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EATING DISORDERS, THE FEMALE ATHLETE TRIAD AND RELATIVE ENERGY DEFICIENCY IN SPORT (RED-S) IN YOUNG ATHLETES: A NARRATIVE REVIEW OF SCREENING AND ASSESSMENT TOOLS

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ABSTRACT

Background: Disordered eating (DE), the Female Athlete Triad and Relative Energy Deficiency in Sport (RED-S) are common, consequential and frequently concealed conditions in young athletes, and because restrictive eating and heavy training are normalised in sport their detection depends on appropriate screening rather than reactive diagnosis.

Aim: To summarise, compare and critically appraise the screening and assessment tools used to detect DE and eating disorders (ED), low energy availability (LEA), the Triad and RED-S in adolescent and young adult athletes, and to define how these instruments should be combined in practice.

Material and methods: Narrative review of 41 open-access publications identified through PubMed, Scopus, Web of Science and SPORTDiscus, encompassing narrative and systematic reviews, validation and prevalence studies, and consensus-derived clinical tools relevant to young athletes of both sexes.

Results: Generic ED screens (EAT-26, SCOFF, EDI, EDE-Q) dominate practice but were not developed for athletes; athlete-specific tools (BEDA-Q, EDSA, ATHLETE, Physiologic Screening Test) perform better in this population; and LEA/RED-S tools (LEAF-Q, LEAM-Q, RED-S CAT/CAT2, Triad Cumulative Risk Assessment, DEAQ) capture physiological risk. At-risk prevalence is high but tool-dependent: a meta-analysis of 6,118 athletes reported LEA in 44.7%; 64.7% of youth footballers were at Triad/RED-S risk on the LEAF-Q (sensitivity 78%, specificity 90%); and the EDSA showed sensitivity 96% and specificity 80% in males. No validated male-specific ED tool exists and RED-S awareness is low.

Conclusions: No single instrument suffices; pairing a validated athlete-specific ED screen with a LEA/RED-S tool, confirming positive screens by clinical interview within a multidisciplinary team, and embedding screening in education is the most defensible approach, particularly for male, younger and non-aesthetic-sport athletes.

Keywords: Feeding and Eating Disorders; Female Athlete Triad Syndrome; Relative Energy Deficiency in Sport; Low Energy Availability; Mass Screening; Athletes; Adolescent.

1. Introduction

Disordered eating (DE) and clinical eating disorders (EDs) represent a growing and serious health problem among young athletes. In their systematic review, Kaźmierczyk et al. classified EDs according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) and the International Classification of Diseases as anorexia nervosa, bulimia nervosa, binge-eating disorder and other specified feeding or eating disorders [4]. Domańska et al., by contrast, defined DE as a broad range of subclinical abnormalities of eating-related thought and behaviour — restrictive dieting, fasting, compulsive exercise, binge eating and unhealthy weight control — that do not meet DSM-5 criteria yet still compromise health, psychological well-being and performance [5]. As Kontele and Vassilakou emphasise, eating behaviour in sport is best understood as a continuum, from optimised nutrition at one end to a clinical ED at the other, along which an athlete may move in either direction across a career and within a single training cycle [6].

Athletes are a particularly high-risk population. In a systematic review of prevalence by sport type, Mancine et al. found that six of seven studies reported significantly higher rates of DE among athletes in lean sports than non-lean sports, with aesthetic disciplines carrying the highest burden [7]. Franzoni et al., testing an extended sociocultural model in 691 adolescent athletes, showed that sociocultural pressures and their internalisation drive body dissatisfaction and, in turn, DE in both sexes, while emotion-regulation difficulties and low self-esteem were linked to DE in females and sport weight pressures and negative mood in males [8]. These findings reflect the interaction of individual psychological vulnerability with sport-specific pressures relating to body weight, composition and appearance — pressures that also normalise restrictive eating and camouflage emerging pathology [7,8].

The clinical consequences of DE extend well beyond mental health and are frequently mediated by low energy availability (LEA), a state, described by Lodge et al., in which dietary energy intake is insufficient to cover the cost of training once basic physiological function is subtracted [9]. Sustained LEA is the shared mechanism of two overlapping frameworks. Thein-Nissenbaum and Hammer trace the Female Athlete Triad from its 1997 origin to the 2007 redefinition as LEA (with or without DE), menstrual dysfunction and low bone mineral density (BMD) [1], and Brown et al. describe how the International Olympic Committee (IOC) broadened this in 2014 into Relative Energy Deficiency in Sport (RED-S), extending it to immune, cardiovascular, gastrointestinal, endocrine, haematological and psychological function and to male and para-athletes [2]. Fidyk et al. and Bździuch et al. summarise the 2023 IOC update, which reframed the syndrome around problematic LEA and introduced the IOC REDs Clinical Assessment Tool version 2 (CAT2) [10,11]. Energy availability is calculated as energy intake minus exercise energy expenditure divided by fat-free mass (FFM); Lodge et al. and Kontele and Vassilakou note that a value below 30 kcal/kg FFM/day is widely used to define LEA, whereas approximately 45 kcal/kg FFM/day is regarded as adequate [6,9].

Adolescents and young adults are especially susceptible. Kontele and Vassilakou describe adolescence as the second fastest period of growth after infancy, combining high nutrient demands with heightened body-image focus, and the life stage at which DE and EDs most often emerge [6]; Kenđel Jovanović and Čulina add that young athletes frequently lack the multidisciplinary support available to elite competitors [12]. In this population, as Wong et al. and Beck and Drysdale show, energy deficiency threatens not only current health but peak bone-mass acquisition and reproductive maturation, producing potentially irreversible deficits [13,14]. Yet awareness of the Triad and RED-S remains low — a point underscored by Donti et al., who documented profound knowledge gaps in adolescent gymnasts [15] — so early identification through structured screening has become a central priority in sports medicine [16].

The stakes of missing these conditions are high and well documented. Ruscheck et al. and Fidyk et al. show that RED-S impairs energy metabolism, reproductive function, musculoskeletal health, immunity, glycogen synthesis, cardiovascular and haematological health, with individual and synergistic effects on well-being, injury risk and performance [10,17]. Kovács and Boros illustrate, in a case report, how an athlete can progress from disordered eating to anorexia nervosa when these signals go unrecognised and care is fragmented [18]. Because, as Kontele and Vassilakou observe, adolescent athletes are more vulnerable than adults to the physical consequences of energy deficiency given their combined demands of growth and training [6], the case for detecting risk early — before a stress fracture, amenorrhoea or performance collapse forces the issue — is especially strong in this age group. Screening is the practical means of doing so, which is why the choice, performance and combination of screening tools is the central concern of this review [6,16].

A wide array of instruments now exists, but as Hoogenboom et al. show in their scoping review, they differ substantially in construct, target population and validation, and no consensus governs which tools, or combinations, should be used for young athletes [16]. The aim of this narrative review is therefore to summarise, compare and critically appraise the screening and assessment tools used to detect DE, LEA, the Female Athlete Triad and RED-S in adolescent and young adult athletes, situating each instrument within the epidemiology, risk factors and consequences that determine what an effective screen must capture, and identifying the principal gaps that should guide practice and research. All factual claims and figures reported here are drawn exclusively from the cited source publications.

2. Material and methods

This work is a narrative review. Peer-reviewed literature was identified through non-systematic searches of PubMed, Scopus, Web of Science and SPORTDiscus, combining terms related to eating disorders, disordered eating, low energy availability, Female Athlete Triad, Relative Energy Deficiency in Sport, screening and assessment tools, adolescent and young athletes. Forty-one open-access publications were selected, comprising narrative and systematic reviews, scoping reviews, validation and prevalence studies, case reports and consensus-derived clinical tools relevant to adolescent and young adult athletes of both sexes across recreational, collegiate and elite levels. Because the review concentrates on screening, particular weight was given to studies reporting the psychometric properties, feasibility and applied performance of specific instruments. The literature was analysed narratively and synthesised thematically to provide a critical, comparative account. A summary of the core source studies is provided in Table 1.

The evidence base spans several study designs, each contributing differently to the appraisal of screening. Systematic and scoping reviews (for example Mancine et al. and Hoogenboom et al.) map the range of instruments and the sports in which they have been used; validation and cross-sectional prevalence studies (for example Puscheck et al., Magee et al., Łuszczki et al. and Torres Dos Ramos et al.) report tool performance and at-risk rates; a longitudinal study (Stenqvist et al.) and a case report (Kovács and Boros) illustrate temporal course and clinical failure; and consensus-derived and narrative reviews (Bździuch et al., Fidyk et al., Syguda et al., Ghazzawi et al., Grabia et al.) situate the tools within the RED-S framework and its management. Because the review concentrates on screening, findings are organised around what an effective screen must detect (epidemiology, risk factors, consequences) and how the instruments perform, rather than around individual sports.

3. From the Female Athlete Triad to RED-S: constructs relevant to screening

A clear understanding of the constructs is a prerequisite for choosing screening tools. Thein-Nissenbaum and Hammer explain that the 2007 redefinition reframed the Triad components — LEA (with or without an ED), menstrual dysfunction and low BMD — as points on a spectrum rather than absolute states, and Brown et al. stress that an athlete need not display all three simultaneously to suffer harm, so identifying one component should prompt evaluation for the others [1,2]. This spectrum logic is fundamental: instruments must detect early, subclinical presentations, not only full-blown disease [1,2].

The RED-S framework broadened this model. Fidyk et al. and Grabia et al. describe how the IOC extended the affected systems beyond the reproductive and skeletal axes to metabolism, immunity, protein synthesis, cardiovascular, haematological, gastrointestinal and psychological function, and to male and para-athletes [10,19]. Lodge et al. detail the RED-S conceptual model as comprising ten health and ten performance consequences of LEA [9]. Syguda et al. note that whether RED-S is a single coherent syndrome remains contested, a controversy with direct screening implications because the central exposure — energy availability — is hard to measure in the field [20].

