

Natural Products **Insider**[®]

Vol. 10, No. 13 November 2020

naturalproductsinsider.com US\$20.75



Sporting women

Emerging understanding
of female systems,
buying power

The impact of female athlete triad on bone health

by Lisa Schofield

INSIDER's take

- ◆ Traditionally, the triad involves decreased bone mineral density, disordered eating and irregular menstruation.
- ◆ Energy deficiency relative to calorie consumption and expenditure needed to support homeostasis underpin the common triad condition.
- ◆ Although missing the obvious component of menstrual issues, athletic men are at risk for triad consequences.

A different kind of “FAT” can affect athletic women—female athletic triad (often called “triad” for short), a syndrome of three clinical factors created by nutrient depletion that accelerates bone aging and energy fluctuations, as well as disrupts menstruation.

Although women have always been involved in competitive athletics, the number of female professional athletes has grown significantly. For example, [according to](#) the International Olympic Committee (IOC), female participation in the 1984 Summer Olympics in Los Angeles was 23%, and was on track for 2020 in Tokyo at an estimated 49%. Winter sports have also seen a tremendous rise in female participation, jumping from 22% in Sarajevo’s 1984 Winter Olympics to 41% in the 2018 Winter Olympics held in PyeongChang.

Competitive female athletes also are contributing to the vigorous growth of the global sports nutrition market, which was valued at \$15.6 billion in 2019, and is expected to enjoy a robust compound annual growth rate (CAGR) of 8.9% from 2020 to 2027, [according to](#) Grand View Research. The firm noted products in demand are protein bars, energy drinks and dietary supplements to fuel performance in endurance and strength, as well as to burn fat.

Competitive female athletes are hyperfocused on body weight and fat by necessity, especially in sports such as diving, gymnastics, figure skating, long distance running and swimming. Attaining top shape is a practice often characterized by extreme eating behaviors (or “disordered eating”) as calorie count and composition are almost fanatically monitored.

According to certified sports nutritionist and endurance sports coach Matt Fitzgerald, one body mass index (BMI) for female athletes does not fit all types of sports. In his book “Racing Weight,” he specified the goal is 12% body fat for female runners, 12% to 16% in cycling, 19% to 21% for swimming, 12% to 15% in triathletes and 11% when focused on cross-country skiing. A healthy body fat percentage for nonathletic, but in-shape women is 18.5% to 24.9%.

And herein lies the spark that can ignite the onset of triad—the only way to control one’s body fat percentage is through caloric consumption and expenditure. Such dramatic diet and exercise habits create the triad, which one group of researchers described as “the interrelationships among energy availability, menstrual function and bone mineral density (BMD), which may have clinical manifestations including eating disorders, functional hypothalamic amenorrhea [missed menstruation] and osteoporosis.”¹

Competitive female athletes are hyperfocused on body weight and fat by necessity, especially in sports such as diving, gymnastics, figure skating, long distance running and swimming.

A review in the *Journal of the American Academy of Orthopaedic Surgeons* detailed that the syndrome was first defined in 1992, with diagnosis requiring the presence of osteoporosis, an eating disorder and amenorrhea.² The definition was refined in 2007 as a spectrum disorder involving low energy availability (with or without disordered eating), menstrual dysfunction and low BMD. With the revised definition, all three components needed not be present for a triad diagnosis.

Further, according to the review authors, women athletes with one risk factor (component) had a 15% to 21% increased risk of stress fractures, while exhibiting two components increased the risk up to 30%, and three, up to 50%. Additionally, when assessing the specific components of the triad, the prevalence of menstrual irregularities among high school female athletes ranged from 19% to 54% based on data collected from self-reported questionnaires.

