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# Nutritional Considerations for Female Athletes

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## ABSTRACT

THIS ARTICLE PROVIDES AN OVERVIEW OF CURRENT LITERATURE RELATED TO NUTRITIONAL CONSIDERATIONS FOR THE FEMALE ATHLETE. THE PREVALENCE OF THE FEMALE ATHLETE TRIAD, EATING DISORDERS, AND BODY IMAGE ISSUES AMONG FEMALE ATHLETES WILL BE REVIEWED. FURTHERMORE, DETRIMENTS IN HEALTH AND/OR SPORTS PERFORMANCE FROM LACK OF PROPER NUTRITION WILL BE DISCUSSED. RECOMMENDATIONS FOR APPROPRIATE NUTRITIONAL GUIDELINES TO SAFELY DECREASE BODY FAT, INCREASE MUSCLE MASS, AND IMPROVE OVERALL SPORTS PERFORMANCE WILL BE ADDRESSED. CONSIDERATIONS WHEN PROVIDING BODY COMPOSITION ADVICE FOR THE FEMALE ATHLETE ARE REVIEWED.

## INTRODUCTION

The participation of females in sports has greatly increased over the last several decades. According to the National Federation of State High School Associations, of the 7.5 million athletes who participated in a school-sponsored activity in 2008–2009, 41% were females (4). In 1972, females comprised only 7% of the total number of athletes (4). Naturally, as the trend of increased participation in high school athletics has risen, so has the number of women participating in college, professional, and recreational sports increased. Although participation in sports and exercise is associated with a range of indicators of physiological and psychological well-being such as cardiovascular fitness, mood, and self-esteem (7), most of the literature shows that the prevalence of eating disorders and disordered eating (DE) is higher in athletes compared to that of nonathletes (30,51).

Research also indicates that women, regardless of whether they participate in sports or not, are at greater risk for body dissatisfaction (14,15) and DE (17,19) than men. Compared to male athletes, female athletes are more likely to engage in compulsive exercising and pathological weight-loss methods such as abuse of laxatives or diets pills, self-induced vomiting, and fasting with the goal to achieving top sporting performance and superior physical condition (12). Data indicate that although the prevalence of clinical eating disorders ranges from 0 to 8% among professional and college female athletes (49), many of them are "at risk" for eating disorders which places them at risk for menstrual irregularity, bone injuries, cardiovascular problems, depression, lower athletic performance, social isolation, and poorer quality of life (32).

The purpose of this article is to provide practical nutrition-related information to the strength and conditioning professional when working with female athletes. Research has indicated that although risk factors such as menstrual disorders, DE, low bone mineral density (BMD), and body image issues are prevalent among female athletes, knowledge and recognition of these risk factors among coaches and athletes was low (13). When it comes to nutrition, there is a wealth of erroneous information available on the Internet and hundreds of unqualified/improperly credentialed "experts" providing nutritional advice to the public. Female athletes seeking to lose body fat, gain muscle mass, or improve performance may seek guidance from unreliable sources and hence may put their bodies, and/or performance, at risk. Research indicates that athletes who are encouraged to diet by their coaches may resort to faster more dangerous methods of weight control (e.g., self-induced vomiting or fasting) to shed pounds quickly (46). The strength and conditioning professional can help to guide female athletes in the right direction and steer them to seek advice from reliable/qualified sources and provide them with appropriate support. Recognition of DE behaviors or body image issues among athletes should be identified as quickly as possible by strength and conditioning coaches so that they may be properly referred to a mental health professional for further intervention because these issues could create major health and psychological problems.

