Running on Empty

The Culture of Eating Disorders among Female Runners

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Abstract

Disordered eating and eating disorders are serious mental conditions that can have significant physiological, psychological, and performance-related consequences, especially among female runners. This population is especially vulnerable to disordered eating and eating disorders due to cultural pressures and expectations within the sport which emphasize thinness and losing weight in order to improve performance. These pressures result in many female runners turning towards disordered eating behaviors to meet their coaches' expectations and improve their times. However, these behaviors can have many negative consequences that affect not just their performance but their overall health as well. In order to combat and prevent this issue, it is important to raise awareness about disordered eating and its consequences among female runners and those who frequently interact with them, such as coaches, athletic trainers, and family. While prevention is preferable, early intervention and treatment are also essential for limiting the damaging effects of disordered eating and promoting a full recovery for female runners.

Introduction

When people name basic human needs, food is typically at the top of the list. Eating is an activity that is necessary for a person's survival. Despite the importance of eating, however, many people participate in unhealthy eating behaviors for a variety of reasons. When these behaviors become severe enough, they can develop into eating disorders. These disorders have many negative effects on a person's physiological and psychological health, and at times they can even be life threatening. Eating disorders, more specifically anorexia nervosa, have the highest mortality rates of any psychiatric disorder: individuals with anorexia nervosa have a mortality rate five times higher than individuals without anorexia nervosa (Van Eeden et al., 2021). While people may initially limit their eating for innocent reasons, or try to limit it minimally, these habits can easily evolve into a clinical eating disorder and can become detrimental to the person's health and livelihood.

Background

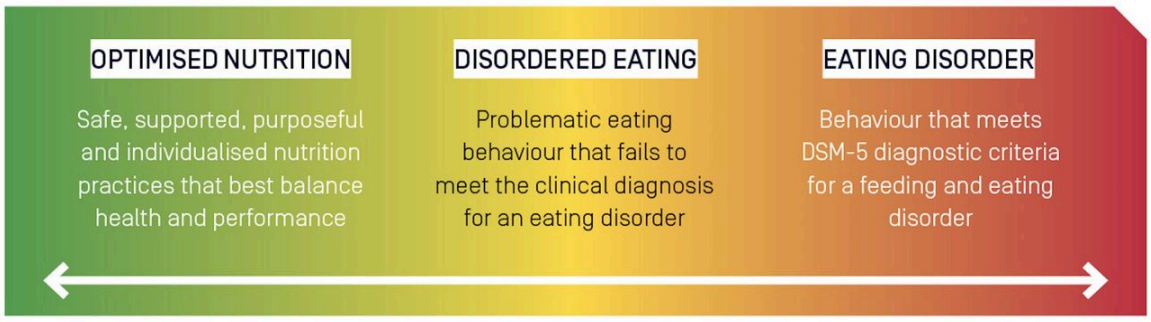
Dr. Faith G. Harper describes normal eating as a "state of mindful consumption where one eats when hungry, enjoys food for pleasure, and incorporates a variety of foods into their diet, excluding only things that they are allergic to or truly don't enjoy" (2023, 39). Beyond what is considered normal eating, disordered eating and eating disorders exist. Disordered eating includes a spectrum of problematic eating behaviors and attitudes towards things such as food, weight, and

appearance. Some common behaviors that can be included in disordered eating are dieting, skipping meals, eliminating or restricting certain foods or food groups, and compensatory behaviors, such as purging or excessive exercise. These behaviors can vary in severity; however, they do not meet the criteria of a diagnosable eating disorder (Dennis, 2025a).

In contrast, eating disorders are complex mental illnesses characterized by disturbances in eating behaviors and impairment in psychological functioning. There are several types of eating disorders, and the diagnostic criteria for each of them is laid out in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) (Dennis, 2025a). Within the DSM-5 category of feeding and eating disorders there are six disorders, but the most commonly discussed are anorexia nervosa and bulimia. Orthorexia is another diagnosis that has become more commonly discussed as well is orthorexia; however, it is not yet formally recognized in the DSM-5 (Dennis, 2025b).

While disordered eating and eating disorders have fairly similar definitions, with both of them revolving around problematic eating behaviors and attitudes, there is a major difference between the two on the diagnosis side. Healthy and unhealthy eating exists on a spectrum, ranging from healthy eating and optimized nutrition, to eating disorders, with disordered eating existing in the middle (see Figure 1).

Figure 1: Spectrum of Eating Behavior



(Wells et al., 2020)

In order for a person with disordered eating to have an eating disorder, they must meet the frequency, duration, and psychological impairment levels necessary in order to be diagnosed with an eating disorder (Dennis, 2025a). Based on the fact that disordered eating does not meet the severity levels of eating disorders, it may seem as though they are not as important or as concerning, but that is not necessarily the case. Disordered eating can still cause many negative health consequences, and it is also a risk factor for the development of eating disorders, and while disordered eating does not always develop into an eating disorder, early intervention with disordered eating is still important in order to diminish the risk of it turning into a diagnosable eating disorder (Bridley & Daffin, 2024).

Among eating disorders, there are two main diagnoses that are primarily discussed. The first is anorexia nervosa, which is known for significant restrictions of energy intake, or calories, and the body weight loss that can occur due to those restrictions. It is also marked by intense fears and anxieties about gaining weight

or becoming fat, even when they are already at a very low weight (Bridley & Daffin, 2024).

The second is bulimia nervosa, which is categorized by recurrent episodes of binge eating, when an individual consumes an amount of food that is significantly more than what most people would eat in a specific amount of time, followed by strategies to compensate for the caloric intake in order to prevent weight gain. The strategies to compensate for the caloric intake are oftentimes purging of the food, such as through vomiting or use of laxatives, or intense exercise (Bridely & Daffin, 2024).

Another eating disorder diagnosis that has become increasingly prevalent in recent years is orthorexia. While orthorexia is not formally recognised in the DSM-5, awareness of it has been on the rise, especially in the past few years. Orthorexia is characterized by an obsession with clean and "healthful" eating and concern about the nutritional quality of food. While concern with the quality and healthiness of food is not an issue by itself, when people with orthorexia become hyper fixated on making sure they are eating "healthy," it can contribute to problems such as malnutrition and impairment of psychosocial functioning (Dennis, 2025.b).

While disordered eating and eating disorders are two distinct conditions, throughout this paper they will be referred to together as disordered eating, since disordered eating encompasses eating disorders as well as eating behaviors that do not meet the diagnostic criteria for clinical eating disorders.

Eating Disorders and Athletes

Eating disorders can occur in any person, with the United States having a lifetime prevalence rate of 9% and a one-year prevalence rate of 1.66% (Deloitte Access Economics, 2020). Compared to the general population, eating disorders are more prevalent among athletes than among non-athletes, with the prevalence of disordered eating and eating disorders ranging from 0-19% in male athletes and 6-45% in female athletes, exhibiting the trend of disordered eating being more common among female athletes than male athletes (Bratland-Sanda & Sundgot-Borgen, 2013).

Beyond being an athlete, depending on the type of sport that the athlete participates in, certain athletes are more likely to have eating disorders than others. 84% of female athletes who screened positive for eating pathology participate in what are considered “lean sports”. Lean sports are sports that emphasize thinness and leanness to either enhance performance or meet aesthetic ideals, and include sports such as gymnastics, ballet, and long-distance running. The expectations and images that are associated with these sports promote a more lean physique, which can then disordered eating behaviors in these athletes for that they can meet those expectations (Mancine et al., 2020).

Looking at running in particular, Skorseth and colleagues (2020) found that among female distance runners with an average age of 17, over 75% exhibited disordered eating behaviors or eating disorders. While adolescents are already at an increased risk of eating disorders, participating in a sport like endurance

running puts them at an even higher risk, and this risk does not go away with age and experience. Berg and colleagues (2022) conducted a study among female runners competing in the 2020 US Olympic Marathon Trials, and they found that 32% reported previous EDs and 6% reported current EDs. These athletes are among some of the most elite runners in the world, and a significant amount of them had experience with eating disorders. No matter what level of competition, eating disorders are a common occurrence among female runners, especially endurance runners.

Female Athlete Triad and RED-S

In reaction to the increase in eating disorders and disordered eating among female athletes, in 1992 the American College of Sports Medicine coined the term "female athlete triad" (also known as "the triad") to describe the relationship of menstrual dysfunction, low energy availability, and decreased bone mineral density (BMD), that had become increasingly common in female athletes. The prevalence of these issues among female athletes is incredibly high when compared to the prevalence among the general population. For example, the rate of secondary amenorrhea, which is defined as the absence of menses for three or more consecutive months and is a major sign of menstrual dysfunction, can be as high as 69% among women in lean sports when that rate is about 2% to 5% in the general population (Kelly & Hecht, 2016; Nazem & Ackerman, 2012). Low BMD is also much more common among female athletes, with osteopenia rates ranging

from 22% to 50%, compared to the general population's rate of 12%, and osteoporosis, a more severe form of osteopenia, among female athletes occurring at a rate as high as 13% compared to 2.3% in the general population (Nazem & Ackerman, 2012).