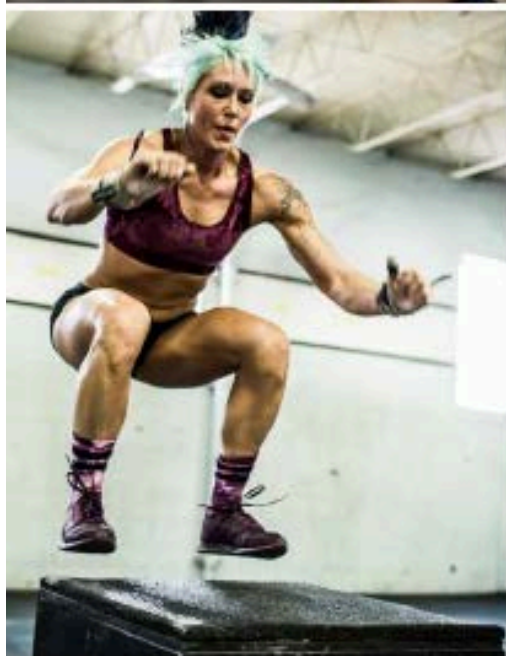
In women, estrogen and progesterone levels are impacted dramatically by regular strenuous physical exertion, and these fluctuating hormones can inhibit normal menstruation, while low body fat and estrogen can cause amenorrhea. According to [a presentation](#) by John Orris, D.O., female athletes with triad-induced amenorrhea have up to a four-fold increased risk of stress fracture, as well as a 10% to 20% reduced lumbar spine BMD compared to athletes with normal menstruation.

In one study, 239 female athletes with known infrequent or ceased periods were assigned to a low-, moderate- or high-risk category using the Female Athlete Triad Cumulative Risk Assessment Score (25.5% were deemed moderate risk, and 3.8% high risk), and followed to identify number of bone stress injuries during sports participation.³ One or more bone stress injuries occurred in 10.5% of athletes assigned to risk groups.

The effects go beyond weakened bones and failure to menstruate, though. Research has shown that women athletes with triad experience more stress fractures, musculoskeletal injuries, anxiety, depression, poor or skewed self-esteem, and even increased mortality.⁴ The condition has far-reaching tentacles that abrade physiological resilience.

A cohort of 163 teenage female athletes competing in eight interscholastic sports were examined throughout each athlete's sports season to assess the relationship between disordered eating, menstrual dysfunction and low BMD.⁵ The researchers discovered that 61 (37.4%) of the participants suffered 90 musculoskeletal injuries, which were associated with disordered eating and amenorrhea/oligomenorrhea (irregular menstrual blood flow). The findings indicated that these factors, along with low BMD—triad—were linked with a higher rate of musculoskeletal injuries.

The findings were validated by the same authors in another study, this one on 89 high school female athletes competing in interscholastic cross-country and track who were followed during their sport season.⁶ At the study's end, 38 runners (42.7%) had at least one musculoskeletal injury, and again, an association existed between the rate of injuries and disordered eating, oligo/amenorrhea and low BMD.



Triad is a global concern. Researchers sought to determine the prevalence of triad among the Malaysian population of female athletes across a wide range of sports.⁷ The 67 elite athletic participants ranged in age from 13 to 30, and were divided into lean and non-lean groups. The study authors found that the prevalence of female athletes who were at risk of menstrual irregularity, poor bone quality and eating disorders were 47.6%, 13.3% and 89.2%, respectively, in the leanness group; and 14.3%, 8.3% and 89.2%, respectively, in the non-leanness group—showing a significant difference between lean athletes and non-lean athletes, suggesting that triad may be more common for women in sports that emphasize or require a lean physique for competitive achievement.

Role of supplementation

While reams have been written discussing the winding pathways entangling hormones and other biochemicals to create the triad risk factors and subsequent presentations, it is important to note that some psychological and behavioral components of triad cannot be addressed by supplementation. Formulating for female athletes who need to fulfill athletic goals through acquiring and maintaining very lean body mass, however, is an ideal opportunity.

Orris noted the importance of making sure female athletes get enough calories and nutrition to support the amount of activity they do. “This helps bone development by receiving at least 1,300 mg of calcium and 600 international units of vitamin D a day,” he added.

Bone support to preserve BMD looms largest for this particular group as it will have lifelong implications. “Arguably, sports supplements have been missing out on the female athlete’s attention as the products have been typically marketed toward male athletes,” observed Anne Roksvåg, senior product manager with NattoPharma ASA, Oslo, Norway. “To the extent sport supplements have been speaking to women, key focus seems limited to protein supplements and weight management.”