In an effort to prevent athletes from following nutritional recommendations from unreliable sources, it is recommended that strength and conditioning professionals work in conjunction with team coaches, athletic trainers, physicians, psychologists, and sports trained dieticians to readily provide reliable resources for their athletes. Instead of

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allowing athletes to seek information on their own, bringing a qualified professional on board to provide some basic nutrition education to the team could prove to be beneficial. Furthermore, the professional who comes to give the nutrition lesson(s) can potentially make himself available for one-on-one consultation to help improve the intervention. If budgeting prevents these types of services, then it is recommended that strength and conditioning coaches compile a list of reliable resources (i.e., books, approved websites, etc.) that athletes can reference as information on where reliable information can be found. Educating athletes on the types of credentials that their source should have could also prove to be an effective intervention so that they are not loosely following anybody's information.

## PREVALENCE OF THE FEMALE ATHLETE TRIAD AND EATING DISORDERS

The female athlete triad was first recognized more than 20 years ago based on the association of DE, functional hypothalamic amenorrhea (FHA), and osteoporosis observed in recreational and elite-level exercising women (42). After several years of progress in the scientific understanding of the female athlete triad, the American College of Sports Medicine redefined the triad in 2007. The most recent model of the triad is a syndrome linking low energy availability (EA) with or without disordered eating (DE), menstrual disturbances, and low BMD across a continuum of healthy (optimal EA, normal and regular menstrual cycles, and optimal BMD) to unhealthy and increasingly severe clinical presentations of each component (42). The triad comes as a result of failure to intake adequate energy to compensate for energy used during exercise; this condition is commonly called low EA. Low EA has been commonly observed in exercising women (42) and is particularly found in women involved in leanness, aesthetic, and/or endurance sports and activity (50). If a state of energy deficiency remains for a prolonged period of time it may translate to metabolic and reproductive suppression (52) that potentially results in a multitude of health concerns.

Research has reported that the prevalence of clinical menstrual disorders (FHA and oligomenorrhea) in female athletes include both high school (6) and premenopausal women (8). Clinical signs of menstrual disorders have been shown to range from 1 to 61% in exercising women and are documented at significantly higher rates than in nonathletic premenopausal women (5). Lean build athletes and aesthetic athletes (cheerleading, dance, and gymnastics) have a significantly higher prevalence of menstrual disorders–26.7 and 28.2%, respectively–when compared to that of general high school athletes (43). The prevalence of secondary amenorrhea has been reported to be as high as 65% in elite long distance runners compared to 2–5% in the general population (22). Although primary amenorrhea prevalence is less than 1% in the general population, the prevalence in collegiate cheerleading, diving, and gymnastics athletes has been reported to be as high as 22% (9).

DE and eating disorders among female athletes often go unnoticed and it is therefore difficult to estimate their real prevalence. Research has indicated that the reported lifetime prevalence of anorexia nervosa and bulimia nervosa in female athletes ranges from 0.5 to 3.7% and from 1.1 to 4.2%, respectively (49). Furthermore, disordered eating, which is characterized by abnormal eating behaviors but does include all the diagnostic criteria for eating disorders, has a lifetime prevalence rate ranging from 0 to 27% (18). Due to the lack of standardized assessment tools and consistent criteria for defining disordered eating, the prevalence estimates can even range as high as 62% among female athletes (11). Research investigating the psychosocial correlates of bulimic symptoms among National Collegiate Athletic Association Division I female collegiate gymnasts and swimmers/divers found that negative affect (negative emotions and poor self-concept), body dissatisfaction, and dietary restraint were related directly to bulimic symptoms (1). Furthermore, the researchers suggest that general sociocultural pressures are influential but weight and appearance pressures in the sport environment may be even more pervasive and negative for female athletes (1).

Low BMD in female athletes has been investigated with the diagnostic criteria set forth by the World Health Organization for postmenopausal women, which are based on T scores instead of Z scores. A T score is defined as the number of SD above or below the mean peak BMD of young adults of the same age and ethnicity. Research for female athletes that used the World Health Organization criteria found the prevalence of T scores between −1.0 and −2.5, which is classified as osteopenia, to range from 22 to 50% (42). Furthermore, the prevalence of T scores less than −2.5, which is classified as osteoporosis, ranged from 0 to 13% (42). These prevalence rates are significantly higher than those reported in the normal population.

