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Eating Disorders in Athletes: A Systematic Review

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Abstract

Eating disorders (EDs) represent a critical and complex issue in sports, particularly among athletes exposed to high-performance demands and appearance-related pressures. Athletic participation is generally associated with health and psychological benefits. However, certain environments increase the risk of developing disordered eating (DE) behaviors. This systematic review examines the epidemiology and risk factors associated with EDs in athletic populations. It focuses particularly on high-risk groups such as female athletes and participants in leanness-focused sports. It introduces a developing understanding of low energy availability, as conceptualized in the Female Athlete Triad and the broader Relative Energy Deficiency in Sport (RED-S) model. The review outlines the multi-system health consequences of RED-S, including effects on reproductive, cardiovascular, immune, and psychological function. Moreover, it highlights the diagnostic challenges in sports settings, where restrictive eating is often normalized or hidden. Finally, the review synthesizes current evidence on clinical management, treatment strategies, and the importance of educational and preventive interventions within sport environments to protect athlete health and performance.

Comprehensive awareness and early multidisciplinary interventions are essential for addressing EDs and supporting sustainable athletic careers.

Keywords

Feeding and Eating Disorders; Athletes; Female Athlete Triad Syndrome; Relative Energy Deficiency in Sport; Energy Metabolism; Body Image; Health Promotion

Introduction

Eating disorders (EDs) represent a significant and growing concern within the athletic population. While sport participation is generally associated with physical and psychological benefits, the competitive environment can paradoxically increase the risk of disordered eating due to pressures related to body weight, performance, appearance, and coaching expectations. Athletes - especially those involved in sports that emphasize leanness, weight classes, or aesthetics (e.g., gymnastics, distance running, figure skating, wrestling) - face a markedly elevated risk of developing eating disorders compared to the general population^{1,2}.

EDs are clinically classified according to standardized diagnostic frameworks. In the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5), the primary diagnoses include: anorexia nervosa (AN) - marked by caloric restriction, intense fear of weight gain, and distorted body image; bulimia nervosa (BN) - involving recurrent binge eating episodes followed by purging or compensatory behaviors; and binge eating disorder (BED) - characterized by episodes of uncontrolled eating without subsequent purging. Additionally, Other Specified Feeding or Eating Disorders (OSFED) encompass clinically significant symptoms that do not meet full diagnostic criteria but still pose health risks³. The *International Classification of Diseases, Tenth Revision* (ICD-10) similarly categorizes eating disorders under code F50, which includes: Anorexia nervosa (F50.0), Bulimia nervosa (F50.2), Other eating disorders (F50.8), and Unspecified eating disorder (F50.9)⁴. While DSM-5 provides more detailed psychological criteria, ICD-10 remains widely used in epidemiological surveillance and clinical coding worldwide.

Recent high-level evidence has further emphasized the complex and multifactorial nature of eating disorders in elite athletes. Body image concerns are among the most consistent and significant predictors of disordered eating, especially in disciplines that emphasize appearance,

thinness, or weight control. Female athletes exhibit higher rates of disordered eating and clinical EDs, although the literature on male athletes remains sparse and likely underestimates true prevalence⁵.

Understanding the intersection between sport, body image, and disordered eating is essential not only for the prevention and early detection of EDs but also for the promotion of long-term athlete health and performance. This review aims to synthesize recent evidence, highlight at-risk groups, examine the health consequences of eating disorders, assess current approaches to clinical management and treatment, and discuss the implications of emerging diagnostic models like The Female Athlete Triad or Relative Energy Deficiency in Sport (RED-S) for future research and clinical practice.

The Female Athlete Triad

An earlier clinical model that brought attention to the health consequences of disordered eating in female athletes is the *Female Athlete Triad*. This model is a set of health disorders that most often occurs in women practising sports where a slim figure plays a significant role. It consists of three elements: low energy availability (EA) with or without DE, menstrual disorders (MD), and reduced bone mineral density (BMD). The American College of Sports Medicine (ACSM) position statement on the triad, published in 2007, introduced the concept of EA, replacing the concept of eating disorders. This acknowledges that energy deficits can also be unintentional and have significant health consequences⁶.