Two further distinctions matter. First, Kontele and Vassilakou and Beck and Drysdale note that LEA may be intentional (arising from DE or deliberate weight loss) or inadvertent (from inadequate nutrition knowledge), so a programme must capture both behavioural and physiological signals [6,14]. Second, Ghazzawi et al. show that LEA and DE are partially independent: an athlete may be energy-deficient without meeting ED criteria and may restrict cognitively without an immediate deficit — the primary rationale for combining a symptom-based ED screen with a physiological LEA/RED-S tool [21]. Lodge et al. add a third layer, low-carbohydrate availability, which can harm iron status, immunity and bone independently of total energy intake and which simple energy screens may miss [9].

The quantitative core of both frameworks is energy availability, and its measurement conventions shape screening. Lodge et al. give the standard equation — energy availability equals energy intake minus exercise energy expenditure, normalised to fat-free mass — and note that a value below 30 kcal/kg FFM/day defines LEA, 30–45 kcal/kg FFM/day is subclinical, and 45 kcal/kg FFM/day or above is adequate, with adolescents requiring more still [9]. Kontele and Vassilakou add that 30 kcal/kg FFM/day approximates resting metabolic rate, below which reproductive and skeletal health are impaired [6]. However, Torres Dos Ramos et al. and Syguda et al. caution that individual susceptibility varies with psychogenic stress, gynaecological age, carbohydrate availability and genetics, so an absolute threshold is not deterministic, and that direct field calculation of energy availability is difficult — which is precisely why symptom- and consequence-based questionnaires, rather than measured energy availability, dominate practice [20,22]. This measurement problem is the practical bridge between the constructs and the tools that follow.

Table 1. Summary of core source studies included in this review.

Author (Year) [ref.]	Design	Population	Key findings relevant to screening
Mancine et al. (2020) [7]	Systematic review	Athletes, multiple sports	6/7 studies: higher DE in lean vs non-lean sports; aesthetic highest;

Author (Year) [ref.]	Design	Population	Key findings relevant to screening
			supports sport-stratified screening
Hoogenboom et al. (2025) [16]	Scoping review	30 studies; 12,009 young athletes	EAT-26 most used, then SCOFF, EDI; only 5 studies used athlete-specific tools; no male-specific ED tool
Ghazzawi et al. (2026) [21]	Narrative review	151 studies; female athletes	LEAF-Q and BEDA-Q effective; ~1/3 of RED-S detected only by BEDA-Q + LEAF-Q; PST sens. 87%/spec. 78%
Puscheck et al. (2025) [23]	Cross-sectional	220 collegiate athletes (M+F)	EDSA 38.2% ED risk; LEAF-Q/LEAM-Q 47.2% LEA; 22.7% both; aesthetic highest ED, gymnasts highest LEA
Magee et al. (2023) [24]	Cross-sectional	94 young athletes (M+F)	BEDA-Q ED risk 68.6% F, 42.9% M; LEAF-Q LEA 52.1% F; normal BMI does not exclude risk
Łuszczki et al. (2021) [25]	Cross-sectional	34 youth female footballers 13–18 y	LEAF-Q flagged 64.7% at Triad/RED-S risk before BMD/composition change
Torres Dos Ramos et al. (2025) [22]	Cross-sectional	1,154 active females (Spain)	LEAF-Q 40.0% Triad risk; FAST 24.3% subclinical, 7.3% clinical ED; tools converge
Donti et al. (2025) [15]	Cross-sectional	84 adolescent artistic gymnasts	EDE-Q 20.2% above cut-off; RED-S Knowledge Q: 51.5% wrong, 86.9% unaware amenorrhoea→fracture
Besor et al. (2024) [26]	Prospective	18 adolescent acrobatic gymnasts	m-DEAQ RED-S risk score; 66% female LEA; top-position lower BMD on DXA
Beck & Drysdale (2021) [14]	Narrative review	Adolescent athletes (BSI)	RED-S CAT, LEAF-Q, Triad CRA, DEAQ, SEAQ-I; <18 use 85% ideal body weight
Wong et al. (2025) [13]	Narrative review	Adolescent female athletes (FHA)	FHA in ~54% adolescents vs 21% non-athletes; amenorrhoea ~4× fracture

Author (Year) [ref.]	Design	Population	Key findings relevant to screening
			risk; DXA if amenorrhoea >6 mo
Franzoni et al. (2026) [8]	Cross-sectional (SEM)	691 adolescent athletes 14–20 y	Sex-specific DE pathways; emotion regulation/self-esteem (F), sport pressures/negative mood (M)
Stenqvist et al. (2023) [27]	3-year longitudinal	13 male adolescent endurance athletes	38% low lumbar BMD at baseline; screen males for impaired bone health
Syguda et al. (2026) [20]	Narrative review	Athletes (BMI/RED-S)	BMI misclassifies athletes (κ=0.169); normal BMI misses LEA; RED-S measurement debated

4. Epidemiology in young athletes: what screening reveals

Estimates of DE, ED and LEA vary widely, and this heterogeneity is itself instructive: as Mancine et al. and Kenđel Jovanović and Čulina show, prevalence depends heavily on population, sport, sex, age and, critically, the tool and cut-off applied [7,12]. Kaźmierczyk et al. report ED prevalence in athletes of roughly 0–19% in males and 6–45% in females, highest in aesthetic and weight-sensitive disciplines [4], and Kontele and Vassilakou note that up to 45% of adolescent athletes may develop DE attitudes, with DE ranging across studies from 18.2% to 91.7%, menstrual irregularities from 18.8% to 48.0%, and low BMD from 15.4% to 42.1% [6].

The broadest quantitative estimate is the meta-analysis of 6,118 athletes summarised by Bździuch et al. and Syguda et al., which reported LEA in 44.7% overall (44.2% of women, 49.4% of men) and RED-S risk in 63.0% of those specifically assessed, with worse running performance, endurance, coordination, concentration, judgement, explosive power and agility in athletes with LEA [11,20]. Lodge et al. add that 80% of elite and pre-elite female athletes show at least one RED-S symptom, versus 47.7% of male Olympic-level athletes, and that 37% of females versus 15.9% of males show two or more [9]. These comparable — indeed marginally higher — rates in men challenge the assumption that LEA is principally a female problem and support male-inclusive screening [9,20].

Instrument-specific studies show both the scale of the problem and the influence of the tool. Puscheck et al., using the EDSA, LEAF-Q and LEAM-Q in 220 collegiate athletes, found 38.2% at ED risk and 47.2% at LEA risk, with 22.7% positive for both; females, aesthetic-sport athletes and (by sport) dance-team and women's gymnastics athletes carried the highest risk [23]. Magee et al., using the BEDA-Q and LEAF-Q, classified 68.6% of females and 42.9% of males at ED risk and 52.1% of females at LEA risk [24]. Łuszczki et al. found that the LEAF-Q flagged 64.7% of youth female footballers as at Triad/RED-S risk despite normal body composition and BMD [25], and Torres Dos Ramos et al. found 40.0% at Triad risk on the LEAF-Q and 24.3% subclinical / 7.3% clinical ED risk on the FAST in 1,154 Spanish women

[22].

Recreational and endurance populations further widen the picture and are often the least screened. Gimunová et al. found that 50% of recreational female athletes were at LEA risk on the LEAF-Q and 37.5% reported menstrual dysfunction, arguing that recreational athletes — with less access to sports-medicine support — deserve explicit screening [28]. Fahrenholtz et al. report a wide range of LEA risk among female endurance athletes and show that it clusters with disordered eating, exercise addiction and food intolerances [29], and Lodge et al. emphasise that endurance athletes frequently under-consume carbohydrate independently of total energy [9]. Prus et al. quantify the injury stakes in a related aesthetic population, showing in competitive dancers that a lower energy-availability score independently predicted soft-tissue injury [30]. These findings extend the at-risk population well beyond elite aesthetic sport and support screening across competition levels [28,29,30].

Sport-specific studies expose concentrated risk. Donti et al. found 20.2% of adolescent artistic gymnasts above the EDE-Q cut-off, with high-level gymnasts scoring significantly higher than lower-level peers [15]; Prus et al. linked lower energy-availability scores to soft-tissue injury in competitive dancers [30]; and Bździuch et al. report that among collegiate athletes and performing artists 81.0% exhibited LEA, rising to 96.2% in ballet dancers, while 100% of competitive cheerleaders showed LEA on training days [11]. Yet risk is not confined to lean or aesthetic sports. Ghazzawi et al. and Gimunová et al. document LEA in ball, power, technical, team and recreational athletes, with recreational LEA reported at 35–69% [21,28], and Borowiec et al. found, unexpectedly, that ED risk in adolescent female athletes was most strongly associated with lean non-aesthetic sports (odds ratio 11.50) [31]. Bździuch et al. add that para-athletes may face greater LEA risk although prevalence is not established [11]. These data argue against confining screening to a narrow list of “thin” sports [21,28,31].

Studies that report tool outputs by specific sport show how sharply risk concentrates within a single institution and how paired tools map it. In Puscheck et al.'s collegiate cohort, dance-team athletes recorded the highest ED-risk prevalence, women's gymnasts the highest LEA-risk prevalence and men's volleyball the lowest ED risk, while every sport type exceeded 50% LEA risk and all dance-team athletes who screened positive for LEA also screened positive for ED risk [23]. Bździuch et al. add that softball players showed the highest concurrent ED risk (82.4%) among collegiate athletes and performing artists, second only to ballet dancers [11]. Such granularity identifies where limited screening resources yield the greatest return, while the appearance of risk in lower-expected sports — men's volleyball, ball sports — argues against exempting any group entirely [11,23].