## FEMALE ATHLETES AND BODY IMAGE ISSUES

Body dissatisfaction is another area of concern among female athletes. This characteristic becomes apparent when there is discrepancy between an individual's image of their body, which is usually in terms of body weight and shape, and the body they perceive as being ideal. Research has demonstrated that body dissatisfaction is associated with a drive for thinness (28), dieting (48), disordered eating patterns (47) and the development of clinical eating disorders (25).

The literature suggests that body image issues may come about as a result of several factors. One factor that affects athletes and nonathletes alike is the typical sociocultural pressure to be thin (48); the media is an example of a means that this ideal is communicated to the public. Athletes, however, are often faced with a secondary pressure known as sports pressure

(21). The sports pressure regarding an athlete's physique may come from their teammates or coaches as a body ideal for optimal sports performance. Further complicating this matter is the fact that some women's sports such as gymnastics and figure skating judge an athlete based on aesthetics of their body in addition to their performance. Another factor that may create body image issues among female athletes is the constraints and paradoxes placed on them where the socially acceptable message is that female athletes may participate in sports as long as it does not weaken their heterosexual attractiveness (33). A final factor that may influence body image issues is known as the objectification theory (23). This theory suggests that in the Western society, women's bodies are sexually objectified for the use and pleasure of others and women are socialized to view their bodies as objects and internalize an observer's perspective of their own bodies; internalization of this standard may lead women to feel shame about their bodies (32). This body shame has been linked to higher body surveillance, body dissatisfaction, a lower psychological well-being, and more eating problems in young women (26).

## HEALTH CONCERNS AND DETRIMENTAL PERFORMANCE DUE TO POOR NUTRITION

Some of the major concerns with lack of proper nutrition for female athletes include a multitude of health issues and detrimental sports performance. Some of the health concerns that may arise include menstrual disorders, low BMD, cardiovascular dysfunction, musculoskeletal injuries, depression, social isolation, and a poorer quality of life. These health concerns are not independent of each other; instead, problems with one typically lead to problems in other areas.

Inadequate nutrition can be defined as a long-term exposure to a negative energy balance where energy consumed is significantly less than energy expended. However, adequate vitamin and mineral intake is also an important component for any athlete to sustain optimal health and performance (39). In addition to a lack of nutrient intake, female athletes could be at risk for vitamin and mineral insufficiency as a result of the lack of nutrient intake itself, menstruation, and inflammatory responses to heavy physical activity (39). An energy deficit sustained over a period of several weeks to several months can lower leptin, estradiol, and insulin-like growth factor-1, and can increase cortisol (31,36). These hormone alterations can decrease osteoblast activity and increase bone resorption which can in turn create an imbalance in bone turnover that may lead to a decrease in BMD (31). Furthermore, higher cortisol levels have been associated not only with lower BMD but also with increased scores of anxiety and depressive symptoms (36) that may lead to social isolation and a lower quality of life.

Menstrual dysfunction, sometimes called menstrual irregularity, includes primary amenorrhea, secondary amenorrhea, and oligomenorrhea (42). Primary amenorrhea is a delay in menarche; the defining age for primary amenorrhea is 15 years (42). Secondary amenorrhea is a cessation of menstruation for 3 consecutive months in a postmenarche woman. Oligomenorrhea is menstrual cycles occurring greater than 35 days apart (42). Long-term menstrual dysfunction has been linked with low BMD. More importantly, however, is that the amount of skeletal mass acquired during adolescence is one of the most important factors in determining osteoporosis and fracture risk later in life (27). Hence, having menstrual dysfunction at an early age can severely impact a woman's bone health later in life. Menstrual dysfunction has also been linked to other health consequences such as cardiovascular dysfunction, endothelial dysfunction, abnormal metabolic hormonal profile (usually due to inadequate energy intake), and muscle injuries (29,40).