Studies show that although the full-blown triad is relatively rare (0-15.9% of female athletes studied), its individual components - in various combinations - may affect up to 50-60% of female athletes in selected sports⁷. For example, MD and low BMD occurred simultaneously in 0-7.5% of participants, and the combination of MD and low EA in 2,7-50%⁸.

However, the model was limited in scope, as it focused exclusively on females and addressed only three physiological outcomes.

Relative Energy Deficiency in Sport (RED-S)

In recent years, a broader clinical framework has gained prominence in the sports medicine field: RED-S. Introduced by the International Olympic Committee in 2014 and revised in 2018, RED-S expands upon the earlier concept of the Female Athlete Triad. It refers to a state of impaired physiological function due to low EA - a mismatch between dietary energy intake and the energy required for both training and normal bodily functions. RED-S may affect multiple systems, including metabolism, bone health, reproductive and cardiovascular function, immune status, and psychological well-being⁹. This model also emphasizes that low EA can be both intentional and unintentional, and its consequences impact not only health but also physical performance. Importantly, RED-S applies to athletes of all genders and disciplines, making it a more inclusive and holistic framework for risk identification and treatment guidance¹⁰.

Epidemiology

Athlete populations show markedly higher prevalence of DE and clinical ED compared to non-athlete controls. In a large Norwegian study including elite athletes (n = 1,620) and population controls (n = 1,696), the overall point prevalence of clinical or subclinical ED among athletes was 13.5 % versus 4.6 % in controls ($p < 0.001$)¹¹. Within that study, 42 % of female athletes in aesthetic sports had EDs, compared to 24 % in endurance, 17 % in technical, and 16 % in ball-game sports¹¹. A comprehensive review by Bratland-Sanda & Sundgot-Borgen (2012) reported prevalence ranges of 6–45 % among female athletes and 0–19 % among male athletes, versus much lower general-population figures¹.

Furthermore, a meta-analysis of aquatic athletes (n = 715 from multiple countries) estimated a pooled ED prevalence of 27.6 % (95 % CI: 14.3–46.5 %) ¹², reinforcing substantially elevated risk in specific sport populations.

Consistent sex differences show female athletes at higher risk than male athletes. The Norwegian study above reported much higher ED prevalence among women in aesthetic sports compared to male counterparts¹¹. A U.S. NCAA Division I distance-runner study (n = 638) found 45.95 % of female athletes screened positive for ED risk at an Eating Disorder Screen for Primary Care cutoff, versus only 13.66 % of males ($p < 0.01$)¹³. The Bratland-Sanda and

Sundgot-Borgen review also summarized female prevalence up to ~45 %, versus male prevalence typically under 20 %¹.

Certain sport disciplines show especially elevated prevalence:

- Aesthetic/leanness sports (e.g. gymnastics, ballet, figure skating): women ~42 % in Norway¹; aquatic athletes ~27.6 %¹².
- Endurance sports (e.g. distance running, rowing): Norwegian female endurance athletes ~24 %¹¹; collegiate distance runners among females ~46 % and males ~14 % risk¹³.
- Technical sports have a lower prevalence (~17 %) than aesthetic¹¹.
- Ball-game/team sports lowest (~16 %) among female athletes in that Norwegian sample¹¹.
- A study of competitive rowers (2024) reported specific prevalence data (not sex-stratified here), supporting elevated risk in rowing as a weight-sensitive sport¹⁴.

Thus, athletes in leanness-dependent and weight-sensitive disciplines face the highest epidemiological burden.

Sport settings present specific challenges in the recognition and diagnosis of EDs. Normalized weight monitoring, dieting behaviours, and emphasis on leanness for performance can mask pathological patterns as “performance strategies.” Athletes and coaches may misinterpret restrictive eating or over-exercise as discipline rather than symptoms¹¹. Preventive screening tools tailored to athletes (e.g. EAT-26, SCOFF, ESP) are recommended. In elite female athletes and endurance runners, menstrual irregularity and pathogenic weight control behaviours were predictive of EDs diagnosis¹⁵. LEA and RED-S reflect extended subclinical maladaptation and may obscure early ED signs, requiring sport-specific awareness¹⁶.