While menstrual dysfunction and BMD can be relatively easy to measure, the third component of the triad, energy availability, can be much more difficult to ascertain. Energy availability (EA) refers to the amount of dietary energy for all physiologic functions after accounting for energy expenditure from exercise (Nazem & Ackerman, 2012). Low EA occurs when a person's energy intake (EI) is not sufficient to account for their exercise load. This causes the body systems to make adjustments to reduce its energy expenditure, which then leads to disruptions in a variety of the body's functions, most notably menstrual function and bone health (Mountjoy et. al., 2014). While low EA is a common symptom of eating disorders and disordered eating, those are not the only causes. Many athletes can contribute to low EA by unknowingly failing to meet their energy requirements due to time constraints or lack of nutritional knowledge (Nazem & Ackerman, 2012). This can occur by athletes not eating soon enough after practices and workouts because they are either not hungry, or because they do not have time to eat before going to class or work, as can be the case for many student athletes. Additionally, athletes may not have enough knowledge about the type of food they should eat after exercising, such as what kind of macronutrients (protein,

carbohydrates, and fat) to consume and how much is best for them to eat after different types of exercise.

For decades, the female athlete triad was the dominant model used for studying and researching eating disorders among female athletes; however, in 2014, the International Olympic Committee (IOC) introduced the term "Relative Energy Deficiency in Sport" (RED-S) as a more inclusive and complex model for understanding eating disorders and low EA in both female and male athletes. RED-S goes beyond the three components of the triad by examining impaired physiological functioning in the areas of metabolic rate, menstrual function, bone health, immunity, protein synthesis, cardiovascular health, and more, caused by relative energy deficiency (Mountjoy et. al., 2014).

In contrast to the female athlete triad, which only examined the three aspects of menstrual dysfunction, energy availability, and bone health, RED-S connects these issues to many different aspects of physiological functioning, health, and athletic performance that can be affected by energy deficiency. This model of understanding eating disorders and energy deficiency also acknowledges that these issues can occur among male athletes as well, opening up the way for more research on this issue as it regards to male athletes, instead of solely focusing on female athletes, as the female athlete triad did (Mountjoy et al., 2014).

While the female athlete triad was the accepted model regarding this issue for decades, RED-S is now replacing it in the literature and research looking at energy deficiency and eating disorders among athletes (Mountjoy et al., 2014).

With its inclusion of male athletes in its discussion, and its expanded scope to now include additional physiological functions, RED-S more holistically examines this issue, making it the preferred model for examining energy deficiency in athletes. Much of the research that is now being done on eating disorders in female athletes is now using the model of RED-S.

Factors Associated with Eating Disorders in Female Runners

The reasons why female athletes, and female runners in particular, turn to eating disorders and disordered eating behaviors at such a high rate is due to many factors, but the majority of these factors revolve around unhealthy views on food and weight within the culture of the running community. Studies show an association made by people within the running community that being a lower weight and thinner leads to having faster times and better performances, which is often achieved by eating less, following restrictive diets, or over training. This idea has caused many female runners to continuously lose weight in order to get faster times, many times at a detriment to their health and their performance in the long term (Mancine et al., 2020; de Borja et al., 2021, Sims et al., 2023).

Sports Environment and Coaching Influences

Title IX, enacted in 1972, created a world where women and girls were finally able to participate in sports at the same level as men, and it opened up new opportunities for girls. Prior to Title IX, however, men were the primary voices in

sports, which created a sporting environment designed by men for men. Women and girls have been forced to step into this model that did not account for them at all. Even 50 years after the enactment of Title IX, women face inequality in sports, which can be most obviously seen in media coverage. Women's sports do not receive as much media coverage as men's sports, and when they do get coverage, female athletes then have to face the sexualization and body attention that tends to come with that media coverage (Scheadler & Wagstaff, 2018). In addition to these obvious inequalities female athletes face, there are some inequalities that are more subtle, such as the lack of consideration for female development and physiology. Girls do not develop at the same rate or on the same timeline as boys, and forcing them to fit on that timeline will result in them either failing to keep up or be as successful, or taking steps that put their bodies and their health on the line (Crouse & Stockton, 2019).

In her book *Good for a Girl* (2023), former pro athlete Lauren Fleshman discusses how, oftentimes, girls experience a performance plateau, or even a performance dip as they go through puberty and continue to develop and enter adulthood. Boys, on the other hand, typically do not face the same plateau or dip in performance; instead, their performance tends to improve when they begin puberty, causing a sex divergence in athletic performance. During puberty, boys and girls go through many biological and physiological changes including changes in body composition, with females having more fat mass and males having more fat-free mass, changes in hormones, most notably a large increase in testosterone

levels for boys (Hunter et al., 2023). Both of these developmental changes play a large role in the differences in performance that can be seen after children have gone through puberty. Despite the major role that hormone changes play in the sex differences in performance, along with many other developmental changes, the increase in fat mass, and the increase in weight that comes with it, among girls can sometimes become the main source of blame for the performance plateau or dip that happens during this time. This then results in many girls eating less, over training, and losing weight in order to prevent these changes as much as possible, without realizing the detrimental effects that can have (Fleshman, 2023). Growing and developing into their adult bodies is seen as a threat to performance for many girls, which can result in them eating less or over training to combat that weight gain and the performance plateau.

Fleshman (2023) also discusses the idea of "race weight," or an ideal weight you should be at in order to optimize your training and racing so that you get the best time possible, which comes from the belief that weighing less will result in faster times and better performance. The idea of race weight leads to runners trying to lose weight in order to get a certain time or a certain result, then if they do not get that result at their original "race weight," that goal weight changes, and the cycle continues. Even very successful runners have fallen into the trap of striving for a certain race weight. Fleshman for example, after winning a huge international race and being in potentially the best shape of her life, limited herself on what she ate because she was not at her "race weight" yet (Fleshman,

2023). Despite winning a very important race, the sense of accomplishment that came with it was forgotten because of Fleshman's intense preoccupation with what she believed her race weight was supposed to be.

This is also closely related to the idea that runners, especially female runners, must have a certain body type or look a certain way. Running is a sport that is literally about comparing oneself to others, and while that comparison is supposed to be made through times, those comparisons can easily go beyond being about times to being about bodies. Many female runners, especially the professional ones that get the most endorsements and screen time, are very thin and fit into Western beauty standards. Additionally, when female athletes do get media coverage and endorsements, the focus is often on their appearance and not on their abilities (Scheadler & Wagstaff, 2018). Western culture and beauty ideals already make comparisons between women and others an easy habit to fall into, but adding a sport that is all about comparing one athlete to another, with many athletes that fit a fairly specific body type, the urge that female athletes experience to compare themselves to others can become so much worse. If a female runner sees a runner who is faster than her who also happens to be thinner than her, there is an added pressure to fit that body type and that weight. Due to the association between lower weight and faster times that was previously mentioned and the direct comparisons that athletes can make between themselves and their competitors through their times, female runners often feel as though they need to

become thinner or weigh less in order to get the same times as their thinner competitors (Beckner & Record, 2016).

The tight minimalist uniforms for women runners can contribute heavily to this issue as well. Female runners are encouraged to wear “bun huggers”, which are briefs that fit like bathing suit bottoms, or spandex shorts and tight fitting singlets. In a study about female volleyball players and their thoughts on their uniforms, which also consists of tight tops and spandex shirts, Steinfeldt and colleagues (2012) found that these players were concerned about societal expectations about what their body should look like. This concern caused discomfort in many of the players due to anxieties about how their bodies looked in the spandex uniforms. In both volleyball and running uniforms, athletes are not able to hide much about their body, and when everyone around them is wearing the same uniforms as well it becomes easy to look at their bodies and compare them to yours and find flaws in your own, causing many athletes to feel uncomfortable and self-conscious (Lauer et al., 2018). Constantly seeing how their body compares to those around them, and not being able to hide any insecurity they may have can lead to body dissatisfaction among female runners, which can then lead to the desire to lose weight or change how your body looks, which is often done through eating disorders and disordered eating.

Another major problem within the running community that has contributed to the high prevalence of eating disorders among female runners is issues with coaching styles of many coaches, especially older male coaches. There are many

coaches who place a large emphasis on decreasing body weight and dieting. Sometimes coaches will routinely assess their athletes' body fat, weigh them, and give weight loss suggestions to them, which can cause athletes to have distorted body images and unhealthy eating habits (Beckner & Record, 2016; Wasserfurth et al., 2020).

One major example of the impact of negative coaching styles is Alberto Salazar who was the coach of Nike Oregon Project and now has a lifetime ban from the sport for doping and sexual assault allegations. In addition to these allegations, multiple female athletes who have trained under Salazar have told stories about how he forced athletes to be weighed in front of one another, which created a culture of shame surrounding weight and made many terrible comments to female athletes about their weights and bodies after they were not performing well (Crouse & Stockton, 2019). Comments like these make female athletes feel insecure about their bodies and pressure to lose weight in order to meet the expectations of their coaches.

One athlete of Salazar's who has spoken out about the abuse she faced from Salazar is Mary Cain. Cain was the youngest American track and field athlete to make the World Championship team ever in 2013, at just age 17. That same year she signed with Nike Oregon Project, with Salazar as her coach. Under Salazar's coaching, Cain was forced on a diet to the point where she broke five bones, lost her period for three years, and developed suicidal thoughts, all of which is incredibly unhealthy and dangerous for a woman who has gone through puberty

(Crouse & Stockton, 2019). Fleshman also described how she witnessed Salazar's treatment of Cain after a race where Cain finished eleventh. Salazar “lit into her for her poor performance, blaming her weight,” a moment that Cain described later as one of the worst moments of her life and one that made her consider committing suicide and drove her to cutting herself (Fleshman, 2023, p. 252).