The distribution of the full syndrome versus its components reinforces why screening must detect components rather than only the complete picture. Kaźmierczyk et al. report that the full Female Athlete Triad is comparatively rare (roughly 0–15.9% of studied female athletes) whereas its individual components, in various combinations, may affect 50–60% in selected sports [4]. Bździuch et al. add that subtle menstrual abnormalities appear in about 50% of exercising women and amenorrhoea in about 33%, and that secondary amenorrhoea reaches 69% in leanness-oriented activity versus 2–5% in the general population [11]. Bielicka et al. show that menstrual disorders vary sharply by discipline — primary amenorrhoea reaching 53.8% in rhythmic gymnasts, secondary amenorrhoea affecting 56% of cyclists — reinforcing sport-stratified interpretation of menstrual screening items [32].

Cross-national studies confirm that the burden is global and instrument-dependent. Syguda et al. and Torres Dos Ramos et al. document elevated RED-S or ED risk among Malaysian, Chinese and Australian athletes (with roughly four in five Australian elite and pre-elite female athletes showing at least one RED-S symptom) and among athletes in India, and Torres Dos Ramos et al. found that Spanish women at clinical ED risk on the FAST were about three times more likely to be at Triad risk on the LEAF-Q — the expected convergence of a symptom-based and a physiological tool when both are applied [20,22]. Woźniak et al. remind, however, that the underlying driver in many young athletes is simply a failure to meet age-appropriate energy and macronutrient requirements during a period of rapid growth, so screening must be read against developmental nutritional needs, not adult norms [33].

Two patterns have direct screening implications. First, female athletes show higher risk than males on nearly every instrument, yet male risk is substantial and probably under-detected because tools were largely built for females — a point made by Hoogenboom et al. and, for male endurance athletes specifically, by Stenqvist et al., who found 38% with low lumbar BMD at baseline in a three-year study [16,27]. Second, as Magee et al. and Syguda et al. emphasise, a normal body mass or BMI does not exclude risk, because energy-deficient athletes maintain stable weight through adaptive reductions in resting metabolic rate, so anthropometric screening alone is insufficient [20,24].

Table 4 contrasts the at-risk prevalence reported with different instruments across populations, illustrating how tool choice and cut-off shape apparent burden and reinforcing that reported prevalence is partly an artefact of the instrument used.

Table 4. At-risk prevalence reported with different screening tools in young/athletic populations.

Population	Tool	At-risk finding	Source
Athletes, meta-analysis (n=6,118)	Energy-availability assessment	44.7% LEA; 63.0% RED-S risk among assessed	Bździuch et al. [11]; Syguda et al. [20]
Collegiate athletes (M+F)	EDSA / LEAF-Q / LEAM-Q	38.2% ED; 47.2% LEA; 22.7% both	Puscheck et al. [23]
Young athletes (M+F)	BEDA-Q; LEAF-Q	ED 68.6% F, 42.9% M; LEA 52.1% F	Magee et al. [24]
Youth female footballers (13–18 y)	LEAF-Q	64.7% at Triad/RED-S risk	Łuszczki et al. [25]
Active females (Spain, n=1,154)	LEAF-Q; FAST	40.0% Triad; 24.3% subclinical, 7.3% clinical ED	Torres Dos Ramos et al. [22]
Adolescent artistic gymnasts	EDE-Q	20.2% above cut-off	Donti et al. [15]
Young European athletes	EDE-A; EDSA	14.9% (EDE-A) and 19.9% (EDSA) at risk	Kenđel Jovanović & Čulina [12]
Recreational female athletes	LEAF-Q	50% at LEA risk; 37.5% menstrual dysfunction	Gimunová et al. [28]
Adolescent/adult female athletes	EAT	ED risk 14.6% adolescents vs 6.9% adults	Borowiec et al. [31]

5. Risk factors that screening should target

5.1. Sport-specific pressures

Sport type is one of the most consistent moderators of DE risk, and Mancine et al. show why several frameworks stratify athletes by discipline: lean sports (distance running, cycling, triathlon, swimming), aesthetic sports (gymnastics, ballet, figure skating, diving, synchronised swimming) and weight-class sports (wrestling, boxing, judo, taekwondo, rowing) report the highest DE and the strongest environmental pressures [7]. Petisco-Rodríguez et al. cite Norwegian data of 42% ED in aesthetic sports, 24% in endurance, 17% in technical and 16% in ball-game sports [34], and Donti et al. explain the gymnastics mechanism — the demand for a lean, sometimes prepubescent physique, with initial performance gains reinforcing restriction [15]. Classifications by weight sensitivity are therefore used to prioritise screening, although Jankauskiene and Baceviciene caution against over-reliance on such categories: in their sample of 732 adolescents, competitive athletes reported greater body satisfaction and no greater DE than controls, whereas girls in weight-sensitive leisure sports showed the greatest disturbed eating [35].

The lean/aesthetic distinction, however, is not the whole story, which complicates screening prioritisation. Jankauskiene and Baceviciene found that competitive sport participation was associated with greater body satisfaction and no greater disturbed eating than in controls, with the greatest risk concentrated instead in girls practising weight-sensitive leisure sports such as dance and gym fitness [35]. Borowiec et al. reported that, in adolescent female athletes, ED risk was most strongly associated with lean non-aesthetic sports (odds ratio 11.50) rather than the classic aesthetic disciplines, and with lower body satisfaction (odds ratio 0.80) [31]. Firoozjah et al. showed that, among male adolescent athletes, individual-sport participants scored higher than team-sport participants on bulimia and food preoccupation [36]. Together these studies argue for broad screening with sport-informed thresholds rather than blanket exemption of any category, and for separate analysis of adolescents and adults, since Baceviciene et al. found that the pressures and presentations differ by age as well as sport [37].

5.2. Psychological vulnerability

Psychological traits are central to onset and maintenance and are increasingly built into athlete-specific tools. Petisco-Rodríguez et al. identify perfectionism, anxiety and low self-esteem as core risk traits, noting that many traits valued in elite athletes overlap with those of eating-disordered individuals [34]. Paixão et al., in a path model of aesthetic athletic girls, found that body-image-related cognitive fusion predicted DE both directly and through perfectionistic self-presentation, explaining 71% of the variance in DE severity — evidence that maladaptive body-image cognition, not actual body composition, drives restriction [38]. Franzoni et al. add that emotion-regulation difficulties and low self-esteem were associated with DE specifically in female athletes [8]. Compulsive exercise is a further target that, as Fahrenholtz et al. show in female endurance athletes, clusters with LEA risk, DE and food intolerances and is hard to identify because heavy training is normative [29]. Consistent with this, Ruscheck et al. report that the 2023 IOC CAT2 now incorporates psychological indicators such as body dissatisfaction and body dysmorphia [17].

The mechanistic detail of these psychological pathways clarifies what screening should capture. Franzoni et al.'s structural models showed that sociocultural pressures drive internalisation of body ideals, which drives body dissatisfaction and, in turn, DE in both sexes, but that the downstream pathway diverges: through emotion-regulation difficulties and low self-esteem in females and through sport weight pressures and negative mood in males [8]. This divergence implies that a single symptom count is unlikely to capture risk equally across sexes and supports tools that combine eating attitudes with psychological predictors, as the ATHLETE questionnaire and the CAT2 attempt [16,17]. Petisco-Rodríguez et al. add a cautionary nuance: in their sample, non-athlete controls scored higher on the SCOFF than gymnasts, suggesting that athletic participation is not uniformly a risk factor and that perfectionism and low self-esteem — rather than sport membership alone — are the more reliable screening targets [34].

5.3. Sociocultural pressures, coaches and social media

External pressures modify risk and are captured by several purpose-built questionnaires. Baceviciene et al., comparing 1,003 athletes, found that adolescent female athletes experienced higher sociocultural and coach-related pressures and a less positive body image than adults, and that aesthetic weight-sensitive female athletes reported more DE and greater coach pressure — leading the authors to conclude that ED-prevention education is compulsory for coaches who train female athletes [37]. Kenđel Jovanović and Čulina found that roughly one third of young European athletes reported coach pressure, significantly more in females, and that nearly half were dissatisfied with their weight [12]. Franzoni et al. and Ruscheck et al. document the amplifying role of image-based social media, with the type of content — not screen time alone — predicting body dissatisfaction and DE [8,17]. These determinants explain why the SCAED battery and the ATHLETE tool include coach- and teammate-pressure items alongside eating attitudes [12,16].

The coach–athlete relationship is both a risk factor and a lever for prevention, which is why several tools embed coach-pressure items. Baceviciene et al. found that aesthetic weight-sensitive female athletes reported greater body-image-related pressure from coaches and more disordered eating, concluding that ED-prevention education is compulsory for coaches who train female athletes [37], and Kenđel Jovanović and Čulina found coach pressure reported by roughly a third of young athletes, significantly more by females [12]. Conversely, coaches are often the first to observe behavioural red flags — avoidance of team meals, obsessive weighing, training through injury — and are therefore indispensable partners in early detection when educated to interpret these as warnings rather than dedication [15,37]. This dual role explains why the SCAED battery and the ATHLETE tool include coach- and teammate-pressure items alongside eating attitudes [12,16].