Risk Factors

Psychological predispositions such as body dissatisfaction, low self-esteem, perfectionism, and anxiety significantly elevate the risk for DE among athletes. Perfectionism - particularly the “self-oriented” and “socially prescribed” subtypes - is strongly linked to restrictive eating and compensatory behaviors in elite sport contexts¹. Athletes who place high demands on themselves, are highly dependent on performance evaluations, and demonstrate a rigid approach to goal setting are particularly vulnerable to developing disorders. Body

dissatisfaction and aiming for thin or muscular figure, can lead to maladaptive and harmful behaviors¹⁷.

The pressures specific to a given sport include many factors, such as frequent weight checks, restrictive diets, and comments from coaches or competitors regarding appearance or performance. Sports that require a slim figure or aesthetic appearance often promote cyclical weight fluctuations and reinforce cultural beliefs that low weight equates to success¹¹.

Athletes competing in weight-class and aesthetic sports share several overlapping risk factors for EDs, such as the pressure to maintain a low body weight and achieve an 'ideal' physique. However, important differences exist in how these pressures manifest. In weight-class sports - such as wrestling, boxing, or rowing - athletes often engage in rapid weight-cutting behaviors to meet competition requirements. These include dehydration, fasting, or excessive exercise prior to weigh-ins¹¹. While these behaviors may be temporarily effective for classification purposes, they are associated with increased risk for binge eating and bulimic tendencies in the off-season or post-competition periods¹⁵. In contrast, aesthetic sports - such as gymnastics, figure skating, and ballet - impose more chronic appearance-based pressures, with athletes often pursuing thinness not just for performance but for subjective judging standards and artistic ideals¹. This leads to prolonged caloric restriction, internalized weight stigma, and higher rates of anorexia nervosa in female aesthetic athletes. Thus, while both categories carry high ED risk, aesthetic sports are more strongly associated with restrictive disorders, whereas weight-class sports more frequently show patterns of weight cycling and compensatory behaviors.

Contemporary athletes increasingly face social comparison pressures via platforms like Instagram, TikTok, and YouTube. Image-based content promoting thin or “fit” ideals strongly correlates with body dissatisfaction, social physique anxiety, and disordered eating behaviors¹⁸. Notably, the type of content consumed - not merely total social media time - is a stronger predictor of negative outcomes; weight-loss content is associated with binge-eating and lower body appreciation, whereas body-positive content offers minimal protective effect¹⁹.

Studies in football and other sports have shown that athletes who frequently compare their body to others on social media have higher ED risk, particularly among females and professional, high-pressure environments²⁰.

Diagnosis and Challenges

Diagnosing EDs in athletes is a complex and multifaceted challenge, particularly due to the normalization of certain behaviors within sports culture that, in other contexts, would be considered pathological. The pressure to perform, strict body composition requirements, and sport-specific demands often obscure the warning signs of DE. This chapter outlines key tools and methods used for detection, emphasizes the importance of behavioral observation, and explores how the sporting environment can make the diagnostic process significantly more difficult, if not impossible at times.

Screening Tools and Dietary Questionnaires

Accurate and early diagnosis of EDs within athletes is facilitated by the use of standardized and validated screening tools. These tools serve as preliminary methods to detect symptoms of DE behaviors, negative body image, and psychological patterns consistent with clinical EDs. One of the most commonly employed instruments is the Eating Attitudes Test (EAT-26), which evaluates an individual's cognitive and emotional relationship with food and body shape²¹. Its use is widespread in both clinical and athletic populations due to its reliability and simplicity.

Another valuable tool is the SCOFF questionnaire, consisting of five yes/no questions that are sensitive to core features of EDs such as loss of control over eating, purging behaviors, and excessive concern with body weight²². Though brief, it is particularly effective in time-limited or high-volume screening situations, such as during team assessments.

For female athletes specifically, the Low Energy Availability in Females Questionnaire (LEAF-Q) offers an essential advantage²³. It targets signs of the Female Athlete Triad - by inquiring about menstrual function, gastrointestinal symptoms, and injury frequency. The RED-S Clinical Assessment Tool (CAT), developed by the International Olympic Committee, further broadens this diagnostic approach by incorporating medical, nutritional, and psychological indicators of RED-S¹⁰.