Low BMD among female athletes, in addition to potentially predisposing adolescent girls to osteoporosis and an increased fracture risk later in life, can lead to injuries. Research has indicated that athletes with stress fractures are more likely to have lower BMD, lower dietary calcium intake, current menstrual irregularity, and lower oral contraceptive use (41). Although attaining a bone scan to determine the BMD for every female athlete is highly impractical and costly, researchers have evaluated several risk factors that significantly predict low BMD. These risk factors include late age at menarche, low body weight (<90% ideal body weight), low body mass index (<18.5 kg/m$^2$), oligomenorrhea/amenorrhea, and current participation in a leanness sport or activity (24).

Sports performance is clearly affected by lack of proper macronutrient and micronutrient intake. Optimal energy intake and nutrition can improve exercise performance and maintain overall health in physically active individuals (45). However, to maintain low body fat or body weight, female athletes often restrict energy intake to make weight goals (45). Due to the lack of proper energy intake and/or diversity in the diet and/or declines in nutritional status due to heavy physical activity, female athletes may also experience problems in maintaining an adequate micronutrient status (37,39). More common micronutrients lacking among female athletes include iron, calcium, and vitamin D. Table 1 outlines some important functions of selected macro and micro nutrients.

## SAFE AND EFFECTIVE NUTRITIONAL RECOMMENDATIONS FOR THE FEMALE ATHLETE

It is important for the strength and conditioning professional to provide proper referrals and support for female athletes requiring nutritional guidance to improve their body composition or with a need to lose weight. Because it has been documented that more than 60% of elite athletes from leanness and nonleanness focused sports reported pressure from their coaches concerning body shape (34), the method in which the information is communicated to the athlete is critical. It is important to realize that body

**Table 1**
**Functions of selected macronutrients and micronutrients**

| Nutrient | Function |
|---|---|
| Carbohydrates | Provide energy for working muscles and the central nervous system, support fat metabolism, and prevent protein from being used as energy. Carbohydrates are the preferred source of energy for muscle contraction and biologic work |
| Proteins | Responsible for most of the work in the cells and are required for the structure, function, and regulation of the body's tissues and organs. They are made up long chains of amino acids |
| Fats | Used to build new cells and is important for normal brain development and nerve function. Fat is needed to carry and help absorb fat-soluble vitamins such as vitamins A, D, E, and K. Fat can be converted into energy when there is a lack of energy available |
| Water | Used in the cells, organs, and tissues to help regulate temperature and maintain bodily functions. It distributes nutrients such as minerals, vitamins, and glucose to the cells as well as removes toxins that the organs reject through the urine and feces. Water is easily lost through breathing, sweating, and digestion |
| Iron | Supports the function of proteins and enzymes essential for maintaining physical and cognitive performance. Predominantly, iron is incorporated in the proteins hemoglobin and myoglobin which are responsible for the transport and storage of oxygen. When hemoglobin levels decline, maximal oxygen consumption declines as well |
| Calcium and vitamin D | These micronutrients are critical for bone health. Deficiency in either micronutrient results in impaired bone mineralization. Calcium must be consumed from food or supplements but vitamin D can come from dietary sources or from cutaneous synthesis in response to UVB radiation from the sun |

weight/body fat topics communicated to the athlete could be a sensitive subject for them and must be discussed with compassion, education, and support. Robertson et al. (44) recommend that athletes should be informed that the purpose of doing body composition assessments is to monitor any unhealthy changes that may occur and to determine whether exercise and eating strategies are having the desired impact. Robertson et al. (44) suggest the following strategies recommended in the 2013–14 NCAA Sports Medicine Handbook (10) to be included when measuring body composition to achieve this goal:

- Obtaining body composition values with 1 athlete at a time.
- Giving athletes information on body composition using phrases such as "within the desirable range" rather than a raw value, such as "your body fat level is 18%."
- Providing athletes with information on how they have changed between assessments, rather than offering the current value (e.g., "your muscle mass has increased since the last measurement").
- Increasing the focus on muscle mass and decreasing the focus on body fat.
- Using body composition values as a means of helping to explain changes in objectively measured performance outcomes.
- Focusing on the changes in body composition as the basis of recommending dietary changes to either sustain positive changes or reverse negative changes.
- Avoiding any punitive action as a result of the assessed values.