5.4. Weight-cutting, orthorexia, muscle dysmorphia and calorie tracking

Several behavioural targets are poorly captured by thinness-oriented items. Mancine et al. describe how weight-class athletes use rapid weight-loss practices — dehydration, fasting, excessive exercise — followed by rebound eating and off-season bulimic tendencies [7], and Kontele and Vassilakou estimate that up to 67% of weight-class athletes attempt rapid weight loss through such methods, warranting explicit screening for these behaviours [6]. Bojanowska et al. highlight two emerging, camouflaged conditions especially relevant to males: orthorexia nervosa (an obsession with food “purity”, affecting an estimated 6–50% of athletes by sport) and muscle dysmorphia (a distorted belief of insufficient muscularity), which can collide to produce LEA and RED-S and which they argue require dedicated instruments such as the Düsseldorf Orthorexia Scale and muscularity measures [39]. SantaBarbara et al. add a contemporary behavioural marker: calorie tracking was far more prevalent in resistance-trained athletes (~65%) than in the general population, and was associated with amenorrhoea and ED severity [40]. Firoozjah et al. further show, in male adolescent athletes during the COVID-19 pandemic, that individual-sport athletes scored higher than team-sport athletes on bulimia, food preoccupation and body-image concerns, identifying a further group for monitoring [36].

The specific methods used to make weight further define what screening should ask about. Kontele and Vassilakou estimate that up to 67% of athletes in weight-class sports attempt rapid weight loss through dehydration practices — fluid restriction, spitting, self-induced vomiting, diuretics, laxatives, saunas and exercise in non-porous suits — which cause electrolyte imbalance, reduced strength and endurance, impaired thermoregulation and heightened heat-illness risk and frequently coincide with low energy and micronutrient intake [6]. Because these behaviours are often concealed and are not captured by thinness-oriented eating-attitude items, Mancine et al. and Bielicka et al. argue that screening in weight-class athletes should probe rapid-weight-loss methods explicitly, and that clinicians should recognise the physical signs — dental erosion, parotid enlargement, knuckle scars and orthostatic change — associated with purging and severe restriction [7,32]. SantaBarbara et al. add that contemporary behavioural markers such as calorie tracking, far more prevalent in resistance-trained athletes than the general population, warrant explicit enquiry [40].

6. Health and performance consequences: the clinical targets of screening

Screening is justified by the severity and partial reversibility of the consequences of LEA, which define the endpoints a programme should pre-empt.

6.1. Endocrine and reproductive function

Wong et al. describe how sustained LEA suppresses hypothalamic gonadotropin-releasing hormone pulsatility, reducing luteinizing and follicle-stimulating hormone and, in turn, oestradiol and progesterone, producing functional hypothalamic amenorrhoea (FHA), mediated by reduced leptin and kisspeptin and elevated cortisol [13]. Bździuch et al. and Fidyk et al. add that insulin, IGF-1, leptin and triiodothyronine fall while, in men, testosterone may decline with hypogonadism — the basis of the male items in the LEAM-Q [10,11]. Because subtle disturbances such as anovulation can occur despite regular cycle length, Ghazzawi et al. argue that menstrual-history items alone are imperfect and multi-signal screening is preferable [21]. Wong et al. report that approximately 54% of adolescent athletes under 18 experience menstrual dysfunction such as FHA versus about 21% of non-athletes [13].

The endocrine signature of LEA offers several candidate screening biomarkers. Bździuch et al. describe how, in both sexes, insulin, IGF-1 and leptin fall while, in women, adiponectin and ghrelin may rise; oestradiol and progesterone decline in women and testosterone in men, and triiodothyronine is consistently reduced [11]. Fidyk et al. add that men with LEA report low libido and reduced morning erections — the physiological basis of the LEAM-Q items — and that a lower TSH-to-T3 ratio has been proposed as a male marker [10]. Wong et al. situate these changes within FHA, mediated by reduced leptin and kisspeptin signalling and elevated cortisol from hypothalamic-pituitary-adrenal activation [13]. Because these hormonal shifts can precede overt menstrual change and, in men, have no menstrual correlate at all, several authors advocate combining menstrual history with metabolic surrogates such as resting metabolic rate rather than relying on a single reproductive signal [13,21].

6.2. Bone health and bone stress injuries

Beck and Drysdale detail why bone stress injuries (incidence 3.9–19% in adolescents, recurrence up to 21%) should prompt RED-S evaluation, clustering at trabecular-rich sites in running, jumping, gymnastics, dance and rowing, with delayed menarche prolonging vulnerability [14]. Wong et al. report that amenorrhoeic athletes carry roughly four times the lifetime fracture risk of non-athletes, with stress fractures in about 32% versus 5.9% of eumenorrhoeic athletes [13], and Stenqvist et al. show that male adolescent endurance athletes may fail to achieve expected pubertal bone accrual, with 38% having low lumbar BMD at baseline [27]. Beck and Drysdale note that the Triad Cumulative Risk Assessment stratifies bone-injury risk, using 85% of ideal body weight for age in those under 18 [14], and Prus et al. show that a lower energy-availability score independently predicted soft-tissue injury in dancers [30].

The skeletal detail is directly relevant because bone stress injuries are a common presenting problem that should itself trigger RED-S screening. Beck and Drysdale describe how decreased oestrogen preferentially affects trabecular before cortical bone, increasing susceptibility at trabecular-rich sites (tibia, metatarsals, tarsals, lumbar spine, pelvis, ribs), and how a prior eating disorder raises bone-stress-injury risk up to five-fold, making ED history itself a screening indication [14]. Prus et al. add that, in competitive female dancers, a lower energy-availability score independently predicted soft-tissue injury while higher training exposure predicted bone injury, so a cluster of injuries should prompt assessment [30]. These relationships are the empirical basis for the injury and bone-health subscales of the LEAF-Q and the Triad Cumulative Risk Assessment [14,32].

6.3. Cardiovascular, metabolic, immune, gastrointestinal and growth effects

Fidyk et al. and Bździuch et al. associate LEA with dyslipidaemia, bradycardia, hypotension, endothelial dysfunction, suppressed resting metabolic rate and impaired immunity [10,11], and Kontele and Vassilakou describe a counter-intuitive pattern in which LEA correlates with higher body-fat percentage and lower resting metabolic rate, producing a weight-loss plateau that can drive further restriction toward an ED [6]. Lodge et al. show that low-carbohydrate availability independently harms iron status, immunity and bone [9], and Grabia et al. document widespread insufficiency of vitamin D, calcium, magnesium, zinc and iron across female-athlete groups [19]. In the growing athlete, Kontele and Vassilakou and Wong et al. warn that prolonged deficiency threatens growth, delays menarche and compromises peak bone mass, of which up to 90% is acquired by around 18 years [6,13] — the core reason screening in adolescents is more urgent than in adults.

A counter-intuitive pattern reinforces why screening cannot rely on weight or body fat. Kontele and Vassilakou describe how, although athletes reduce intake to lose weight, LEA correlates with higher body-fat percentage and lower resting metabolic rate, because chronic restriction triggers an adaptive metabolic slowdown; the resulting weight-loss plateau may prompt further restriction, creating a vicious cycle that can culminate in a clinical eating disorder [6]. Grabia et al. and Lodge et al. add that this state is typically accompanied by low micronutrient and carbohydrate intake, impairing glycogen replenishment, muscle repair and bone formation, and thereby undermining the very performance goals restriction was intended to serve [9,19]. This physiology means that unhealthy weight-control methods often fail to produce the desired body composition and may worsen it — a message that is itself an important component of the education that should accompany screening [9,19].

6.4. Neurocognitive, psychological and performance effects

Subalatha et al. argue that cognition depends on adequate energy availability and that changes in cognitive performance could serve as an early indicator of energy and nutrient deficits [3]. Bździuch et al. and Fidyk et al. describe mood disturbance, poor sleep, exercise addiction, perfectionistic striving and depression as psychological consequences of LEA [10,11], and Kovács and Boros illustrate, in a case of an orienteer who progressed from DE to anorexia nervosa, how interruption of psychological care and poor coordination between specialists precipitated deterioration [18]. On performance, Ruscheck et al. note that LEA surrogates correlate with the health and performance consequences the RED-S model predicts [17], and Syguda et al. summarise experimental and pooled evidence that LEA measurably degrades endurance, coordination, judgement and explosive power [20]. Because short-term LEA can transiently appear to improve performance, its long-term costs are easily overlooked — the scenario structured screening is intended to interrupt [17,20].

The performance dimension is central to why RED-S matters to athletes and coaches, and it also supplies surrogate markers for screening. Ruscheck et al. note that surrogates of LEA — menstrual disturbance and a suppressed resting metabolic rate — correlate with both the health and performance consequences the RED-S model predicts, lending empirical support to multi-signal screening [17]. Syguda et al. summarise the largest pooled analysis, in which athletes with LEA performed worse on running performance, endurance, training response, coordination, concentration, judgement, explosive power and agility, and cite controlled evidence that deliberately inducing LEA reduces explosive power — establishing a causal, not merely correlational, relationship [20]. Subalatha et al. argue that, because cognition and motor control depend on adequate fuelling, an observed decline in cognitive performance could act as an early, first-level indicator prompting nutritional and RED-S assessment before overt clinical signs appear [3]. Fahrenholtz et al. add that exercise addiction and food intolerances cluster with LEA risk in female endurance athletes, widening the set of behavioural signals a screen might capture [29].

Low-carbohydrate availability deserves separate emphasis because it can be missed by energy-only screening. Lodge et al. show that endurance athletes frequently fail to meet carbohydrate recommendations (45–98% across studies) and that low-carbohydrate availability independently impairs bone formation, immune function and iron regulation, sometimes even when energy availability is adequate; they note that the resulting harm maps onto the same RED-S health and performance domains as LEA [9]. Grabia et al. reinforce the nutritional dimension, documenting insufficient intake of vitamin D across all female-athlete groups studied and inadequate calcium, magnesium, the calcium-to-phosphorus ratio, zinc and iron, all of which bear on bone and haematological health [19]. These findings imply that a thorough assessment should consider carbohydrate and micronutrient adequacy, not energy availability alone, and that dietitian involvement is integral to interpreting positive screens [9,19].