Despite the utility of these tools, their effectiveness can be undermined by athletes' reluctance to disclose symptoms. In elite sports, underreporting is common due to stigma, fear of judgment, or fear of being excluded from competition¹. Therefore, screening tools should be supplemented with contextual understanding and behavioral monitoring.

Observing Behavioral Red Flags

Beyond formal assessments, observing an athlete's day-to-day behavior often provides the earliest and most tangible clues that something is wrong. DE frequently manifests in subtle, yet progressively disruptive patterns. For instance, some athletes begin avoiding communal meals, claiming they follow a personalized nutrition plan or need to eat alone due to training requirements. Others exhibit obsessive self-weighing, often checking their weight multiple times a day as a form of reassurance or control.

Additionally, the use of laxatives or diuretics - though less openly discussed - is a dangerous yet documented behavior in both aesthetic and weight-class sports. Another concerning pattern is excessive exercise outside of prescribed training, particularly when it continues despite fatigue, pain, or medical advice. Emotional signs may also appear, such as mood swings, irritability, or social withdrawal, which can reflect both the psychological burden of the disorder and the physiological effects of undernutrition. Female athletes may also experience menstrual irregularities or amenorrhea, which should not be dismissed as "normal" within intense training schedules¹.

Coaches, teammates, and medical staff are often the first to witness these behaviors. However, their ability to interpret them correctly depends on education, sensitivity, and a collaborative, nonjudgmental environment.

Diagnostic Challenges: When Sport Culture Masks Pathology

One of the most significant obstacles in identifying EDs among athletes lies in the cultural norms of sport itself, which often normalize or even glorify harmful behaviors. Practices such as extreme weight cutting, fasting, or eliminating entire food groups are frequently justified under the guise of discipline, performance optimization, or making weight categories. What may be viewed as a red flag in the general population is too often perceived as professional commitment in competitive sports.

This blurring of lines between dedication and dysfunction makes early diagnosis difficult. In certain disciplines - especially aesthetic, endurance, or weight-class sports - unhealthy behaviors are not only tolerated but expected^{10,24}. This cultural tolerance leads to a delayed recognition of symptoms by both athletes and those around them. Moreover, lack of awareness

among coaches and support staff can prevent necessary interventions, especially when weight loss or strict diets are misinterpreted as signs of motivation¹¹.

Fear also plays a major role. Athletes may avoid reporting their symptoms or seeking help due to concerns about losing their spot on a team, appearing weak, or facing judgment. Meanwhile, their physical appearance may continue to conform to idealized images of fitness and success, further masking their underlying struggles.

In light of these challenges, an interdisciplinary and athlete-centered approach is essential. Only through collaboration among sports medicine professionals, psychologists, nutritionists, and coaches can a culture of prevention and early detection be fostered - one where performance is never prioritized over long-term health.

Prevention and Education in the Sporting Environment

Preventing EDs in athletic populations requires a multidimensional approach that integrates education, early identification, and the promotion of a healthy performance culture. Among the most effective strategies is structured nutrition education, tailored to the needs of athletes, coaches, and support personnel. Many individuals in sport environments lack formal training in energy balance, nutrient needs, and recognizing early symptoms of disordered eating, increasing the likelihood of both underdiagnosis and normalization of harmful behaviors.

Nutrition education not only improves knowledge about fueling for performance but also plays a preventive role by addressing misconceptions about weight, leanness, and dietary restriction. Evidence suggests that nutrition-focused interventions can improve eating attitudes and reduce risk behaviors in high-risk groups such as aesthetic and endurance athletes⁸. Moreover, coaches and athletic staff play a central role in shaping team norms; thus, their inclusion in educational programs is crucial for reinforcing healthy practices and body image ideals.

Several leading sports organizations have implemented prevention programs and policy-based guidelines. The International Olympic Committee (IOC) introduced the RED-S (Relative Energy Deficiency in Sport) model as an evolution of the Female Athlete Triad, encompassing a wider range of performance and health consequences linked to low energy availability¹⁶. The RED-S framework emphasizes education on energy intake, hormonal function, bone health, and psychological well-being in both male and female athletes. IOC's consensus guidelines

advocate for screening, multidisciplinary collaboration, and a shift from punitive to supportive responses when disordered behaviors are detected.