While Salazar’s treatment of Cain may seem very extreme, he is certainly not the only coach who has spoken to their female athletes that way and driven them to such dark places. The Nike Oregon Project was one of the best track teams in the world with Alberto Salazar as one of the most famous coaches in the world, and he got away with emotional and physical abuse of female athletes until the past few years, when these athletes started to speak out against him. If Salazar, one of the most prominent coaches in the track and field world was able to get away with this mistreatment for years, then less prominent coaches are likely able to get away with the same mistreatment of female athletes. While Salazar has received a lifetime ban from coaching, not all coaches who treat their athletes this way face the same consequences, due to athletes fears about speaking out against them, which allows these coaching styles to continue to occur.

Barriers to Eating Well

Another reason for developing eating disorders and disordered eating behaviors that is often not discussed is knowledge, or lack thereof, about eating. Sometimes eating disorders or unhealthy eating behaviors can develop and occur unknowingly

because of the individual's time constraints or a lack of nutritional knowledge (Cabre et al., 2022; Wasserfurth et al., 2020). Lack of knowledge around what to eat and how much can cause some athletes to struggle with eating and feeding themselves in a healthy manner, since they may not be aware of what the most important things to eat after exercising are.

Additionally, being an athlete is a very big time commitment. Especially at the collegiate level, many student athletes have intense time commitments, which can make cooking and eating healthy meals that meet the nutritional needs of an athlete very difficult. In the sport of running, eating and getting calories soon after you have completed a workout or run is crucial, but if you have class or work right after practice, which is the case for many student-athletes, you might not have time to eat as much as you should (Wasserfurth et al., 2020). This lack of sufficient time to eat consistently can cause low energy availability and other fueling concerns that are very important for athletes, especially those in endurance sports such as distance running.

Psychological Factors

In addition to these external factors, the psychological factors that influence female runners and cause them to turn to eating disorders are also important to consider. Many high level runners have identities that are centered around their sport. Running can easily become the most important aspect of their personalities and their lives, so when running is not going well they will often do whatever is

needed for them to be as successful and as fast as they were previously (Beckner & Record, 2016) . This centralization of running in the athlete's life causes them to take extreme action and turn to these diets and extreme training regimens that result in eating disorders and other disordered eating behaviors.

When an athlete develops an eating disorder, it can easily become one of the most important things in their life and control everything they do. One example of this is Kim Mortensen. In the summer of 1995, before her senior year of high school, she decided to cut fatty foods out of her diet and she increased the intensity of her training. Mortensen said that she wanted a senior season she could be proud of and she believed that cutting out these foods and increasing training would get her there. However, her diet progressively got more strict, with her eventually cutting out foods like candy, fruit juices, granola bars, and even nuts. During this time her daily caloric intake was between 800 and 1500 which is not enough for runners (Ortega, 1998).

Mortensen said "it was all about control. I felt if I could be disciplined in all aspects of my life, I could be disciplined on the track. And no matter what happened, I could withstand any amount of pain out there." That control led to her going from 115 pounds her junior year to only 95 pounds as a senior. And in the short term the diet and weight loss seemed to pay off. Mortensen won the national high school cross country title in December 1995, and she set the national high school record for the 3200m in May 1996. While she did have a senior year to be proud of, like she had wanted, it came at the cost of getting a stress fracture in her

lower back in the middle of her freshman year of college while running for UCLA. This injury forced her to sit out of track in the spring and to finally confront her anorexia after months of friends and family expressing concern for her weight loss (Ortega, 1998). While her diet and eating restrictions did have their intended effect at first, they eventually caused her more harm than good and gave her an injury that caused the end of her career. What began as a simple diet of just cutting out fatty foods turned into a full blown eating disorder that she could not escape. It took over her entire life.

Consequences of Eating Disorders for Female Runners

Female runners turn to eating disorders and disordered eating for many of the reasons stated previously, but the basis for many of those reasons is a desire to be able to run faster. While these actions may help them achieve this goal in the short-term, there are many consequences that can happen as a result of not eating enough to account for the nutritional needs of the exercise these athletes are doing. Over a longer period of time, these consequences can add up and have a huge negative effect not only on the person's running and performance, but on their health as a whole.

Physiological

Some of the most obvious consequences that can be seen in female runners with an eating disorder are the effects that are described in the female athlete triad.

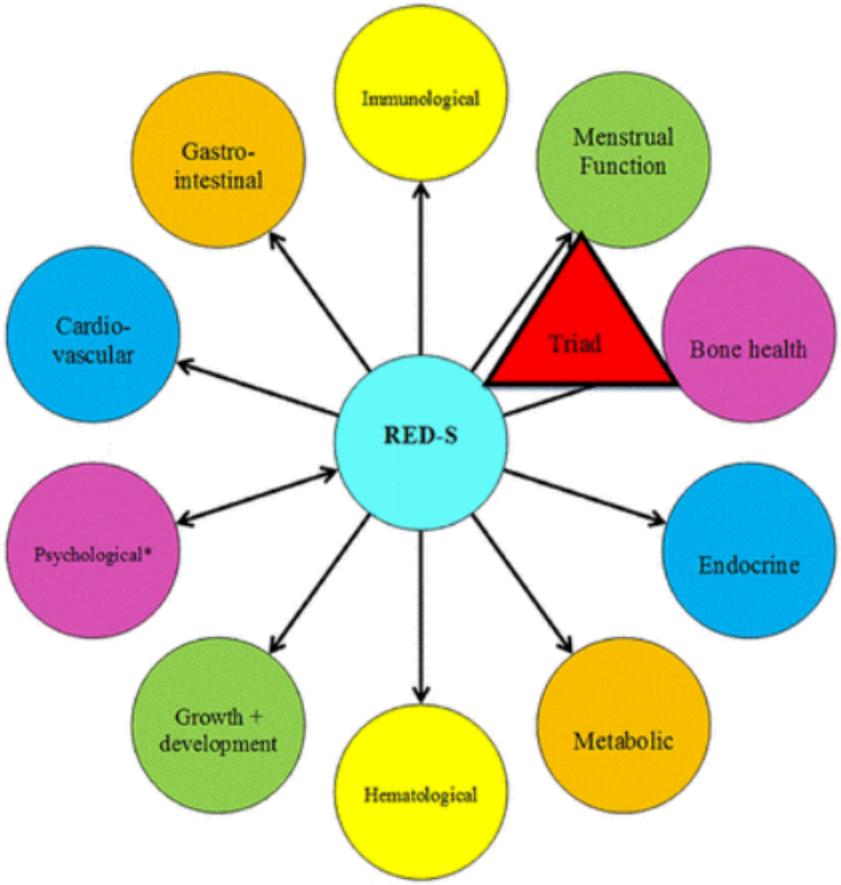
While the female athlete triad is not the current model that is used for understanding and looking at disordered eating among athletes, the main components of the triad are still some of the most obvious and discussed consequences that occur as a result of it. Menstrual dysfunction and disturbances are one that can be especially common among female runners, especially distance runners. The two main forms of menstrual dysfunction are primary amenorrhea, which is the absence of menarche by 15 years, and secondary amenorrhea, which is the absence of menses for 3 consecutive months (Nazem & Ackerman, 2012; Kelly & Hecht, 2016). Studies have found that the rate of menstrual irregularities in adolescent athletes ranged from 12% to 54%, with the rate of primary amenorrhea being between 1.2% and 6%, and secondary amenorrhea between 5.3% and 30% (Kelly & Hecht, 2016). Other studies have found rates much higher than that in female distance runners with one study that looked at female endurance runners found that 51% experienced menstrual abnormalities (Cabre et al., 2022), while others have reported rates as high as 65% (Mountjoy et al., 2014).

Because of the inconvenience that is caused by menses, such as cramps and weight fluctuations, many female athletes tend to see losing their period as a positive thing; however, prolonged amenorrhea can have many consequences, especially in relation to another aspect of the female athlete triad, bone mineral density. Female athletes with prolonged amenorrhea or low EA, especially during adolescents, tend to have significantly lower BMD and may struggle to achieve age appropriate BMD in adulthood, with up to 90% of peak bone mass being

attained by age 18 (Armento et al., 2023) , and can be as much as 3 times more likely to experience bone stress injuries and other musculoskeletal injuries than athletes with regular and healthy menses (Kelly & Hecht, 2016). Adolescents and young adulthood are critical periods for attaining and growing bone mass. Disturbances to BMD growth during these years can put an athlete at an increased risk of osteoporosis in adulthood (Kelly & Hecht, 2016). Duckham and colleagues (2012) found that 27% of female athletes had a history of stress fractures, which often result from low BMD, reflecting the high rate of bone stress injury that can result throughout a female athlete's career. The high rate of menstrual dysfunction in female runners puts these athletes at an increased risk of bone stress injuries and other similar injuries, which is especially problematic for a sport where athletes are exercising for prolonged periods of time and are experiencing consistent impact, with their steps hitting the ground, causing injuries like stress fractures and stress reactions to be fairly common among these athletes (Duckham et al., 2012).

Beyond the consequences that are found in the female athlete triad, RED-S also focuses on an array of consequences that can affect just about all aspects of human health. Figure 2 shows all of the different aspects of health that can be affected by RED-S and the disordered eating that precedes it.

Figure 2: Health Consequences of RED-S



(Mountjoy et al., 2014)

The impact on these body systems can have both short-term and long-term consequences on the health and performance of the physiological functioning of them. Long-term low EA can cause athletes to develop nutrient deficiencies, most notably anemia, along with chronic fatigue and an increased risk of infections and illnesses. In addition to these effects, prolonged low energy-availability also has negative impacts on the areas of cardiovascular, immunological, gastrointestinal, endocrine, skeletal, renal, and central nervous system functioning (Mountjoy et al., 2014). Negative impacts on these areas of physiological functioning can be very

harmful not just to the athlete's overall health but also to their performance, the thing they are trying to improve with eating disorders and disordered eating.