7. Screening and assessment tools in young athletes

Two families of instruments are used: symptom-based tools that detect DE/ED, and physiological or clinical tools that detect LEA, the Triad and RED-S. As Hoogenboom et al. emphasise, most ED tools applied in sport were developed for the general population, few were built for athletes, and none has been validated specifically for male athletes [16]. The following sections describe the principal instruments, summarise their reported performance, and appraise their clinical utility.

7.1. Generic eating-disorder screening tools

Hoogenboom et al., across 30 studies of more than 12,000 young athletes, found the Eating Attitudes Test (EAT-26, occasionally EAT-40) to be the single most used instrument, favoured for its long history and ease of administration, but note that its thinness-oriented items may be answered differently by male athletes, reducing its usefulness in muscularity-oriented populations [16]. The same review identified the SCOFF questionnaire — five yes/no items — as the second most used, highly feasible and, against a clinical interview, showing sensitivity of about 84.6% and specificity of 89.6%, though whether it captures the full athlete ED spectrum is unresolved [16]. Notably, Petisco-Rodríguez et al. found SCOFF scores higher in non-athlete controls than in gymnasts, a reminder that generic tools can behave unexpectedly in athletes [34]. Jankauskiene and Baceviciene, Baceviciene et al. and Borowiec et al. used the EAT-26 to expose sport- and sex-specific patterns of disturbed eating [31,35,37], while Franzoni et al. applied a 16-item EDE-Q derivation [8] and Donti et al. used the EDE-Q global score, with 20.2% exceeding the cut-off, cautioning that its behavioural items diverge from clinical interview [15]. Because the EDE-Q was developed in females, Kenđel Jovanović and Čulina applied a lower male cut-off (~1.68 versus ~2.8) [12]. The Eating Disorder Inventory, and narrower tools such as the Bulimia Test-Revised, the Three-Factor Eating Questionnaire and the ORTO-15 (orthorexia), also appear but, as Hoogenboom et al. conclude, have limited utility as general athlete ED screens [16].

The scale of reliance on general-population tools is striking. Hoogenboom et al. found that, across their 30 included studies of more than 12,000 athletes from 74 sports and 15 countries, only five studies used an athlete-specific instrument, and that when several tools were combined no consistent battery emerged — evidence of an immature field without an agreed standard [16]. They also catalogue narrower instruments used sporadically in this population — the Questionnaire for Eating Disorder Diagnosis, the Eating Disorder Screen for Primary Care and the Yale-Brown-Cornell Eating Disorder Scale — and judge tools targeting a single condition (the Bulimia Test-Revised for bulimia, the ORTO-15 for orthorexia) to have limited utility as general athlete ED screens [16]. Franzoni et al. illustrate a pragmatic middle path, deriving a 16-item disordered-eating score from the EDE-Q to avoid conceptual overlap with body-dissatisfaction measures while retaining a validated core [8]. The practical implication is that most young athletes are currently screened with instruments neither designed nor validated for them — the gap athlete-specific tools were created to close [16].

7.2. Athlete-specific eating-disorder tools

The generic EDE-Q and its derivatives illustrate the sex- and age-adaptation problem common to non-athlete tools. Kenđel Jovanović and Čulina used both the adolescent EDE (EDE-A) and the athlete-specific EDSA in young European athletes and found 14.9% at risk on the EDE-A versus 19.9% on the EDSA, with the shorter athlete tool proving more sensitive and practical; because the EDE-Q was developed in females, they applied a lower male cut-off of about 1.68 against a general threshold near 2.8 [12]. Donti et al. similarly cautioned that, although the EDE-Q global score screened adolescent gymnasts well, its individual behavioural items diverge from clinical interview and should be interpreted with care [15]. These observations support using a validated athlete-specific screen where feasible and, when generic tools are used, applying sex- and age-appropriate cut-offs rather than a single generic threshold [12,15].

Recognising these limits, several athlete-specific tools have been developed. Bielicka et al. describe the Brief Eating Disorder in Athletes Questionnaire (BEDA-Q), validated for sportswomen, addressing body dissatisfaction, perfectionistic traits and dieting [32]; Magee et al. and Ghazzawi et al. report sensitivity of about 82–83% and specificity of about 84.6% [21,24]. Hoogenboom et al. detail the Eating Disorder Screen for Athletes (EDSA), a brief six-item instrument validated for both sexes with excellent criterion validity against the EDE-Q and reported sensitivity of 96% and specificity of 80% in males (96% and 64% in females), recommending it for athlete screening [16]; Kenđel Jovanović and Čulina and Puscheck et al. deployed it successfully in large young-athlete cohorts [12,23]. Hoogenboom et al. also highlight the ATHLETE questionnaire, which targets the psychological predictors of DE rather than symptoms alone [16], and Ghazzawi et al. describe the Physiologic Screening Test, which adds objective measurements and achieved sensitivity of 87% and specificity of 78% — superior to purely psychological tests [21].

The relative merits of these athlete-specific tools reflect what each was built to do. Bielicka et al. note that the BEDA-Q, unlike general screens, is validated specifically for sportswomen and probes appearance- and performance-linked pathology [32]; Hoogenboom et al. observe that the EDSA's brevity and validation in both sexes make it attractive for routine team screening and that its criterion validity against the EDE-Q supports first-line use [16]; and Ghazzawi et al. show that the Physiologic Screening Test, by adding objective measurements to behavioural items, outperformed purely psychological tests — the same principle underlying paired ED-plus-LEA screening [21]. Hoogenboom et al. add that the ATHLETE questionnaire is distinctive in targeting the aetiology of DE rather than symptom counts, which may make it especially useful for guiding prevention, and that among general tools occasionally used for males the Questionnaire for Eating Disorder Diagnosis remains a general-population instrument rather than a male-specific one [16]. The consistent message is that athlete-specific tools better match the population, but none is yet a substitute for combination and clinical confirmation [16,21].

7.3. Low energy availability, Triad and RED-S tools

The Low Energy Availability in Females Questionnaire (LEAF-Q) is the most widely used LEA/Triad/RED-S screen. Bielicka et al. describe its three thematic groups — injuries, gastrointestinal symptoms, and menstrual function — validated in endurance athletes with sensitivity of 78% and specificity of 90% and a risk cut-off of 8 [32]. Łuszczki et al. showed it flags youth footballers before body-composition change [25], and Gimunová et al. found that a positive LEAF-Q in recreational athletes reflected risk of, rather than established, impairment, since BMD was not adversely affected [28]. For men, Puscheck et al. used the newer, less-validated LEAM-Q, noting limited sensitivity and a sex-hormone focus that may not capture the full male presentation [23]. Beck and Drysdale describe discipline-specific alternatives — the Dance-specific Energy Availability Questionnaire (DEAQ) and the Sport-Specific Energy Availability Questionnaire with Interview (SEAQ-I) [14] — and Besor et al. show that the modified acrobatic-gymnastics version (m-DEAQ) yields a quantitative RED-S risk score that identified top-position and female gymnasts as highest risk, cross-validated against DXA-measured BMD [26]. At the level of formal assessment, Bździuch et al. and Syguda et al. describe the IOC RED-S Clinical Assessment Tool and its second version (CAT2), a multi-step protocol that stratifies athletes into green, yellow, orange and red categories and treats anthropometry as one input among several; in one cohort of 150 athletes, 29% were green, 64% yellow and 7% red [11,20]. Beck and Drysdale add the Triad Cumulative Risk Assessment, which integrates energy, menstrual and BMD data and uses 85% of ideal body weight in adolescents [14].

The IOC REDs CAT2 deserves particular attention as the most comprehensive instrument. Bździuch et al. describe its four-category stratification: green denotes none-to-very-low risk requiring no treatment; yellow (mild) and orange (moderate-to-high) risk require treatment, monitoring and possible modification of training or competition; and red denotes very high-to-extreme risk requiring immediate clinical intervention, possible hospitalisation and removal from training [11]. Applying the earlier RED-S CAT to 150 athletes, one cohort classified 29% green, 64% yellow and 7% red [11]. Syguda et al. emphasise that CAT2 works through screening, severity and risk stratification, and clinical diagnosis and treatment, and — unlike a single-number anthropometric screen — never bases a diagnosis on one measurement, treating body composition as one input among physiological, behavioural and psychological indicators [20]. Beck and Drysdale add that the Triad Cumulative Risk Assessment integrates energy availability, menstrual status and DXA-derived BMD to grade bone-injury risk as low, medium or high, with the adolescent modification of using 85% of ideal body weight for age [14]. These structured tools represent the second tier to which a positive first-tier screen should advance [11,14,20].

Applied studies show how these physiological tools behave in practice. Łuszczki et al. found that the LEAF-Q identified 64.7% of youth footballers as at risk despite normal body composition and BMD, catching a signal (lower energy intake) that anthropometry missed [25]; Gimunová et al. observed that a positive LEAF-Q in recreational athletes did not correspond to adversely affected BMD or postural stability, indicating that a positive result reflects risk of, rather than established, impairment [28]; and Besor et al. cross-validated the m-DEAQ against DXA, showing that top-position acrobatic gymnasts — encouraged to stay light — combined higher RED-S risk scores with lower bone mineral density [26]. These examples position the LEA/RED-S questionnaires as early-warning screens whose positive results require physiological and clinical follow-up rather than standalone interpretation, and they show the added value of pairing a questionnaire with an objective measure such as DXA where feasible [25,26,28].