The National Collegiate Athletic Association (NCAA) provides detailed guidance through its *Mind, Body and Sport* initiative, highlighting the intersection of mental health, disordered eating, and performance²⁵. NCAA encourages regular mental wellness training for athletes and staff, anonymous self-report screening, and clear referral pathways for psychological and medical support. It also discourages the use of weigh-ins or body composition testing as routine performance metrics, unless medically indicated.

Although FIFA does not maintain an ED-specific policy, its FIFA Medical Network promotes athlete health holistically by integrating medical, nutritional, and psychological care into its training standards²⁶. Initiatives supporting youth development, gender equality, and injury prevention provide opportunities to introduce ED awareness and nutrition education into football's global infrastructure.

In conclusion, effective prevention of eating disorders in sport relies on systemic, sport-specific education, robust institutional policy, and fostering cultures that prioritize health over appearance or short-term results. When coaches, athletes, and sports governing bodies work collaboratively, the risk of disordered eating can be significantly reduced, and performance enhanced through sustainable practices.

Management and treatment

Effective treatment of EDs in athletes often requires a multidisciplinary approach that includes both psychological and physical care. This is achieved through the work of a multidisciplinary treatment team (MDTT). This team provides comprehensive and coordinated support to individuals struggling with EDs. The MDTT may include representatives of the athletic staff (including coaches, physiotherapists, and medical directors), as well as physicians, psychotherapists, clinical dietitians, and psychiatrists.

Members are selected for their experience in athlete care and, where available, hold relevant credentials such as Certified Mental Performance Consultant (CMPC), Certified Eating Disorder Specialist (CEDS), Certified Eating Disorders Registered Dietitian (CEDRD), or Board Certification in Sports Medicine (BCSM)²⁷. This collaborative structure supports

coordinated care, continuous communication, and interventions tailored to both the physical and psychological needs of the athlete.

Role of medical physician in MDTT

A physician, if available, may serve as the leader and primary coordinator of an MDTT. Their responsibilities include conducting initial medical assessments, collaborating with the team on an ongoing basis, monitoring the athlete's health, and referring them to other specialists as needed. They are responsible for diagnosing, treating, and prescribing additional therapy, as well as managing health complications resulting from eating disorders, which may affect the cardiovascular, gastrointestinal, musculoskeletal, hormonal, and mental health systems.

The test may include laboratory analysis, weighing, body composition assessment, bone composition assessment, measurement of sitting and standing blood pressure, resting heart rate, electrocardiogram (ECG), and documentation of growth charts in children and adolescents.

The physician should also identify, monitor, and refer to appropriate specialists for co-occurring disorders such as anxiety, depression, OCD, PTSD, substance abuse, or self-harming behaviors²⁸.

Role of mental health support

A licensed mental health professional (MHCP) is a key member of the multidisciplinary treatment team (MDTT) and should be certified as a psychologist, social worker, or therapist. Effective treatment plans for eating disorders are based on a variety of evidence-based psychotherapeutic methods. Their primary goals include improving the ability to recognize, express, and regulate emotions.

Therapy also aims to improve body image, normalize eating patterns, achieve healthy nutritional status and body weight, and address psychosocial factors. These include family relationships, community or team-related stressors, relationship difficulties, sexuality issues, identity development, traumatic experiences, and other co-occurring disorders that often accompany ED treatment.

Adapted physical activity

Achieving high scores in athletic performance typically requires athletes to push their physical and mental limits to meet the rigorous demands of their sport. Maintaining a high level of performance requires consistent commitment, strong discipline, mental resilience, and an openness to learning from coaches. However, some athletes develop a "more is better" mindset, which can lead to overtraining. It results in both physical exhaustion and mental burnout.

EDs and DEBs, as well as chronic malnutrition, negatively impact an athlete's ability to develop strength, flexibility, and cardiovascular fitness. When overtraining coexists with current or past EDs and DEBs, it can result in decreased athletic performance, increased frustration, decreased self-confidence, and an increased risk of developing symptoms and behaviors associated with eating disorders.

