running an analogue of anorexia nervosa? An empirical study of obligatory running and anorexia nervosa. JAMA. 1984;252(4):520–3. https://doi.org/10.1001/jama.1984.03350040050022.
89. Pierce EF, Daleng ML, McGowan RW. Scores on exercise dependence among dancers. Percept Mot Skills. 1993;76(2):531–5. https://doi.org/10.2466/pms.1993.76.2.531.
90. Furst DM, Germone K. Negative addiction in male and female runners and exercisers. Percept Mot Skills. 1993;77(1):192–4. https://doi.org/10.2466/pms.1993.77.1.192.
91. Villella C, Martinotti G, Di Nicola M, Cassano M, La Torre G, Gliubizzi MD, et al. Behavioural addictions in adolescents and young adults: results from a prevalence study. J Gambl Stud. 2011;27(2):203–14. https://doi.org/10.1007/s10899-010-9206-0.
92. McNamara J, McCabe MP. Striving for success or addiction? Exercise dependence among elite Australian athletes. J Sports Sci. 2012;30(8):755–66. https://doi.org/10.1080/02640414.2012.667879.
93. Freitag-Honsberger S. The relationship between body image and obligatory exercise behavior among physically active women of various ages. Mc. [Montreal, Canada]: McGill University; 2001.
94. Griffiths MD, Szabo A, Terry A. The exercise addiction inventory: a quick and easy screening tool for health practitioners. Br J Sports Med. 2005;39(6):e30. http://dx.doi.org/10.1136/bjsm.2004.017020.
95. Cook BJ, Hausenblas HA. The role of exercise dependence for the relationship between exercise behavior and eating pathology: mediator or moderator? J Health Psychol. 2008;13(4):495–502. https://doi.org/10.1177/1359105308088520.
96. Veale D. Does primary exercise dependence really exist? In: Annett J, Cripps B, Steinberg H, editors. Exercise addiction: motivation for participation in sport and exercise. Laicester: The British Psychological Society; 1995. https://doi.org/10.1177/135910530808852.
97. Calogero R, Pedrotty K. Daily practices for mindful exercise. In: Low-cost approaches to promote physical and mental health: theory, research, and practice. New York: Springer; 2007. p. 141–60.
98. Kokkinos P, Kim K, Myers JN. Physical activity, health benefits, and mortality risk. Int Sch Res Netw ISRN Cardiol. 2012;2012:14. https://doi.org/10.5402/2012/718789.
99. World Health Organization. Prevention of mental disorders effective interventions and policy options. Summary Report. 2004. https://www.who.int/mental_health/evidence/en/prevention_of_mental_disorders_sr.pdf.
100. Gibson AL, Wagner D, Heyward V. Advanced fitness assessment and exercise prescription, 8E. In: Gibson AL, Wagner D, Heyward V, editors. Advanced fitness assessment and exercise prescription. 8th ed. Champaign, IL: Human Kinetics; 2019. p. 1–27.
101. Rockhill B, Willett WC, Manson JE, Leitzmann MF, Stampfer MJ, Hunter DJ, et al. Physical activity and mortality: a prospective study among women. Am J Public Health. 2001;91(4):578. https://doi.org/10.2105/ajph.91.4.578.
102. Myers J, Prakash M, Froelicher V, Do D, Partington S, Edwin Atwood J. Exercise capacity and mortality among men referred for exercise testing. N Engl J Med. 2002;346(11):793–801. https://doi.org/10.1056/NEJMoa011858.
103. Sesso HD, Paffenbarger RS, Lee I-M. Physical activity and coronary heart disease in men. Circulation. 2000;102(9):975–80. https://doi.org/10.1161/01.CIR.102.9.975.
104. Gauvin L, Szabo A. Application of the experience sampling method to the study of the effects of exercise withdrawal on well-being. J Sport Exerc Psychol. 1992;14:361–74. https://doi.org/10.1123/jsep.14.4.361.