7.4. Body-image adjuncts, awareness and body-composition assessment

Ruscheck et al., in a scoping review of body image in RED-S, conclude that no single validated instrument records body-image attitudes across sexes in relation to RED-S, and recommend pairing a LEA screen (LEAF-Q or LEAM-Q) with a sex-appropriate body-image tool — the Body Image Avoidance Questionnaire for women, the Drive for Muscularity Scale or Muscle Dysmorphic Disorder Inventory for men [17]; Jankauskiene and Baceviciene and Franzoni et al. also used the Multidimensional Body-Self Relations Questionnaire and the Drive for Muscularity Scale to capture these constructs [8,35]. Awareness is a screening prerequisite: Donti et al. found that adolescent gymnasts answered 51.5% of RED-S-knowledge items incorrectly and that 86.9% did not know amenorrhoea raises fracture risk [15], and Bździuch et al. cite data that only 32.98% of athletic trainers had heard of RED-S versus 98.61% for the Triad [11]. Finally, Syguda et al. show that anthropometry is a poor screen — BMI agreement with DXA in male athletes was only fair (κ=0.169), and athlete-adjusted cut-offs performed better (κ=0.522) — so DXA, skinfolds and BMI are adjuncts to, not substitutes for, validated multidimensional tools [20].

Awareness deserves particular emphasis because screening presupposes that athletes and staff can recognise the risks the instruments address. Donti et al. found that adolescent gymnasts, irrespective of performance level, were largely unaware of the definitions of LEA, the Triad and RED-S, answered 51.5% of knowledge items incorrectly, and — in 86.9% of cases — did not know that amenorrhoea increases fracture risk, with over 60% believing that missing periods during intensive training is normal [15]. Bździuch et al. cite complementary data that only 32.98% of athletic trainers had heard of RED-S, against 98.61% for the Triad [11]. This gap has two consequences for screening: it undermines the validity of self-report, because athletes cannot report risks they do not recognise, and it means screening must be paired with education for athletes, coaches and families [11,15]. Knowledge instruments therefore serve both as needs assessments and as outcome measures for educational programmes such as those described by Patel et al. [41].

7.5. Comparative overview and a tiered pathway

Table 2 summarises the construct, population, reported performance and principal limitation of the main instruments, and Table 3 sets out an evidence-informed tiered pathway. Synthesising the literature, a first, feasible tier applies a validated athlete-specific ED screen (EDSA or BEDA-Q; SCOFF or EAT-26 where familiarity aids uptake) together with a LEA/RED-S tool matched to sex and sport (LEAF-Q, LEAM-Q or a sport-specific questionnaire), ideally at annual or pre-participation evaluations and anonymously [16,23]. A positive first-tier screen advances to structured stratification (CAT2 or the Triad CRA), and then to a clinical interview and multidisciplinary evaluation — the diagnostic gold standard emphasised by Hoogenboom et al. [16]. Ghazzawi et al. show the value of combination: approximately one third of RED-S cases were detected only by using the BEDA-Q and LEAF-Q together [21]. Education is embedded throughout to address the knowledge gap documented by Donti et al. [15].

Table 2. Principal screening and assessment tools for DE/ED, LEA and RED-S in young athletes.

Tool	Construct / target	Population	Reported performance	Principal limitation
EAT-26/40	General ED attitudes	General; used in athletes	Most used; reliable [16]	Not athlete-specific; weak for males [16]
SCOFF	Core ED features	General; used in athletes	Sens. 84.6%, spec. 89.6% [16]	May miss athlete ED spectrum [16,34]
EDI; EDE-Q / EDE-A	Dimensional ED psychopathology	General; adolescent form	Global score useful [15]	Female-derived; sex/age cut-offs needed [12,15]
BEDA-Q	Athlete ED risk (9 items)	Athletes (F focus)	Sens. ~82–83%, spec. ~85% [24,32]	Limited male validation [16]
EDSA	Athlete ED risk (6 items)	Athletes, both sexes	M sens. 96%/spec. 80% [16]	Newer; less widely used [16]
ATHLETE; PST	Psychological predictors; objective	Athletes	PST sens. 87%/spec. 78% [21]	Less validated; PST needs measurement [16,21]
LEAF-Q	LEA / Triad risk	Female athletes	Sens. 78%, spec. 90%; ≥8 [32]	Female-only; specificity questioned [21,25]
LEAM-Q	LEA in males	Male athletes	Screens male LEA [23]	Newer; limited sensitivity [23]

Tool	Construct / target	Population	Reported performance	Principal limitation
DEAQ / m-DEAQ; SEAQ-I	Sport-specific EA	Dancers; gymnasts; cyclists	m-DEAQ RED-S score [26]	Discipline-specific [14,26]
RED-S CAT / IOC REDs CAT2	Multi-step clinical RED-S	All athletes	Green–red stratification [11,20]	Needs clinician; EA hard to measure [20]
Triad CRA	Bone-injury risk	Female athletes	Risk stratification [14]	<18 use 85% ideal body weight [14]
BIAQ; DMS; MDDI; MBSRQ	Body image / dysmorphia	F (BIAQ); M (DMS, MDDI)	Adjunct to LEA tools [17]	No sex-inclusive RED-S body-image tool [17]

Table 3. An evidence-informed tiered screening pathway for young athletes.

Tier	Purpose	Instruments / actions	Source basis
Tier 1 – Screen	Broad, feasible triage at annual/pre-participation checks	Athlete ED screen (EDSA/BEDA-Q) + LEA screen (LEAF-Q/LEAM-Q/sport-specific EA); anonymous	[16,23,24,25]
Tier 2 – Stratify	Structured clinical risk assessment of positive screens	IOC REDs CAT2 or Triad CRA; menstrual, psychological, behavioural data; DXA where indicated	[11,14,20]
Tier 3 – Diagnose & manage	Confirm diagnosis and initiate care	Clinical interview (gold standard); multidisciplinary team; risk-based return-to-play	[16,18]
Throughout – Educate	Close the knowledge gap, support disclosure	RED-S/Triad education for athletes, coaches, families; ATHENA/SCAED programmes	[12,15,41]

8. Special populations and screening considerations

8.1. Adolescents

Thein-Nissenbaum and Hammer and Kontele and Vassilakou stress that adolescence combines high nutrient demands with a peak period of DE onset, so screening must be sensitive to early risk while accounting for developmental variation: menstrual irregularity in the first two years after menarche is common and should generally be excluded from interpretation, and menstrual status cannot be used before menarche [1,6]. Beck and Drysdale recommend 85% of ideal body weight for age in place of adult BMI cut-offs for those under 18 [14]. Because, as Wong et al. and Stenqvist et al. show, irreversible bone and reproductive deficits can accrue during this window, adolescent screening is both more urgent and more nuanced than in adults and is best performed at annual or pre-participation evaluations [13,27].

The developmental stakes are quantifiable and make adolescent screening uniquely urgent. Wong et al. note that approximately 25% of adult bone mass is accrued in the two years around menarche and up to 90% by around 18 years, so energy deficiency and menstrual suppression in this window can permanently lower peak bone mass [13]; Stenqvist et al. show the male counterpart, with roughly 25% of adult BMD accrued between 13 and 19 years and most of their male adolescent athletes failing to achieve expected accrual [27]. Kontele and Vassilakou and Grabia et al. add that adolescent athletes with disordered eating frequently consume below-recommended carbohydrate, protein, calcium and iron, compounding the skeletal risk during a period of high demand [6,19]. Although some catch-up may occur when intake normalises, deficits may not fully resolve, which is why the literature consistently stresses early identification in this age group above all others [6].

8.2. Male athletes

Male athletes are the clearest gap. Hoogenboom et al. report that no instrument has been validated to identify DE specifically in males and that female-derived tools may misclassify male athletes whose pathology centres on muscularity rather than thinness [16]. Puscheck et al. note that the LEAM-Q is newer, less validated and of limited sensitivity [23], and Bojanowska et al. and Stenqvist et al. show that muscle dysmorphia, orthorexia and impaired bone health in male athletes demand muscularity- and bone-oriented screening [27,39]. Firoozjah et al. add that male individual-sport athletes may be at particular risk [36]. Given meaningful and under-detected male risk, the development of male-specific instruments is a priority [16,27].

8.3. Aesthetic, endurance, weight-class, recreational and para-athletes

Sport-specific tools improve fit but narrow applicability. Beck and Drysdale and Besor et al. describe discipline-specific energy-availability questionnaires (DEAQ, m-DEAQ, SEAQ-I) reflecting particular demands [14,26]; Fahrenholtz et al. and Lodge et al. focus on endurance athletes, in whom LEA and low-carbohydrate availability are common [9,29]; and Gimunová et al. emphasise recreational athletes, who combine high prevalence with low support yet are under-represented in validation studies [28]. Bździuch et al. note that para-athletes may be at elevated LEA risk but lack established prevalence data and validated tools [11]. Across these groups, the recurring recommendation is a validated ED screen plus a population-appropriate LEA/RED-S tool, with clinical confirmation [16,21].

Team and individual sports, and the training calendar, add further nuance. Firoozjah et al. found that male individual-sport athletes scored higher than team-sport athletes on bulimia, food preoccupation and body-image concerns, and that the disruption of the COVID-19 period intensified these concerns — a reminder that screening cadence should account for context and season [36]. Kontele and Vassilakou likewise stress that an athlete can move back and forth along the eating-behaviour continuum within a single training cycle, so a single screen is a snapshot rather than a verdict, and periodic re-screening is preferable to one-off assessment [6]. Baceviciene et al. reinforce that adolescent and adult athletes differ in both pressures and presentations, so age-appropriate interpretation is essential [37]. Across all these populations, the recurring recommendation is a validated ED screen plus a population-appropriate LEA/RED-S tool, repeated over time and confirmed clinically [16,21].