Additionally, these athletes may develop a negative body image, become overly concerned with their appearance, and exhibit increased sensitivity to bodily sensations. Moreover, they might struggle with regulating emotions and coping with the demands of sport, social relationships, and daily life.²⁹ Appearance dissatisfaction and body image concerns may persist for a long time and become more severe.

Relapse prevention

Lapses or relapses often occur during the recovery journey but should not be seen as signs of failure or an inability to recover. Therefore, it is important to avoid blaming or shaming athletes who experience these setbacks. MDTT plays a key role in helping athletes learn from lapses, maintain positive recovery progress, and reduce the chance of relapse by offering necessary support. Recovery in physical health, nutrition, athletic performance, and emotional well-being must happen simultaneously. All members of the MDTT should agree on action plans and treatment goals, clearly communicate them to the athlete, and consistently implement them.

Before athletes return to sports, clinical signs and relapse risks should be recognized and understood by both the athlete and specialists. It is crucial to avoid rushing or shortening

treatment, as an early return to training or competition during ED recovery increases the risk of relapse³⁰.

Trust in the MDTT and confidence in the recovery process are crucial for successful outcomes. Athletes thrive when teachers, coaches, sports staff, family, and friends believe in their potential to improve, respond calmly to setbacks or slower progress, and maintain hope. When sports teams, athletic organizations, healthcare providers, and families collaborate by utilizing resources and awareness programs, they can collectively lower illness risks, support recovery, and enable a safe and successful return to a sport.

Conclusions

Eating disorders pose a significant health risk in athletic populations, especially in leanness-focused and weight-sensitive sports. The shift from the Female Athlete Triad to the RED-S model highlights the broader systemic impacts of low energy availability across all genders.

Effective prevention and management require early recognition, sport-specific education, and multidisciplinary care involving medical, psychological, and nutritional support. Creating a culture that prioritizes long-term health over appearance or performance is essential for sustainable athletic development.

Future research should address gaps related to male athletes, long-term recovery outcomes, and the influence of social media. Ultimately, sustainable athletic careers require environments that value health, mental well-being, and resilience as much as physical performance.

Disclosure

Author's Contribution

Conceptualization - Aleksandra Kaźmierczyk; Methodology - Aleksandra Kaźmierczyk, Jan Wojtas, Jędrzej Kęsik, Paulina Duda, Zbigniew Dębicki, Julia Czerwik, Karol Stępniaik; Software - Aleksandra Kaźmierczyk, Jan Wojtas, Jędrzej Kęsik, Paulina Duda, Zbigniew Dębicki, Julia Czerwik, Karol Stępniaik; Check - Aleksandra Kaźmierczyk, Karol Stępniaik; Formal analysis - Aleksandra Kaźmierczyk, Jan Wojtas, Jędrzej Kęsik, Paulina Duda, Zbigniew Dębicki, Julia Czerwik, Karol Stępniaik; Investigation - Aleksandra Kaźmierczyk, Jan Wojtas, Jędrzej Kęsik, Paulina Duda, Zbigniew Dębicki, Julia Czerwik, Karol Stępniaik; Resources - Aleksandra Kaźmierczyk, Jan Wojtas, Jędrzej Kęsik, Paulina Duda, Zbigniew Dębicki, Julia Czerwik, Karol Stępniaik; Data curation - Aleksandra Kaźmierczyk, Jan Wojtas, Jędrzej Kęsik,

Paulina Duda, Zbigniew Dębicki, Julia Czerwik, Karol Stępniaak; Writing (rough preparation) - Aleksandra Kaźmierczyk, Jan Wojtas, Jędrzej Kęsik, Paulina Duda, Zbigniew Dębicki, Julia Czerwik, Karol Stępniaak; Writing (review and editing) - Aleksandra Kaźmierczyk, Jan Wojtas, Julia Czerwik, Karol Stępniaak; Visualization - Aleksandra Kaźmierczyk, Jan Wojtas, Jędrzej Kęsik, Paulina Duda, Zbigniew Dębicki, Julia Czerwik, Karol Stępniaak; Supervision - Aleksandra Kaźmierczyk; Project administration - Aleksandra Kaźmierczyk;

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