Performance

Because of the physiological consequences that can occur as a result of disordered eating, there are many performance consequences that can arise as a result of disordered eating. Negative impacts to any of the physiological functions that can be affected by disordered eating and RED-S can have an overall negative effect on the athlete's health in general, which then affects their ability to train and compete well. Low EA can also have a profound effect on a runner's ability to recover from their workouts and races (Mountjoy et al., 2023). Getting good nutrition after working out or competing is a very important aspect of recovery. When a female runner does not eat enough after working out or racing, her recovery is compromised, which makes performing as well during following practices and races more difficult.

In addition to poor performance as a result of low EA and compromised recovery, female runners with eating disorders and disordered eating are also more likely to experience injuries. As previously mentioned, female runners with low EA are more likely to have lower bone mineral density, which increases their risk of developing an injury. Bone stress injuries can be fairly common among athletes with low BMD, causing many female runners' performance to deteriorate, or even

preventing some from being able to run at all depending on the severity of the injury (Kelly & Hecht, 2016; Duckham et al., 2012).

Beyond worsened performance and injury, at times, female runners even have to drop out of or quit the sport because of their injuries or other negative health impacts they have as a result of eating disorders. When an injury or negative health outcomes are severe enough, some athletes are forced to "injure out" of their sport and quit because of the injury. Even if the injury is not severe enough for the runner to be forced to quit, their injury can still prevent them from being able to participate in practices or competition as was the case with Kim Mortensen (Ortega 1998). When an athlete is injured and not able to participate in practices or competition, they are not able to spend as much time with their teammates, whether that be running with them at practice or traveling with them for meets. These injured athletes are forced to observe from the sidelines, not participating as much as they would like to. When athletes are injured, they often do not receive as much attention from their coaches and are met with indifference, causing athletes to feel as though they are not supported by their coaching staff during a time when they need that support. This can also significantly contribute to female runners who are injured wanting to quit the sport (Crane & Temple, 2015).

Psychological

In addition to these physiological and performance consequences of disordered eating, there are also many psychological consequences that can occur as a result.

Research has found that athletes with low EA experience a 2.4 times increased likelihood of having psychological problems like irritability, depression, impaired judgement, and decreased coordination and concentration (Cabre et al., 2022). These psychological impacts can either be a cause of the low EA and disordered eating, or they can occur as a result of them. Oftentimes there is some level of psychological problems the individual is experiencing before the disordered eating and low EA occur, and they become worse as the low EA and its consequences occur and become more prominent (Mountjoy et al., 2014).

Whether an athlete is forced to quit or is not able to participate in practices or competitions as much, this separation from the team can create feelings of isolation and loneliness in the injured athletes. Traveling with the team to meets and competitions is a very big part of the student athlete experience and where a lot of bonding between teammates occurs. When an athlete is not able to travel to these meets because of their injury, they miss out on those important team bonding opportunities and can feel detached from their team. Similarly, in a sport like distance running, where teammates are spending a lot of time together during their runs and practices, not being able to participate in those runs or practices further isolates and detaches an injured athlete from their teammates. These feelings of isolation and loneliness can create many other mental health and psychological issues for these athletes, such as feelings of depression and anxiety (Putukian, 2016).

In addition to these feelings of loneliness, many female runners who deal with the side effects of eating disorders on their running may experience intense struggles with their self-esteem and their identity. For many female runners, especially those who are competing at a higher level or are very competitive at the sport, much of their identity is centered around them being a runner and their performance in the sport. If their performance declines or if they are not able to compete because of injuries, they lose that portion of their life that is so integral to how they view themselves. Losing that aspect of their identity can cause these runners to experience distress and other mental health issues (Putukian, 2016).

These consequences can have a severe negative effect on the athlete's mental health and their confidence in themselves. This lack of confidence and other mental health issues can then cause these runners to become more desperate to go back to the level they were running at previously, which can then cause them to turn to further unhealthy habits and worsened eating disorders, creating a negative cycle with disordered eating.

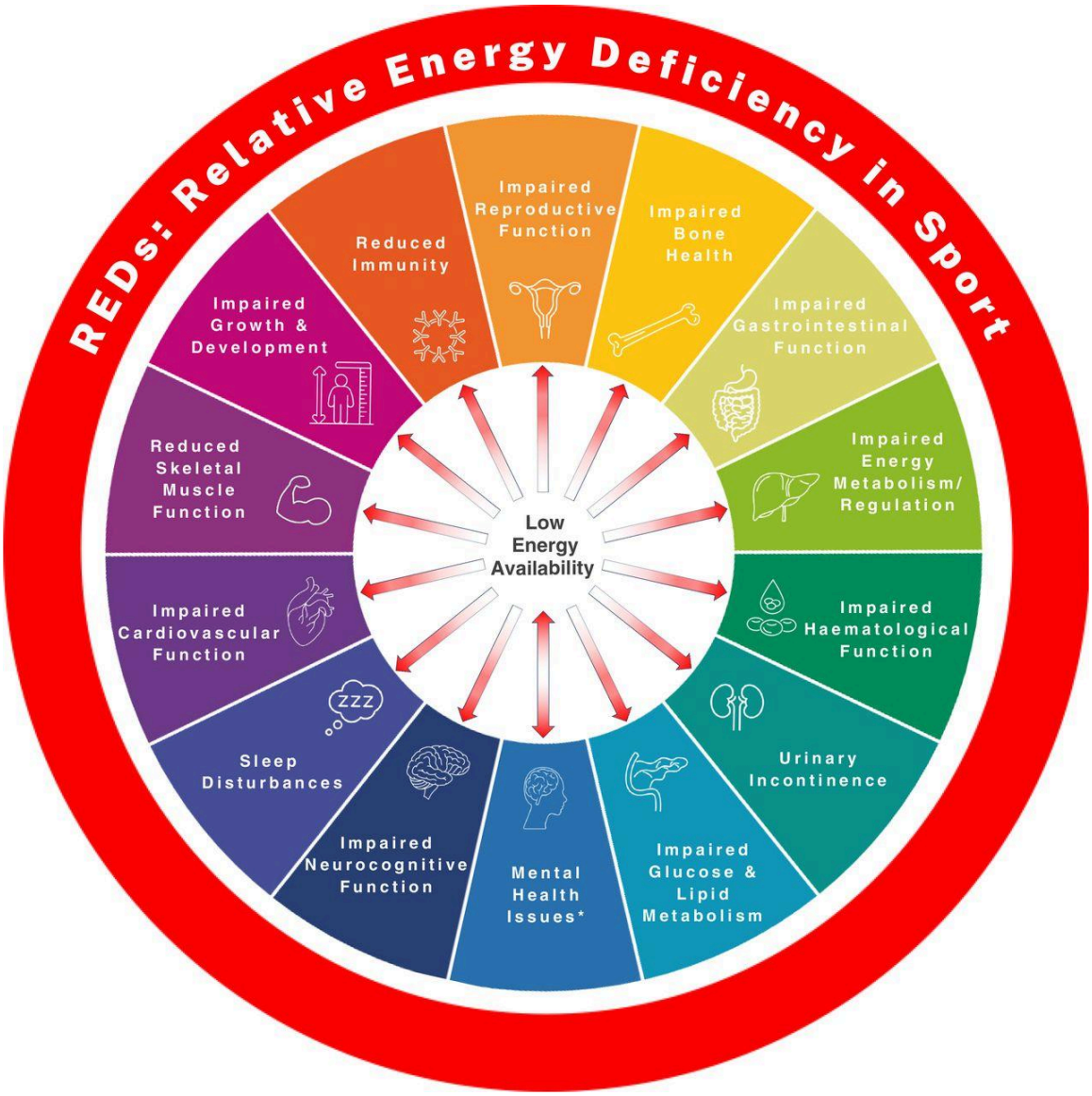
Models and Assessment Tools

As the main model for discussing disordered eating and low energy availability among athletes, RED-S and its diagnosis tools are the primary mechanisms that are used when discussing this issue and informing future research on it. Since the IOC's transition from the female athlete triad to RED-S in 2014, there have been dozens of studies and articles written on the syndrome, furthering the knowledge

on this syndrome and how to best diagnose and treat it. In their 2023 consensus statement on RED-S, the IOC describes models and assessment tools they created to increase awareness of and diagnose RED-S, along with recommended prevention and treatment principles (Mountjoy et al., 2023). These tools can be used to aid in the diagnosis of RED-S among female runners who are experiencing disordered eating and low EA and aid in recommending treatment that will be most effective and beneficial for them.