It is also important that the entire support/education team, which should consist of some (and in some occasions all) of the following professionals–the coach, strength coach, dietician, athletic trainer, physician, and psychologist–all share the same approach in terms of providing accurate and consistent information to the athlete. The credibility of the support/education system can easily be questioned and doubted by the athlete if there is evidence of inconsistent information provided to them by various professional sources. Evidence has shown that the risk of eating disorders in young athletes may be reduced in supportive sporting and coaching environments (20), which is one of the first steps in providing safe and effective nutritional recommendations for female athletes.

Another step in providing safe and effective nutrition recommendations for the female athlete is in the timing of when the information is given. Telling an athlete that they need to lose weight or body fat at the beginning of their competitive season is counterproductive because they should be focusing on sport-specific activities and fueling their bodies to maximize performance. Placing athletes on a caloric deficit at the beginning of their competitive season could potentially hamper their performance. Hence, the time to address body weight/body composition issues is at the start of their off-season program immediately after the competitive season. During this time period, the athlete will not only have more time to seek the help of the appropriate support team personnel but they will also be in a position where a caloric deficit will not impede their sports performance. Furthermore, it will give athletes more time to achieve realistic weight-loss/body fat loss goals instead of feeling the need to quickly reduce their weight/body fat when the season is in place. It is important to note, however, that in cases where female athletes are suffering from menstrual

dysfunction (or other components of the female athlete triad) during the season, the nutritional interventions (and sometimes psychological interventions) are appropriate. Research recently demonstrated that a 6-month carbohydrate-protein (CHO-PRO) supplement (360 kcal/d, 54 g CHO/d, and 20 g PRO/d) intervention improved energy status enough to reverse exercise-related menstrual dysfunction (16).

Table 2 outlines some basic nutritional recommendations for the female athlete looking to lose body fat.

Sometimes, female athletes will have goals to build more muscle mass and improve performance. If these are their goals, caloric restriction should be eliminated. Table 2 can be modified as athletes will need to be slightly hypercaloric to increase muscle mass and isocaloric (at minimum) to improve sports performance. To increase muscle mass, an intake of an extra 300–500 kcal/d is recommended (2).

A final recommendation for athletes trying to lose body fat, gain muscle mass, or maintain their weight is nutrient timing. Aragon and Schoenfeld (3) recently published a literature review on nutrient timing and recommended that a high-quality protein dosed at 0.4–0.5 g/kg of lean body mass at both pre- and postexercise is a relatively fail-safe general guideline that reflects the current evidence showing a maximal acute anabolic effect of 20–40 g. They also stated that carbohydrate dosage and timing relative to resistance training is a gray area lacking enough evidence to form specific recommendations. However, they did discuss that carbohydrate availability during and after exercise is of greater importance to endurance as opposed to hypertrophy goals. Their recommendation on carbohydrate intake to maximize muscle gain is to ensure that athletes meet their total daily carbohydrate intake throughout the day as opposed to focusing on specifically timing carbohydrate dosages.