9. Critical appraisal and controversies

9.1. The LEAF-Q specificity debate

Although the LEAF-Q is the most established LEA screen, its diagnostic usefulness is contested. Bielicka et al. describe its structure — 25 items across injury history, gastrointestinal symptoms and menstrual function, with a risk cut-off of 8 and reported sensitivity of 78% and specificity of 90% in endurance athletes [32]. Ghazzawi et al., however, note that while several studies confirm it as a reliable indicator of LEA risk, others report that it lacks specificity in particular sports — notably football — and conclude that it cannot accurately classify athletes as high risk or serve as a surrogate diagnostic tool [21]. Łuszczki et al. and Gimunová et al. show that a positive LEAF-Q reflects risk of, rather than established, impairment, since BMD and body composition were often unchanged [25,28]. The evidence therefore positions the LEAF-Q as a screening — not a diagnostic — instrument with a high negative predictive value that is more useful for reassuring low-risk athletes than for confirming high risk, and whose positive results require physiological and clinical confirmation [21,25].

9.2. The male gap

Hoogenboom et al. repeatedly document the absence of validated male-specific ED tools and the risk of misclassifying male athletes with female-derived instruments [16]. The LEAF-Q is female-only by construction and, as Puscheck et al. show, the LEAM-Q remains newer and less validated [23]. Because male athletes show meaningful, probably under-detected LEA and DE — with male-typical presentations including muscle dysmorphia and orthorexia (Bojanowska et al.) and impaired bone health (Stenqvist et al.) — development and validation of male-relevant instruments is a priority [16,27,39].

The male gap is compounded by the fact that male presentations are qualitatively different. Bojanowska et al. show that male pathology often centres on muscularity and orthorexia rather than thinness, so instruments dominated by drive-for-thinness items may register a false negative in a genuinely at-risk male athlete [39]; Franzoni et al. found that sport weight pressures and negative mood, rather than the emotion-regulation and self-esteem pathway seen in females, drove DE in male athletes [8]; and Stenqvist et al. show that impaired bone health can be the principal detectable indicator of male RED-S in the absence of any menstrual signal [27]. Screening male athletes therefore requires muscularity-oriented and bone-oriented content — the Drive for Muscularity Scale, the Muscle Dysmorphic Disorder Inventory and DXA — rather than a female-derived questionnaire applied unchanged [8,27,39].

9.3. Anthropometry and the RED-S measurement problem

Syguda et al. show that BMI misclassifies muscular athletes (κ=0.169 against DXA) while failing to detect energy-deficient athletes of normal weight, so a normal BMI cannot exclude LEA or RED-S and should be treated as a preliminary flag [20]. They further note the deeper controversy over whether energy availability can be measured accurately in the field, which bears on whether RED-S is a single syndrome; if the central exposure resists field measurement, prevalence figures are best read as estimates [20]. This strengthens the case for structured, multi-input tools such as CAT2 over any single surrogate [11,20].

9.4. Self-report, under-reporting and heterogeneity

All questionnaire screening shares intrinsic limitations. Ghazzawi et al. and Hoogenboom et al. note recall and reporting bias and, in elite settings, deliberate under-reporting driven by stigma and fear of exclusion, compounded by the normalisation of restrictive eating in sport [16,21]. Kovács and Boros and Donti et al. add that behavioural observation and education are needed because athletes cannot report risks they do not recognise [15,18]. Finally, Kontele and Vassilakou and Kenđel Jovanović and Čulina highlight methodological heterogeneity — differing tools, cut-offs and populations — that limits comparability and argues for a standardised, sex-inclusive, athlete-specific battery [6,12].

Behavioural observation is a necessary complement to formal instruments precisely because self-report is fallible. Kontele and Vassilakou and Kovács and Boros describe day-to-day signs that should prompt screening or referral — avoidance of communal meals under the guise of a personalised plan, obsessive self-weighing, laxative or diuretic use, excessive exercise outside prescribed training that continues despite fatigue or injury, mood change and social withdrawal, and, in females, menstrual irregularity that should not be dismissed [6,18]. Baceviciene et al. found such behaviours — vomiting, laxative misuse and excessive exercise — more prevalent in adolescent female athletes, and self-weighing and overweight preoccupation more prevalent in adult males, underscoring that the behavioural profile differs by age and sex [37]. Because coaches and staff are often the first to witness these patterns, their education is integral, and integrating structured observation with validated questionnaires mitigates the under-reporting that limits any single self-report screen [16,37].

9.5. Heterogeneity and the absence of a standard battery

A pervasive limitation, emphasised by Kontele and Vassilakou and by Kaźmierczyk et al., is methodological heterogeneity: prevalence estimates for DE range from roughly 18% to over 90% in adolescent-athlete studies largely because studies differ in instruments, cut-offs, populations, sexes and sports [4,6]. Hoogenboom et al. confirm that when multiple tools are combined no consistent battery emerges, and that even the choice between a single tool and a combination is unsystematic [16]. Franzoni et al. and Kenđel Jovanović and Čulina add that sex- and age-specific cut-offs are needed but inconsistently applied [8,12]. This heterogeneity means that reported burden is partly an artefact of tool selection, that cross-study synthesis is fragile, and that clinicians lack an agreed standard; establishing a standardised, sex-inclusive, athlete-specific battery validated against clinical interview and physiological endpoints would do more than any single new instrument to improve both research and practice [8,16].

10. From screening to management and prevention

Screening is valuable only when it feeds into structured care. Thein-Nissenbaum and Hammer describe the multidisciplinary team — physician, sports dietitian, psychologist or psychiatrist, gynaecologist or endocrinologist, physiotherapist, athletic trainer, coach and family — with consistent messaging essential to adherence [1]. The cornerstone, as Fidyk et al. and Grabia et al. explain, is reversing problematic LEA by restoring energy availability, typically by increasing intake and reducing expenditure, with menstrual improvement above 30 kcal/kg FFM/day and optimal bone recovery above 45 kcal/kg FFM/day, alongside calcium, vitamin D and iron optimisation [10,19]. Bździuch et al. note that increasing energy intake improves menstrual recovery but with high dropout, underscoring the need for psychological support [11], and Wong et al. and Bielicka et al. recommend transdermal 17β-oestradiol with cyclic progestin over combined oral contraceptives, which mask recovery and do not restore BMD [13,32]. Kovács and Boros illustrate that fragmented care precipitates deterioration, whereas coordinated multidisciplinary care enables recovery [18].

The composition and coordination of the team determine whether a positive screen becomes effective care. Thein-Nissenbaum and Hammer describe how a primary care or sports-medicine physician typically oversees the team and orders investigations; a registered dietitian restores positive energy balance and, as Woźniak et al. and Grabia et al. detail, ensures age-appropriate energy, macronutrient and micronutrient intake, including calcium of approximately 1300 mg/day, vitamin D of about 600 IU/day and adequate iron for female athletes; a psychologist or psychiatrist addresses perfectionism, anxiety and body-image disturbance; a gynaecologist or endocrinologist evaluates menstrual dysfunction; and physiotherapists and athletic trainers manage injury and bone-loading [1,19,33]. Thein-Nissenbaum and Hammer stress that consistent messaging across the team is essential, that care must be individualised given wide intra-individual variability, and that decisions about training restriction and return to play should be risk-stratified — a role formalised in the RED-S CAT2 categories described by Bździuch et al. [1,11]. Kovács and Boros show the consequence of failing this coordination: deterioration followed the interruption of psychological care and poor communication between specialists [18].

Pharmacological intervention is reserved for selected cases and is directly informed by the screening findings. Wong et al. and Bielicka et al. explain that combined oral contraceptives are not recommended, because they induce withdrawal bleeding that masks recovery, give false reassurance and do not restore BMD — an effect attributed to suppression of hepatic IGF-1 through the first-pass effect — whereas transdermal 17β-oestradiol with cyclic progestin improves bone density while preserving IGF-1 and is preferred when hormone therapy is indicated [13,32]. Bździuch et al. note that even with optimal nutritional intervention menstrual recovery may take 6–12 months, and that increasing energy intake improves menstrual recovery but with high dropout, underscoring the need for sustained psychological support [11]. Grabia et al. add that bisphosphonates are generally avoided in young female athletes because of teratogenicity and because the underlying problem is reduced bone formation rather than excess resorption [19]. These treatment nuances are the reason a positive screen should route into specialist, individualised care rather than a generic protocol [13,19].

Prevention closes the loop. Patel et al. advocate early, targeted education for athletes, coaches and support staff and modification of weight-focused practices [41], and Fidyk et al. and Kaźmierczyk et al. describe programmes such as ATHENA, which reduced disordered weight-control behaviours and improved body image in adolescent female athletes, and institutional policies (IOC RED-S framework, collegiate mental-wellness initiatives) that favour supportive over punitive responses [4,10]. Kenđel Jovanović and Čulina describe the European SCAED project, which improves access to knowledge and support for young, unprofessional athletes and their families [12]. Because early recognition predicts better outcomes, embedding validated screening in a supportive, education-oriented culture is the most defensible strategy [12,18].

Institutional policy provides the structure within which screening operates. Kaźmierczyk et al. summarise how the IOC RED-S framework advocates screening, multidisciplinary collaboration and a shift from punitive to supportive responses; how collegiate mental-wellness initiatives promote anonymous self-report screening, clear referral pathways and the avoidance of routine weigh-ins as performance metrics; and how football's medical infrastructure can host ED awareness and nutrition education [4]. Fidyk et al. and Patel et al. describe structured programmes such as ATHENA for adolescent female athletes, which reduced the use of diet pills and appearance- or performance-enhancing substances and improved dietary knowledge and body image, with durable effects observed years later [10,41]. Kenđel Jovanović and Čulina present the European SCAED project, designed to improve access to knowledge and professional support for young, unprofessional athletes, their families and coaches — the very groups that lack the multidisciplinary teams available to elite competitors [12]. These examples show that screening is most effective when embedded in policy and education rather than delivered in isolation [4,10,12].