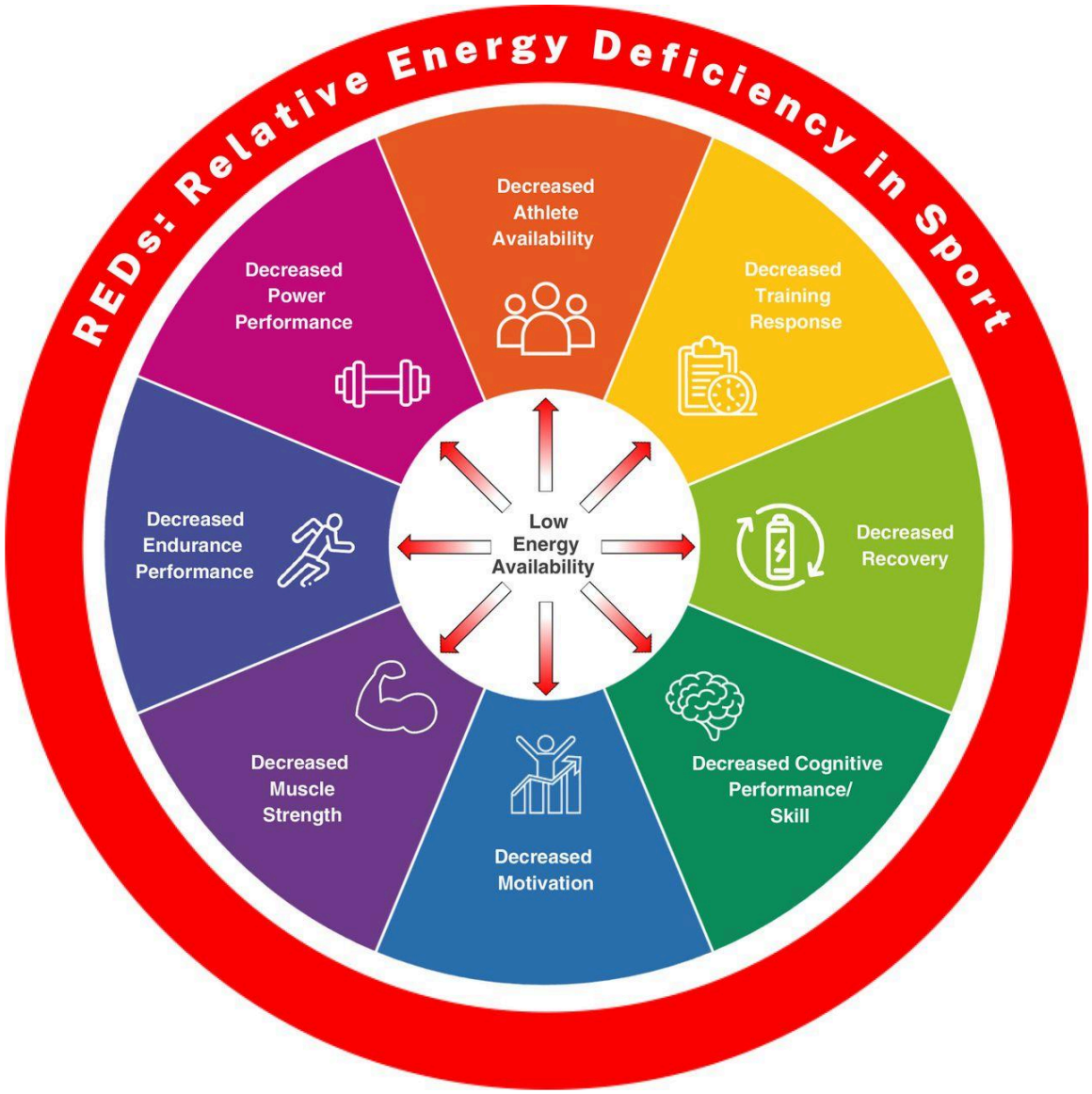
The first two models the IOC introduced in regards to RED-S are the REDs Health Model and REDs Performance Model. These models were created with the intention of raising awareness of RED-S among athletic, coach, sports science, and sports medicine communities by demonstrating the range of body systems that can be impaired by RED-S. The REDs Health Model (see Figure 3) shows the different body systems that can be impaired by low EA, while the REDs Performance Model (see Figure 4) shows the different impairments that directly affect an athlete's performance, such as decreased training response, decreased motivation, and decreased recovery (Mountjoy et al., 2023).

Figure 3: RED-S Health Conceptual Model



(Mountjoy et al., 2023)

Figure 4: RED-S Performance Conceptual Model



(Mountjoy et al., 2023)

The next model the IOC introduced in their 2023 consensus statement was the REDs Physiological Model. Ideally, with more research physiological models will be developed for each of the body systems within the REDs Health Model, but the current physiological model can be used for any of the body systems. This model explains the biological complexity and interaction between various body

systems, along with the signs and symptoms of RED-S that result from low EA (Mountjoy et al., 2023). The first step when using this model is to identify the range of specific health and performance that might occur as a result of low EA. The second step is to focus on the characteristics of an athlete's low EA exposure that could create a higher risk of it being problematic. These characteristics include severity, duration, consistency, origin, within day energy balance, and accumulated dose. The third step is considering moderating factors (see Figure 5) that could either amplify or protect against low EA health or performance impairments. The final step is to identify how the moderating factors are associated with and impact the performance and health outcomes that were previously identified (Mountjoy et al., 2023). This model demonstrates the complexities that go into the interaction between low EA and moderating factors and how those can impact both health and performance outcomes.

Figure 5: Moderating Factors of Low Energy Availability

Moderating factors

Categories	Potential moderating factors
Personal characteristics	Sex
	Age/gynaecological age
	Genetics/epigenetics
	Anatomical/ biomechanical features
Medical history	Co-existing medical disorders
	Medication use
	Past medical history
	Menstrual disturbances/low oestrogen (female)
	Low testosterone (male)
	PCOS/high androgen (female)
Training characteristics	Low impact exercise
	High impact exercise
	Training errors
	Resistance training
Dietary/ nutritional characteristics	Energy intake
	Carbohydrate availability
	Protein intake
	Vitamin D status
	Bioavailable iron intake
	Calcium intake
	Energy density
	Intake of caffeine and other stimulants
Other	Psychological/lifestyle stress
	Environmental stress

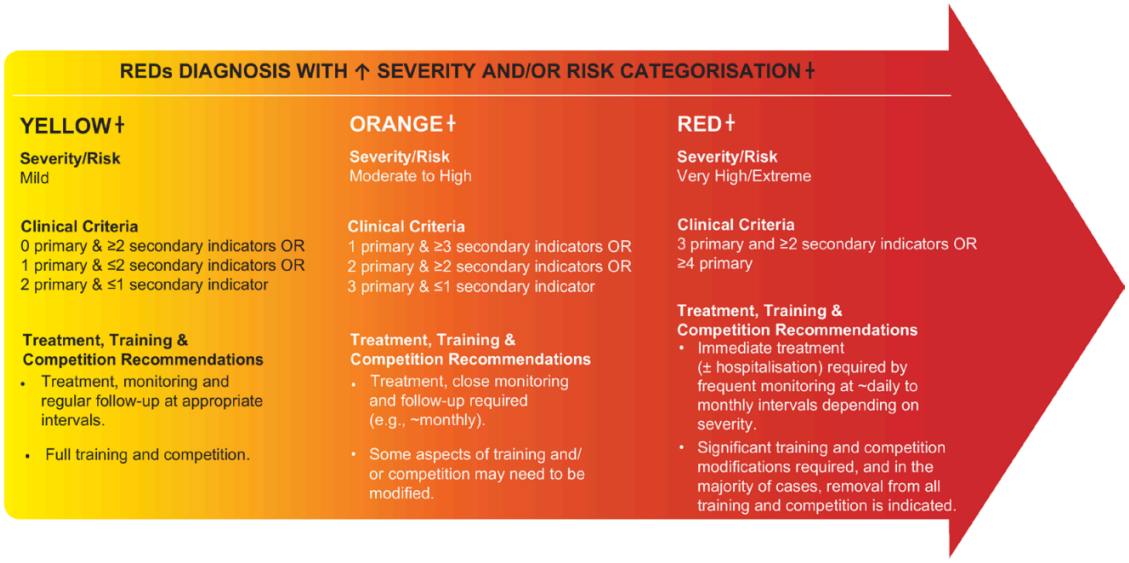
(Burke et al., 2024)

Following their original consensus statement about REDs, the IOC released the REDs Clinical Assessment Tool in 2015. Since its publication, there has been significant scientific research and progress about RED-S, causing the IOC to now use their REDs Clinical Assessment Tool-Version 2 (IOC REDs CAT2). The IOC REDs CAT2 is used to help with detection and clinical diagnosis of RED-S based on severity and risk stratification, using clinical assessment of disordered eating/eating disorder screening and susceptibility, body weight fluctuations, EA assessment through clinical interviews, menstrual history, and bone mineral

density (Matkin-Hussey et al., 2024). It follows a three step process, which begins with RED-S screening using population specific validated RED-S Screening Questionnaire(s) and/or clinical interviews. The second step is to assess the severity and risk of RED-S using the IOC REDs CAT2 Severity/Risk Assessment and Stratification with Sport Participating Guidelines, which are based on the of primary and secondary risk indicators, such as BMD and injury history, which then results in the stratification of the athlete's severity into one of four categories. The final step is an expert physician diagnosis which includes a treatment plan. (Stellingwerff et al., 2023).

During step 2 of the IOC REDs CAT2, athletes are placed into one of four categories in a traffic-light severity/risk categorisation system (see Figure 6). This system ranges from green, little to very low risk; yellow, mild risk; orange, moderate to high risk; and red, very high/extreme risk. Each of these colors is associated with appropriate clinical criteria, which are based on the number of primary and secondary indicators the athlete is exhibiting. Each category also provides recommendations regarding treatment, training, and competition (Stellingwerff et al., 2023).