105. Berlin AA, Kop WJ, Deuster PA. Depressive mood symptoms and fatigue after exercise withdrawal: the potential role of decreased fitness. Psychosom Med. 2006;68(2):224–30. https://doi.org/10.1097/01.psy.0000204628.73273.23.
106. Kop WJ, Weinstein AA, Deuster PA, Whittaker KS, Tracy RP. Inflammatory markers and negative mood symptoms follow-

ing exercise withdrawal. Brain Behav Immun. 2008;22(8):1190–6. https://doi.org/10.1016/j.bbi.2008.05.011.
107. La Gerche A, Prior DL. Exercise-Is it possible to have too much of a good thing? Hear Lung Circ. 2007;16(Suppl. 3):S102–4. https://doi.org/10.1016/j.bbi.2008.05.011.
108. Adams J, Kirkby RJ. Excessive exercise as an addiction: a review. Addict Res Theory. 2002;10:415–37. https://doi.org/10.1080/1606635021000032366.
109. Weinstein AA, Koehmstedt C, Kop WJ. Mental health consequences of exercise withdrawal: a systematic review. Gen Hosp Psychiatry. 2017;49:11–8. https://doi.org/10.1016/j.genhosppsych.2017.06.001.
110. CDC—Centers for Disease Control and Prevention. Making Physical Activity a Part of a Child's Life | Physical Activity | CDC. 2020. https://www.cdc.gov/physicalactivity/basics/adding-pa/activities-children.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fphysicalactivity%2Feveryone%2Fgetactive%2Fchildren.html.
111. Bratland-Sanda S, Sundgot-Borgen J, Rø Ø, Rosenvinge JH, Hoffart A, Martinsen EW. Physical activity and exercise dependence during inpatient treatment of longstanding eating disorders: an exploratory study of excessive and non-excessive exercisers. Int J Eat Disord. 2010;43(3):266–73. https://doi.org/10.1002/eat.20769.
112. Bouten CVC, Verboeket-Van De Venne WPHG, Westerterp KR, Verduin M, Janssen JD. Daily physical activity assessment: comparison between movement registration and doubly labeled water. J Appl Physiol. 1996;81(2):1019–26. https://doi.org/10.1152/jappl.1996.81.2.1019.
113. Sallis JF, Saelens BE. Assessment of physical activity by self-report: status, limitations, and future directions. Res Q Exerc Sport. 2000;71:1–14. https://doi.org/10.1080/02701367.2000.11082780.
114. Abel MG, Hannon JC, Sell K, Lillie T, Conlin G, Anderson D. Validation of the Kenz Lifecorder EX and ActiGraph GT1M accelerometers for walking and running in adults. Appl Physiol Nutr Metab. 2008;33(6):1155–64. https://doi.org/10.1139/h08-103.
115. Pate RR, Almeida MJ, McIver KL, Pfeiffer KA, Dowda M. Validation and calibration of an accelerometer in preschool children. Obesity. 2006;14(11):2000–6. https://doi.org/10.1038/oby.2006.234.
116. Prince SA, Adamo KB, Hamel ME, Hardt J, Connor Gorber S, Tremblay M. A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. Int J Behav Nutr Phys Act. 2008:5. https://doi.org/10.1186/1479-5868-5-56.
117. Schmidt MD, Freedson PS, Chasan-Taber L. Estimating physical activity using the CSA accelerometer and a physical activity log. Med Sci Sport Exerc. 2003;35(9):1605–11. https://doi.org/10.1249/01.mss.0000084421.97661.17.
118. Alberti M, Galvani C, El Ghoch M, Capelli C, Lanza M, Calugi S, et al. Assessment of physical activity in anorexia nervosa and treatment outcome. Med Sci Sports Exerc. 2013;45(9):1643–8. https://doi.org/10.1249/MSS.0b013e31828e8f07.
119. Staudenmayer J, Pober D, Crouter S, Bassett D, Freedson P. An artificial neural network to estimate physical activity energy expenditure and identify physical activity type from an accelerometer. J Appl Physiol. 2009;107(4):1300–7. https://doi.org/10.1152/japplphysiol.00465.2009.