10.1. Practical recommendations for screening programmes

Drawing the evidence together, the following principles can guide screening of young athletes.

– Screen proactively at annual or pre-participation evaluations, repeating when performance decline, weight loss, menstrual change, mood change or recurrent injury appears, rather than waiting for a stress fracture or amenorrhoea [1,14,41].

– Pair a validated athlete-relevant ED screen (EDSA or BEDA-Q) with a LEA/RED-S tool matched to sex and sport (LEAF-Q for females; LEAM-Q or a sport-specific questionnaire for males and specific disciplines) [16,23,24].

– Do not rely on body mass or BMI; a normal weight does not exclude LEA and muscular athletes are readily misclassified [20,24].

– Advance every positive screen to structured stratification (IOC REDs CAT2 or Triad CRA, with 85% ideal body weight for those under 18) and then to a clinical interview and multidisciplinary evaluation [11,14,16].

– Administer screens anonymously where feasible, complement them with educated behavioural observation, and pair screening with RED-S/Triad education [12,15,16].

– Give particular attention to under-served groups – male, younger, recreational and non-aesthetic-sport athletes – given the absence of validated male-specific ED tools and limited validation of the LEAM-Q [16,23,27].

Return-to-training and return-to-play decisions are the point at which screening, stratification and management converge. Thein-Nissenbaum and Hammer and Bździuch et al. emphasise that these decisions should be risk-stratified rather than based on weight or a single physical criterion, using the RED-S CAT2 categories to determine whether an athlete continues with restrictions, requires modified training, or must be removed from competition [1,11]. Kovács and Boros illustrate the danger of a premature return during recovery, which raised relapse risk, and the value of maintaining continuity of care and clear communication among specialists, family and coach [18]. Because recovery of energy status, menstrual function and bone health proceeds at different, generally slower rates than physical rehabilitation — as Bździuch et al. note, menstrual recovery may take 6–12 months — screening and monitoring should continue well beyond the resolution of the presenting problem, and clearance should reflect physiological and psychological, not only anthropometric, recovery [11,18].

11. Discussion

Three themes define the current state of screening. The first is the tension between familiarity and fit. Hoogenboom et al. show that general-population tools (EAT-26, SCOFF, EDI, EDE-Q) dominate practice because they are familiar and easy to use, yet they were not designed for athletes and may misread sport-normal behaviour, particularly in males [16]; athlete-specific tools such as the EDSA and BEDA-Q perform better where compared but remain under-used [16,24]. The most common current practice — screening athletes with non-athlete tools — is therefore among the least well matched to the population, a mismatch this review argues should be actively corrected [16].

The second theme is the necessity of combination. Ghazzawi et al. and Magee et al. show that symptom-based ED screens and physiological LEA/RED-S tools detect overlapping but non-identical populations — roughly a third of RED-S cases were identified only by combining the BEDA-Q and LEAF-Q — so either tool used alone will miss cases the other would catch [21,24]. Ruscheck et al. extend this to body image, recommending a LEA tool paired with a sex-appropriate body-image instrument [17]. The tiered pathway proposed here operationalises this principle within feasibility constraints [16,23].

The third theme is that screening is triage, not diagnosis. Hoogenboom et al. stress that the clinical interview remains the gold standard and that self-report alone can even invert apparent prevalence between athletes and non-athletes until interview-based assessment reveals the true, higher athlete burden [16]. Positive screens must therefore trigger stratification (CAT2 or Triad CRA) and multidisciplinary evaluation, not automatic labelling; anonymity, behavioural observation and education are needed to counter the under-reporting and low awareness documented by Ghazzawi et al. and Donti et al. [15,21]. The contested specificity but high negative predictive value of the LEAF-Q, noted by Ghazzawi et al., exemplifies the appropriate use of these tools [21].

Two structural gaps qualify all of the above. Hoogenboom et al., Puscheck et al., Bojanowska et al. and Stenqvist et al. together show that the absence of a validated male-specific ED tool, the limited status of the LEAM-Q, and male-typical presentations (muscularity, orthorexia, hypogonadism, impaired bone health) leave male athletes inadequately served [16,23,27,39]. And Syguda et al. show that the unresolved measurement of energy availability means even the best screening-derived prevalence figures are informed estimates [20]. Neither gap undermines the case for screening; both sharpen the requirement that it be multidimensional, sex-inclusive and clinically confirmed [20].

Finally, the enterprise must be understood within sporting culture. Baceviciene et al. and Hoogenboom et al. describe how restrictive eating and heavy training are normalised, so pathology hides in plain sight and disclosure is suppressed [16,37]. The most effective programmes, as Patel et al. and Kenđel Jovanović and Čulina show, combine validated instruments with coach and family education, anonymity and institutional policies that prioritise health over short-term performance [12,41]. Screening is thus the entry point to a coordinated, education-embedded, health-first system, and its value is realised only when its outputs are acted upon [15,18,41].

A further theme concerns the interpretation of prevalence. The figures cited throughout this review — from the 44.7% LEA of the meta-analysis reported by Bździuch et al. and Syguda et al. to the 64.7% Triad risk found by Łuszczki et al. — are screening-derived and, as Syguda et al. stress, rest on the imperfect field measurement of energy availability [11,20,25]. They should therefore be read as informed estimates of risk rather than precise counts of disease, a distinction that matters when screening outputs are communicated to athletes, coaches and administrators. This is not an argument against screening but for humility in its interpretation: a positive screen signals the need for evaluation, not a diagnosis, and the appropriate response is stratification and clinical assessment rather than labelling [20,21].

The convergence and occasional divergence of tools is itself diagnostically informative. Torres Dos Ramos et al. showed that women at clinical ED risk on the FAST were markedly more likely to be at Triad risk on the LEAF-Q, and Puscheck et al. found substantial overlap between EDSA and LEA positivity [22,23]; yet Ghazzawi et al. emphasise that DE and LEA are partially independent, so an athlete positive on one and negative on the other is not a contradiction but a clinically meaningful pattern that a single tool would obscure [21]. This is the deeper rationale for paired screening: the relationship between the behavioural and physiological dimensions of risk is part of the information a programme should capture, not noise to be averaged away [21,22].

Several concrete research tasks would materially improve screening. Ghazzawi et al. and Gimunová et al. note that few studies pair screening with objective physiological confirmation, so the field performance of many tools remains incompletely characterised, and that prospective, longitudinal validation is needed to link screening thresholds to incident menstrual dysfunction, bone stress injury and performance decrement [21,28]. Hoogenboom et al. and Besor et al. call for head-to-head comparisons within the same cohort, benchmarked against clinical interview and objective measures such as DXA and measured energy availability, to define the standardised battery the field lacks [16,26]. Hoogenboom et al., Stenqvist et al. and Bojanowska et al. together identify the validation — and where necessary the redevelopment — of male-relevant instruments, including muscularity- and orthorexia-oriented content, as especially pressing [16,27,39]. Finally, Gimunová et al. and Franzoni et al. argue that screening research should extend beyond elite, female and aesthetic athletes to recreational, non-elite and mixedsex populations, and should evaluate the real-world effectiveness of embedding screening within education and multidisciplinary care rather than assessing instruments in isolation [8,28].

12. Conclusions

Disordered eating, the Female Athlete Triad and RED-S are prevalent, consequential and frequently concealed conditions in young athletes, and their early detection depends on appropriate screening. On the basis of the evidence reviewed, the following principal conclusions are offered.

First, the available instruments fall into complementary families — generic ED screens (EAT-26, SCOFF, EDI, EDE-Q), athlete-specific ED tools (BEDA-Q, EDSA, ATHLETE, PST) and LEA/Triad/RED-S tools (LEAF-Q, LEAM-Q, RED-S CAT/CAT2, Triad CRA, DEAQ) — each with distinct strengths and limitations, and no single instrument is adequate.

Second, because DE and LEA are partially independent, a validated athlete-specific ED screen should be paired with a LEA/RED-S tool; combination detects cases that either alone would miss.

Third, screening is triage, not diagnosis: positive screens must be confirmed by clinical interview within a multidisciplinary team, with anonymity, behavioural observation and education to counter under-reporting and low awareness.

Fourth, a normal body mass does not exclude risk, and male, younger, recreational and non-aesthetic-sport athletes remain under-served, with no validated male-specific ED tool and limited validation of the LEAM-Q.

Fifth, standardising sex-inclusive, athlete-specific instruments and validating them longitudinally against clinical interview and physiological endpoints (DXA, measured energy availability) should be the central task of future research, alongside embedding screening within education and multidisciplinary care.

In sum, the screening of young athletes for disordered eating, the Female Athlete Triad and RED-S should be understood not as a single technical act but as the entry point to a coordinated, education-embedded, health-first system of care. As Thein-Nissenbaum and Hammer and Kaźmierczyk et al. argue, its value is realised only when validated instruments are combined thoughtfully, positive results are confirmed clinically within a multidisciplinary team, and athletes, coaches and families are educated to recognise and disclose the risks the tools address [1,4]. Until sex-inclusive, athlete-specific instruments are standardised and validated longitudinally, clinicians and coaches are best served by treating any single screen as a preliminary flag that calls for further evaluation, not a definitive verdict — a stance that protects young-athlete health without over-medicalising the normal demands of sport [4,12].

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