Figure 6: IOC REDs CAT2 Severity/Risk Stratification



(Stellingwerff et al., 2023)

While the IOC REDs CAT2 provides a scientific framework and scoring system for the diagnosis of RED-S, there is no singular validated diagnosis method for RED-S due to the complexities associated with the syndrome and all of the components that go into it (Mountjoy et al., 2023). However, given the current knowledge about RED-S, the current model is an effective method for diagnosing RED-S and informing the direction that treatment should follow for athletes dealing with RED-S.

Recommendations

Prevention

When responding to disordered eating in female runners, prevention of disordered eating is far easier and more beneficial than treating the disorder once it has begun.

Preventing these habits from developing and preventing the consequences of them from occurring is the most beneficial thing that can be done for the female runner's health, especially long term.

In their consensus statement about RED-S, the IOC lists three different levels of interventions for RED-S, with the first two focusing on prevention and the third focusing on treatment. The primary prevention they discuss revolves around tackling inadequate knowledge and awareness of the health and performance consequences of RED-S and nutrition among athletes and those in the sports environment, such as coaches, parents, and athletic trainers (Mountjoy et al., 2023). Improving not just athletes' knowledge about RED-S and nutrition, but also the knowledge of those around them and in the sports environment with them, will help everyone around them recognize when the athlete is falling into these unhealthy habits in order to prevent these habits from developing further (Kroshus et al., 2018; Wells et al., 2020).

Educating female runners about disordered eating and its consequences is also important to preventing them from developing disordered eating habits because it warns them about what could happen if they were to develop those habits. Many female runners develop these habits because they want to run faster and improve their performance. However, if they were more aware of the consequences of these habits and how they can lead to injuries, compromised recovery, and other health issues that can negatively impact their performance in a huge way, many likely would not want to take this risk. Knowing that it could

have the opposite effect of what they are wanting would likely prevent many female runners from wanting to turn to these habits (Arthur-Cameselle & Quatromoni, 2014).

Beyond improving education and awareness about disordered eating, its consequences, and RED-S, changing the culture around eating and weight in the running community is an important aspect of preventing female runners from developing disordered eating. In her book, Lauren Fleshman (2023) describes various aspects of running culture that could be changed or worked on to improve the community's attitudes towards eating and weight.

Fleshman argues that one major cultural shift in the running community that would help prevent female runners from developing disordered eating habits is if the adults around them, especially their parents and their coaches, were to address and deal with their own issues around eating and weight so that they do not pass those same issues onto their children or athletes. Parents play a critical role in the development of their children's eating habits, with evidence suggesting that children are influenced by both the intentional and unintentional modelling of their parents. For example, mothers with higher eating psychopathology reported higher levels of unintentional modelling, indicating that their child is picking up on their unhealthy eating behaviors and copying them (Palfreyman et al., 2013). When these runners see unhealthy eating habits and disordered eating modelled in their parents they are more likely to follow those same habits and see them as acceptable. Similarly, when parents or coaches are talking negatively about eating

or weight then these athletes are likely to internalize these beliefs and ideas, which can then fuel their disordered eating habits (Beckner & Record, 2016). Addressing these attitudes among parents and coaches, who are typically the most influential adults for female runners, will prevent them from spreading these attitudes onto these runners, which will then prevent the unhealthy eating patterns that can come with these beliefs (Fleshman, 2023).

Another important factor that can help prevent female runners from developing disordered eating habits is for coaches to change their approaches and attitudes towards eating and weight to something that promotes healthy eating habits and weight goals among their athletes. One suggestion that Fleshman gives to do this is to create a formal certification that is required in order to work with female athletes. This certification would require education on things like female physiology, puberty, breast development, menstrual health, and the performance wave that many female athletes go through. Many distance coaches, 80% of whom are male, report that they do feel ill-equipped to discuss issues like periods and puberty with their athletes, and a program like this which discusses these issues would help with that (Fleshman, 2023). Wells and colleagues (2020) also discuss a comprehensive education program that addresses disordered eating and related elements, such as nutrition and body image, which coaches should take and have regular refresher sessions in order to raise awareness on these issues and their prevention and treatment. Requiring coaches to become educated in these issues will make them better equipped to discuss these things with their athletes, which

then empowers athletes to confide in their coaches whenever they are struggling with one of these things. This education would also teach coaches what is normal for girls to experience as they are going through puberty and the performance wave, which would likely make them more understanding and compassionate when one of their athletes is experiencing these things and maybe not performing as well, instead of putting pressure on them to push through it and potentially lose weight in order to get their desired results.

Another aspect of coaching that can be improved is putting boundaries in place that prevent coaches from discussing things like race weight and body composition, especially among high school and college runners. Discussing these matters, especially with teenage and young adult runners who may be more impressionable, promotes the idea that they need to be at a certain weight or have a certain body composition in order to run faster, which then results in female runners developing disordered eating habits to reach that weight and body composition (Beckner & Record, 2016. Banning or preventing discussions of these things in high school and college will keep these ideas about weight and body composition from becoming influential to female runners until it is developmentally appropriate for these athletes to be concerned about these things (Fleshman, 2023). If discussion and assessment about weight or body composition of an athlete is deemed necessary and important for optimizing performance, the assessment should be reflective of individual needs and should emphasize the

athlete's choice for it to be done, and it should only be done by trained health care personnel (Wells et al., 2020; Bratland-Sand & Sundgot-Borgen, 2013).

Educating coaches and runners on menstrual health is another very important aspect of preventing disordered eating. Among the aspects of the certification that Fleshman suggests, education on menstrual health is one of the more important aspects of that education that coaches should be required to go through. Menstrual health is one of the biggest health indicators that an athlete is not eating enough. Educating both female runners and those around them on menstrual health and how to recognize when their menstrual cycle is not how it should be is important for early recognition of unhealthy eating habits and the effects it may be having on their body (Fleshman, 2023; McGawley et al., 2023). Considering the major impact that menstrual dysfunction can have on many other aspects of a female runner's health, monitoring menstrual health and their menstrual cycle is crucial for preventing other consequences of disordered eating from happening.

Something that can be done at more of an institutional level is for schools and teams to get rid of rules mandating uniform styles that are known to promote self-consciousness and decrease body satisfaction in athletes. Certain uniform styles, like those discussed previously, cause runners to feel self-conscious about how their body looks and make them want to lose weight so that they feel less self conscious, and many of these uniforms types are the ones that athletes are required to wear (Fleshman, 2023; Lauer et al., 2018). Teams should get rid of these rules

requiring these uniform styles and explicitly allow athletes to wear alternative options that make them feel more confident and have higher body satisfaction.

Prevention of disordered eating among female runners should be the main course of action when it comes to tackling this issue within the running community. By preventing disordered eating from ever occurring, it prevents runners from having to deal with any of the consequences that are associated with it. If female runners never develop disordered eating habits they are more likely to stay healthy throughout their careers without facing any of the setbacks that typically come with these habits, even in the early stages of disordered eating.

Early Intervention

Despite prevention of disordered eating in female runners being the preferred method response to this issue, there are many cases where prevention does not happen in time. The focus then needs to shift to treatment and recovery as soon as possible. The likelihood that someone will make a full recovery from disordered eating and RED-S is strongly correlated with the length of time before intervention (Fleshman, 2023; Bryant et al., 2021). The faster female runners with disordered eating receive intervention and treatment, the more likely they are to fully recover from it and be able to participate in their sport the way they want to again.

For a runner to receive intervention and treatment early, early identification of disordered eating and its symptoms is crucial. In their original consensus statement on RED-S, the IOC emphasizes the importance of early detection of

RED-S for improving performance and preventing long-term health consequences. They suggest screening for RED-S as part of a Periodic Health Examination when an athlete presents with warning signs of RED-S and disordered eating. Some of these warning signs include weight loss, lack of normal growth and development, menstrual dysfunction, and recent injuries and illnesses (Mountjoy et al., 2014). Identifying these symptoms early then screening for RED-S and disordered eating can help athletes get treatment as soon as possible, thus maximizing their likelihood to make a full recovery. In addition to screening for RED-S, there are many screening tools available for eating disorders. Bryant and colleagues (2021) discuss the development of a digital screening tool, the InsideOut Institute-Screener, which is used to detect high risk and early stage eating disorders. Online screening tools, such as this one, allow easier access to early detection, and thus early intervention, for eating disorders

Athletic trainers can be especially impactful in early identification of disordered eating and its symptoms in female runners. Athletic trainers typically are the health professionals who interact with athletes the most on a day to day basis. This puts them in a position where they can identify changes in health and performance that could indicate disordered eating early on (Kroshus et al., 2018). With further education and awareness about RED-S and disordered eating, athletic trainers can be a vital resource for identifying when a female runner is struggling with disordered eating and getting them to interventions and treatments they need.

Another group of people who can be vitally important for early identification of disordered eating and its symptoms are coaches and coaching staff. Coaches interact with female runners on a daily basis and are in a good position to monitor changes in the athlete, especially in their performance. If coaches are able to recognize when an athlete may be struggling with disordered eating and work with the athletic training staff to monitor their symptoms, the two groups can work together to help runners get the early intervention that they need (Fleshman, 2023; Bratland-Sand & Sundgot-Borgen, 2013).