120. Ogden J, Veale D, Summers Z. The development and validation of the exercise dependence questionnaire. Addict Res Theory. 1997;5(4):343–55. https://doi.org/10.3109/16066359709004348.
121. Szabo A, Griffiths MD. The exercise addiction inventory: a new brief screening tool. Addict Res Theory. 2004;12:489–99. https://doi.org/10.1080/16066350310001637363.
122. Taranis L, Touyz S, Meyer C. Disordered eating and exercise: development and preliminary validation of the compulsive exercise test (CET). Eur Eat Disord Rev. 2011;19(3):256–68. https://doi.org/10.1002/erv.1108.
123. Davis C, Brewer H, Ratusny D. Behavioral frequency and psychological commitment: necessary concepts in the study of excessive exercising. J Behav Med. 1993;16(6):611–28. https://doi.org/10.1007/BF00844722.
124. Loumidis KS, Wells A. Assessment of beliefs in exercise dependence: the development and preliminary validation of the Exercise Beliefs Questionnaire. Pers Individ Dif. 1998;25(3):553–67. https://doi.org/10.1016/S0191-8869(98)00103-2.
125. Smith DK, Hale BD, Collins D. Measurement of exercise dependence in bodybuilders. J Sport Med Phys Fit. 1998;38(1):66–74.
126. Downs DS, Hausenblas HA, Nigg CR. Factorial validity and psychometric examination of the exercise dependence scale-revised. Meas Phys Educ Exerc Sci. 2004;8(4):183–201. https://doi.org/10.1207/s15327841mpee0804_1.
127. Anderson DF, Cychosz CM. Development of an exercise identity scale. Percept Mot Skills. 1994;78(3):747–51. https://doi.org/10.1177/00315125940780031.
128. Morrow J, Harvey P. Exermania. Am Heatlh. 1990;9:21–32.
129. Kline TJB, Franken RE, Rowland GL. A psychometric evaluation of the exercise salience scale. Pers Individ Dif. 1994;16(3):509–11. https://doi.org/10.1016/0191-8869(94)90078-7.
130. Danielsen M, Bratberg GH, Rø. A pilot study of a new assessment of physical activity in eating disorder patients. Eat Weight Disord. 2012;17(1):e70–7. https://doi.org/10.1007/BF03325332.
131. Chapa DAN, Hagan KE, Forbush KT, Perko VL, Sorokina DA, Alasmar AY, et al. The Athletes' Relationships with Training scale (ART): a self-report measure of unhealthy training behaviors associated with eating disorders. Int J Eat Disord. 2018;51(9):1080–9. https://doi.org/10.1002/eat.22960.
132. Ainsworth BE. How do I measure physical activity in my patients? Questionnaires and objective methods. Br J Sport Med. 2009;43(1):6–9. http://dx.doi.org/10.1136/bjsm.2008.052449.
133. Booth M. Assessment of physical activity: an international perspective. Res Q Exerc Sport. 2000;71:114–20. http://dx.doi.org/0.1080/02701367.2000.11082794.
134. Kowalski KC, Crocker PRE, Donen RM, Honours B. The Physical Activity Questionnaire for Older Children (PAQ-C) and Adolescents (PAQ-A) Manual, vol. 87. Saskatoon, SK, Canada: College of Kinesiology, dUniversity of Saskatchewan; 2004.
135. Nagel DL, Black DR, Leverenz LJ, Coster DC. Evaluation of a screening test for female college athletes with eating disorders and disordered eating. J Athl Train. 2000;35(4):431.
136. Mond JM, Myers TC, Crosby RD, Hay PJ, Rodgers B, Morgan JF, et al. Screening for eating disorders in primary care: EDE-Q versus SCOFF. Behav Res Ther. 2008;46(5):612–22. https://doi.org/10.1016/j.brat.2008.02.003.
137. Mond JM, Hay PJ, Rodgers B, Owen C. An update on the definition of "excessive exercise" in eating disorders research. Int J Eat Disord. 2006;39(2):147–53. https://doi.org/10.1002/eat.20214.