**Table 2**
**Nutritional recommendations to lose body fat**

| Category | Recommendation |
|---|---|
| Goal setting | Make the goal realistic. Although it is possible to lose weight quickly, setting high weight-loss goals may lead to failure. Drastic weight loss is often the result of not only body fat loss, but also loss of water and a loss of muscle mass. The more muscle mass that is lost, the slower the metabolism becomes. Losing 1–2 pounds of body fat per week is recommended (2) |
| Caloric restriction | Caloric restriction is necessary to lose body fat, but an excessive caloric restriction can lead to major health issues. A modest caloric deficit of 500 cal/d from what the body burns in a day is enough to lose a pound of body fat per week (46). A metabolic cart can be used to more accurately measure an athlete's basal metabolic rate (BMR), or the Harris–Benedict equation for women can be used. That equation is as follows: BMR (cal/d) = 655.1 + (9.5663 × weight in kg) + (1.85 × height in cm) − (4.676 × age in years). Once the BMR is calculated, a physical activity level factor is used to estimate total daily energy requirement. The BMR value is multiplied by 1.53 (sedentary/light activity), 1.76 (active or moderately active), or 2.25 (vigorous active). For weight loss, 500 cal is subtracted from the total daily energy requirement (2) |
| Caloric expenditure | Burning extra calories is another good method to lose body fat, but excessive caloric expenditure can also lead to health problems. A modest increase in caloric expenditure of 250–500 cal/d is enough to create a caloric deficit that is not detrimental to health and can still induce weight loss |
| Macronutrient intake | A registered dietician specializing in sports nutrition is the best person to determine an athlete's macronutrient intake. Avoiding specific foods all together (i.e. carbohydrates) is usually not recommended and may lead to failure in adhering to a successful weight-loss plan. Macronutrient intake will vary based on the athlete's sport, position, needs, age, sex, weight, lean body mass, and several other factors. Generally, protein intake should be 1.5–1.7 g/kg of body weight (45), carbohydrate intake should be 55% of total calories (2), and the remaining calories should come from fat |
| Iron intake | Female athletes not experiencing an iron deficiency should incorporate foods rich in iron in their diet, such as meat, seafood, and legumes coupled with foods rich in ascorbic acid (to help absorb the iron), such as dark green leafy veggies, peppers, guavas, broccoli, and berries. Female athletes identified with an iron deficiency should eat these foods and take iron-fortified foods or an iron supplement (38) |
| Calcium/vitamin D intake | Supplemental levels of 2,000 mg of calcium and 800 mg of vitamin D per day have been shown to reduce the incidence of stress fractures by 20% among female navy recruits undergoing 9 wk of initial military training (35) |
| Water | Maintenance of hydration during exercise is strongly related to a high level of athletic performance. The hydration beverage should contain approximately 100 mg sodium per 240 mL water and approximately 6–8% carbohydrate for exercise events lasting longer than 1 hour (45). Women should also consume at least 88 oz of water (2) |

## CONCLUSION

The evidence presented thus far indicates that female athletes are at risk for disordered eating, body image issues, menstrual dysfunction, low BMD, a negative energy balance, and a myriad of other health concerns that relate to one another. Some of these health concerns can lead to an increase in cardiovascular risk factors, hormonal imbalances, musculoskeletal injuries, and poor sports performance. Female athletes, more so than male athletes, are at a higher risk of developing eating disorders or disordered eating patterns. Female athletes participating in aesthetic type sports are at a higher risk of developing issues that fall within the female athlete triad than female athletes in nonaesthetic type sports. Furthermore, elite female athletes have the highest risk of having the female athlete triad because of their competitive nature to obtain the ideal sports physique and competitive physique. Peers, coaches, society, and the media all influence some of the body dissatisfaction issues often experienced by female athletes. Providing proper education and support to female athletes may help to prevent injuries, future health problems, and improve athletic performance.

## PRACTICAL APPLICATIONS

The strength and conditioning professional should be well aware of the signs of the female athlete triad and be able to recognize athletes potentially at risk for developing the triad. Furthermore, strength and conditioning coaches should refer at-risk athletes to the appropriate mental health professional for further assessment/treatment. Strength and conditioning professionals play an integral role in the daily (or almost daily) interaction with athletes and are in a position where they can intervene, support, educate, and refer athletes to appropriate resources to help them with their sports nutrition goals. Furthermore, because it is often the strength and conditioning coach who performs (or oversees) the body composition assessments as part of an overall physical assessment to develop an appropriate strength and conditioning program for athletes, using the strategies and approaches presented in this article can be useful in working with female athletes. Finally, the basic nutritional guidelines presented in this article can act as a guideline when working with other professionals involved with the nutrition of female athletes, such as the physician, dietician, athletic trainer, and psychologist.

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