While coaches and athletic trainers are in an important position for early detection and intervention of disordered eating in female runners, they do not have any policies or guidelines set in place for them to aid them in this effort. Currently the National Collegiate Athletic Association (NCAA), the governing body regarding intercollegiate athletics in the United States, does not have any specific policies addressing disordered eating or RED-S. While they have some information about these issues on their website, they do not have any policies about how coaches should respond to these issues (Fleshman, 2023). Bratland-Sanda and Sundgot-Borgen (2013) recommend development of guidelines for all national and international sport federations, such as the NCAA, which states how to respond to athletes with disordered eating in order to guide coaches on how to best help their athletes. This is further supported by Wells and colleagues (2020), who suggest that every sporting organization should have guidelines on prevention and early identification of disordered eating. Considering

the research that has been done in recent years showing the harm that can be done due to disordered eating and low energy availability, the NCAA should create policies addressing this issue that give guidance to coaches, athletic training staff, and other people working within the collegiate sports community on what interventions that should be implemented when they encounter an athlete who is struggling with disordered eating.

Treatment

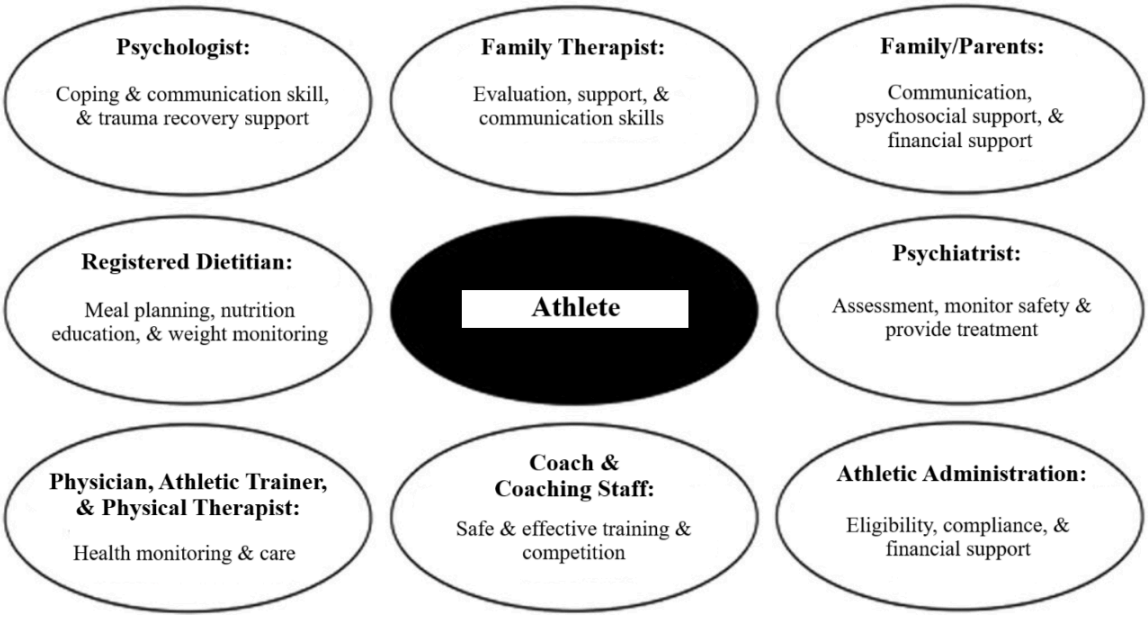
Once a female runner has been diagnosed with disordered eating, implementing interventions and treatment as soon as possible is vitally important to minimize harm and to maximize the chance of full recovery. During this time, athletes should receive multiple types of interventions, such as medical, nutritional, and psychiatric treatment (Bratland-Sanda & Sundgot-Borgen, 2013). Utilizing multiple types of treatment means that the different aspects of a runner's life that are contributing to the disorder will be addressed and improved upon, whether that be physical or psychological aspects.

The tertiary level of prevention the IOC introduced in their 2024 Consensus Statement on RED-S focuses on the clinical treatment of diagnosed RED-S cases based on their risk stratification within the IOC REDs CAT2 Severity/Risk stratification model. They state that the primary treatment of RED-S should be restoration of optimal energy availability using non-pharmacological means like changes to diet and exercise. The aim of this is to achieve sustained optimal

energy availability with appropriate contributions of both macronutrients and micronutrients. The IOC also acknowledged the importance of using pharmacological and psychological approaches to treating some of the clinical issues associated with RED-S, such as BMD (Mountjoy et al., 2023).

In order to fully treat RED-S, a comprehensive team approach to athlete health and performance with sports medicine, nutrition, psychology, and sports science personnel, along with coach and family engagement, is recommended. A comprehensive team approach is very important to ensuring a complete treatment plan and recovery for the athlete. The goals of this treatment should ensure safe sports participation while going through long-term treatment and monitoring to assess the safety of continued sports participation (Mountjoy et al., 2023). A similar approach to treatment of disordered eating in female runners is the Multidisciplinary Treatment Team Model (MDTT; see Figure 7), which in the context of eating disorders is a group of professionals who are experienced in working with athletes and have specialized training in eating disorders and disordered eating behaviors. This team should consist of athletic personnel, such as coaches and athletic trainers, physician, psychotherapist, dietician, psychiatrist, and professionals with other expertise areas (Conviser et al., 2018).

Figure 7: Multidisciplinary Treatment Team Model



(Conviser et al., 2018)

Each member of this team plays a unique and important role in assisting in athletes' recovery from disordered eating based on their specialties and their connection with the athletes.

Looking at some of the members of this MDTT and their role in an athlete's recovery from disordered eating, physicians are the ones who may anchor and lead the team, conducting the initial medical exam, monitoring the athlete's health over time, and referring the athlete to other medical specialists when necessary. They are also the ones who help manage related medical complications, such as cardiovascular, gastrointestinal, orthopedic, and endocrinological conditions (Conviser et al., 2018). A mental health care provider, such as a licensed psychologist, social worker, or counselor, also plays an important role in recovery

by providing individual, group, or family therapy, and things like coping skills training. They also monitor the athlete's mental status and their readiness to return to sports participation (Conviser et al., 2018). Dieticians also play a vital role in this model, conducting nutrition assessments, providing sports nutrition education, and creating individualized meal plans. They also help guide improved nutrition intake and help monitor body weight and body composition (Conviser et al., 2018).

While the MDTT and other similar approaches to disordered eating is the ideal treatment option given its well-rounded and comprehensive process, these forms of treatment are not available to the majority of female runners dealing with disordered eating. Many runners do not have access to all of the different members of the MDTT, whether that be because of time or money constraints or a lack of availability of these members. In the case that an athlete does not have access to a full MDTT, they should still utilize as many members of this approach as possible. The use of multiple professionals from various disciplines in the treatment of disordered eating among female runners is one of the best ways to treat a runner facing this issue and minimize their risk of remission. By addressing all aspects of life that may be contributing to the issue and helping to teach healthy behaviors to the runner, their chances of making a full recovery increase, and their chances of relapsing in the future decrease (Conviser et al, 2018).

Beyond MDTT approaches to treatment, there are many other forms of treatment that can be effective for eating disorders in any population. One such

treatment that has been shown to be especially effective in treating anorexia nervosa among children and adolescents is family-based treatment. Family-based treatment is an outpatient treatment option where the patient's family is the primary resource for recovery (Couturier et al., 2013). By working with a trained mental health provider, parents are given responsibility to help bring about weight restoration in their child by making all decisions regarding eating for them until the eating disorder is no longer influencing the child's behaviors and thoughts. After that has been achieved, the child is gradually given back responsibility over their eating to whatever extent is age-appropriate and normal for the family (Rienecke & Le Grange, 2022). Despite this treatment option being developed specifically for eating disorders among adolescents, it can still be applied to general disordered eating among adolescent female runners. With the support and care of family and their aid in developing healthy eating habits again, family-based treatment can be an effective method for recovering from disordered eating, especially among children and adolescent runners.

Conclusion

Disordered eating and eating disorders are serious mental health conditions that can lead to harsh physiological consequences and impairments. Female runners experience disproportionately high rates of disordered eating due to a mix of many cultural aspects in the running community, such as an emphasis on thinness for performance, pressures from coaches to lose weight, inadequate support for female

development, time and knowledge barriers to proper nutrition, and psychological fixation on control and success. These factors cause many female runners to adopt harmful disordered eating behaviors that can lead to serious long-term physiological, performance related, and psychological consequences that harm both their overall health and their athletic success. Tools such as the RED-S Health, Performance, and Physiological Models and the IOC's RED-S CAT2 can help raise awareness about disordered eating and its consequences and guide research about these issues. Raising awareness is essential for preventing disordered eating in female runners, which should be the primary line of defense against this issue. If prevention is not possible, early intervention and treatment are vital for facilitating a full recovery and minimizing the damaging effect disordered eating can have on female runners.

References

Armento, , A., Heronemus, M., Truong, D., & Swanson, C. (2023). Bone health in young athletes: A narrative review of the recent literature. *Current Osteoporosis Reports, 21*, 447-458.

Arthur-Cameselle, J. N., & Quatromoni, P. A. (2014). Eating disorders in collegiate female athletes: Factors that assist recovery. *Eating Disorders, 22*, 50-61.

Beckner, B. N., & Record, R. A. (2016). Navigating the thin-ideal in an athletic world: Influence of coach communication of female athletes' body image and health choices. *Health Communication, 31*(3), 364-373.

Berg, S., Pritchett, K., Ogan, D., & Larson, A. (2022). Self reported history of eating disorders, training, weight control methods, and body satisfaction in elite female runners competing at the 2020 U.S. Olympic Marathon Trials. *International Journal of Exercise Science, 15*(2), 721-732.

Bratland-Sanda, S., & Sundgot-Borgen, J. (2013). Eating disorders in athletes: Overview of prevalence, risk factors, and recommendations for prevention and treatment. *European Journal of Sport Science, 13*(5), 499-508.

Bridley, A. & Daffin, L. W., Jr. (2024). *Fundamentals of Psychological Disorders (formerly Abnormal Psychology)* (3rd ed., 5-TR). Press Books.

Bryant, E., Miskovic-Wheatley, J., Touyz, S. W., Crosby, R. D., Koreshe, E., & Maguire, S. (2021). Identification of high risk and early stage eating

disorders: First validation of a digital screening tool. *Journal of Eating Disorders, 9*(109).

Burke, L. M., Ackerman, K. E., Heikura, I. A., Hackney, A. C., & Stellingwerff, T. (2024). Mapping the complexities of Relative Energy Deficiency in Sport (REDs): Development of a physiological model by a subgroup of the International Olympic Committee (IOC) consensus on REDs. *British Journal of Sports Medicine, 57*, 1098-1110.

Cabre, H. E., Moore, S. R., Smith-Ryan, A. E., & Hackney A. C. (2022) Relative energy deficiency in sport (RED-S): Scientific, clinical, and practical implications for the female athlete. *German Journal of Sports Medicine, 73*, 225-234.

Conviser, J. H., Tierney, A. S., & Nickols, R. (2018). Essentials for best practice: Treatment approaches for athletes with eating disorders. *Journal of Clinical Sport Psychology, 12*, 495-507.

Couturier, J., Kimber, M., & Szatmari, P. (2013). Efficacy of family-based treatment for adolescents with eating disorders: A systematic review and meta-analysis. *International Journal of Eating Disorders, 46*(1), 3-11.

Crane, J., & Temple, V. (2015). A systematic review of dropout from organized sport among children and youth. *European Physical Education Review, 21*(1), 114-131.

Crouse, L., & Stockton, A. (2019, November 7) I was the fastest girl in America, until I joined Nike. *The New York Times*. https://www.nytimes.com/2019/11/07/opinion/nike-running-mary-cain.html

De Borja, C., Holtzman, B., McCall, L. M., Carson, T. L., Moretti, L. J., Farnsworth, N., & Ackerman, K. E. (2021). Specific dietary practices in female athletes and their association with positive screening for disordered eating. *Journal of Eating Disorders, 9*(50).

Deloitte Access Economics. (2020). Social and economic cost of eating disorders in the United States of America: Report for the Strategic Training Initiative for the Prevention of Eating Disorders and the Academy for Eating Disorders. *Deloitte Access Economics*. https://hsph.harvard.edu/wp-content/uploads/2024/10/Social-Economic-Cost-of-Eating-Disorders-in-US.pdf.

Dennis, A. B. (2025a). *Disordered eating vs. eating disorders*. National Eating Disorders Association. https://www.nationaleatingdisorders.org/what-is-the-difference-between-disordered-eating-and-eating-disorders/.

Dennis, A. B. (2025b). *Orthorexia*. National Eating Disorders Association. https://www.nationaleatingdisorders.org/orthorexia/.

Duckham, R. L., Peirce, N., Meyer, C., Summers, G. D., Cameron, N., & Brooke-Wavell, K. (2012). Risk factors for stress fracture in female endurance athletes: A cross-sectional study. *BMJ Open, 2*.

Fleshman, L. (2023). *Good for a girl: A woman running in a man's world*. Penguin Books.

Harper, F. G. (2023). *Unf*ck your eating: Using science to build a better relationship with food*. Microcosm Publishing.

Hunter, S. K., Angadi, S. S., Bhargava, A., Harper, J., Hirschberg, A. L., Levine, B. D., Moreau, K. L., Nokoff, N. J., Stachenfeld, N. S., & Bermon, S. (2023). The biological basis of sex differences in athletic performance: Consensus statement for the American College of Sports Medicine. *Translational Journal of the ACSM, 8*(4).

Kelly, A. K. W., & Hecht, S. (2016). The female athlete triad. *American Academy of Pediatrics. 138*(2).

Kroshus, E., DeFreese, J. D., & Kerr, Z. Y. (2018). Collegiate athletic trainers' knowledge of the female athlete triad and relative energy deficiency in sport. *Journal of Athletic Training, 53*(1), 51-59.

Lauer, E. E., Zakrajsek, R. A., Fisher, L. A., Bejar, M. P., McCowan, T., Martin, S. B., & Vosloo, J. (2018). NCAA DII female student-athletes' perceptions of their sport uniform and body image. *Journal of Sport Behavior, 41*(1), 40-63.

Mancine, R. P., Gusfa, D. W., Moshrefi, A., & Kennedy, S. F. (2020). Prevalence of disordered eating in athletes categorized by emphasis on leanness and activity type- a systematic review. *Journal of Eating Disorders, 8* (47), 1-9.

Matkin-Hussey, P. A., Baker, D., Ogilvie, M., Beagle, S., & Black, K. E. (2024). RED-S: A review of the screening, diagnosis, treatment, and recovery. *Strength and Conditioning Journal, 46*(3), 344-359.

McGawley, K., Sargent, D., Noordhof, D., Badenhorst, C. E., Julian, R., & Govus, A. D. (2023). Improving menstrual health literacy in sport. *Journal of Science and Medicine in Sport, 26*(7), 351-357.

Mountjoy, M., Ackerman, K. E., Bailey, D. M., Burke, L. M., Constantini, N., Hackney, A. C., Heikura, I. A., Melin, A., Pensgaard, A. M., Stellingwerff, T., Sundgot-Borgen, J. K., Torstveit, M. K., Jacobsen, A. U., Verhagen, E., Bundgett, A., Engebretsen, L., & Erdener, U. (2023). 2023 International Olympic Committee's (IOC) consensus statement on relative energy deficiency in sport (REDs). *British Journal of Sports Medicine, 57*, 1073-1098.

Mountjoy, M., Sundgot-Borgen, J., Burke, L., Carter, S., Constantini, N., Lebrun, C., Meyer, N., Sherman, R., Steffen, K., Budgett, R., & Ljungqvist, A. (2014) The IOC Consensus statement: Beyond the Female Athlete Triad-Relative Energy Deficiency in Sport (RED-S). *British Journal of Sports Medicine, 48,* 491-497.

Nazem, T. G., & Ackerman, K. E. (2012). The female athlete triad. *Sports Health, 4*(4), 302-311.

Ortega, J. (1998, August 8). Running scared. *Los Angeles Times*. https://www.latimes.com/archives/la-xpm-1998-aug-08-sp-11330-story.html.

Palfreyman, Z., Haycraft, E., & Meyer, C. (2013). Unintentional role models: Links between maternal eating psychopathology and the modelling of eating behaviors. *European Eating Disorders Review, 21*, 195-201.

Putukian, M. (2016). The psychological response to injury in student athletes: A narrative review with a focus on mental health. *British Journal of Sports Medicine, 50*, 145-148.

Rienecke, R. D., & Le Grange, D. L. (2022). The five tenets of family-based treatment for adolescent eating disorders. *Journal of Eating Disorders, 10*(60).

Scheadler, T. & Wagstaff, A. (2018). Exposure to women's sports: Changing attitudes toward female athletes. *The Sport Journal, 22*.

Sims, S. T., Kerksick, C. M., Smith-Ryan, A. E., de Jonge, X. A. K. J., Hirsch, K. R., Arent, S. M., Hewlings, S. J., Kleiner, S. M., Bustillo, E., Tartar, J. L., Starratt, V. G., Kreider, R. B., Greenwalt, C., Rentería, Ormsbee, M. J., VanDusseldorp, T. A., Campbell, B. I., Kalman, D. S., & Antonio, J. (2023). International society of sports nutrition position stand: Nutritional concerns of the female athlete. *Journal of the International Society of Sports Nutrition, 20*(1), 390-429.

Skorseth, P., Segovia, N., Hastings, K., & Kraus, E. (2020). Prevalence of female athlete triad risk factors and iron supplementation among high school distance runners: Results from a triad risk screening tool. *The Orthopaedic Journal of Sports Medicine, 8*(10), 1-7.

Steinfeldt, J. A., Zakrajsek, R. A., Bodey, K. J., Middendorf, K. G., & Martin, S. B. (2013). Role of uniforms in the body image of female college volleyball players. *The Counseling Psychologist, 41*(5), 791-819.

Stellingwerff, T., Mountjoy, M., McCluskey, W. T. P., Ackerman, K. A., Verhagen, E., & Heikura, I. A. (2023). Review of the scientific rationale, development and validation of the International Olympic Committee Relative Energy Deficiency in Sport Clinical Assessment Tool: V2 (IOC REDs CAT2)- by a subgroup of the IOC consensus on REDs. *British Journal of Sports Medicine, 57*, 1109-1121.

Van Eeden, A. E., Van Hoeken, D., & Hoek, H. W. (2021). Incidence, prevalence and mortality of anorexia nervosa and bulimia nervosa. *Current Opinion Psychiatry, 34*, 515-524.

Wasserfurth, P., Palmowski, J., Hahn, A., & Krüger, K., (2020). Reasons for and consequences of low energy availability in female and male athletes: Social environment, adaptations, and prevention. *Sports Medicine- Open, 6*(44).

Wells, K. R., Jeacocke, N. A., Appaneal, R., Smith, H. D., Vlahovich, N., Burke, L. M., Hughes, D. (2020). The Australian Institute of Sport (AIS) and National Eating Disorders Collaboration (NEDC) position statement on

disordered eating in high performance sport. *British Journal of Sports Medicine, 54*, 1247-1258.