While regular exercise is known to improve bone strength and density, athletic women with triad illustrate an exception occurs with every rule. Key nutrients such as calcium, and vitamins D and K2 that have been predominantly associated with an older demographic are proving highly relevant for the market of women’s sports nutrition, she pointed out. “As low bone density is one of the components in female athlete triad, formulating to optimize calcium is important to enhance and strengthen BMD for this group of young women. However, if calcium is not paired with vitamin K2 as MK-7 and vitamin D3, calcium is not optimally utilized for strengthening their bone health.”

One trial showed a three-year daily dose of 180 mcg MenaQ7 improved bone mineral content, BMD and bone strength.⁸ Another study showed that healthy prepubertal girls taking 45 mcg MenaQ7 daily

improved activation of osteocalcin, resulting in more osteocalcin working to grow bone and improving BMD.⁹ This study is of particular relevance as top competitive female athletes tend to be fully invested in their sport as young as age four.

Angie Rimel, marketing coordinator, GELITA, agreed that in sports, “bone problems can be significant. Sports of non-weightbearing nature, such as endurance cycling, also put many well-trained athletes at risk of low bone mineral density at premature age.¹⁰ Poor bone health ultimately manifests as osteoporosis in later life and is characterized by critically low BMD and deterioration of the bone microarchitecture,” she commented.

GELITA’s Bioactive Collagen Peptides FORTIBONE is, Rimel described, “a potential solution to protect against stress fractures in sports as it is shown in our patent (#10,34,283) to stimulate the osteoblast activity to increase bone matrix collagen, resulting in improved bone stability and flexibility. FORTIBONE stimulates bone collagen formation, counterbalancing degradation and resulting in increased bone mineral density.”

The ingredient’s potential impact on bone health was shown in an observational study.¹¹ Twenty-eight patients with different fracture locations supplemented daily either 10 g FORTIBONE or placebo. The 14 patients who received the Bioactive Collagen Peptides treatment had a better bone health outcome than the placebo group.

According to their physicians, 79% of the patients in the supplemented group had either a good or very good outcome. In the placebo group, 21% were assessed as having a very good outcome. The data suggested FORTIBONE may improve fracture recovery.

Bone health support is critical for athletes, and a couple of companion nutrients can help maintain overall health and performance for competitive athletes who adhere to restrictive diets.

OptiMSM brand methylsulfonylmethane (MSM) demonstrates the ability to upregulate innate antioxidant capacity without directly neutralizing free radicals, enabling the body to address the consequences of training without inhibiting the adaptive response needed for physical improvement, according to Tim Hammond, vice president sales and marketing, Bergstrom Nutrition.¹² The ingredient may help balance inflammatory and immune responses to various stressors like exercise and toxins.¹³ “By addressing the consequences of the stress exerted by training, OptiMSM can help provide relief from many downstream effects on women athletes,” Hammond said.

Another supplement that may be useful in helping female athletes to achieve their training and competitive goals (and potentially reserve energy) is a natural testosterone production booster, such as LJ100 Tongkat ali from HP Ingredients. According to CEO Annie Eng, one study showed that in women who took 400 mg LJ100 daily for five weeks,



total testosterone increased by 48.6%, free testosterone increased by 122% and muscle force increase by 13.7%.¹⁴ Sex hormone binding globulin (SHBG) concentration decreased by 20.8%. “The increase in free testosterone in women is thought to be due to the significant decline in SHBG concentrations,” Eng explained. “The study affirms the ergogenic benefit of LJ100 through enhanced muscle strength.”

A redefinition

Scientific evolution sometimes creates the need to change an original definition. In 2014, IOC convened an expert panel to update its 2005 consensus statement on female athlete triad.¹⁵ Apparently, men can get triad, too, albeit without the obvious menstrual difficulties.

IOC noted that since 2007, research and clinical experience revealed that what underpins the triad is an energy deficiency relative to calorie consumption and expenditure needed to support homeostasis—a deficiency that also affects male athletes. The syndrome, IOC argued in its update, “is not a triad of three entities of EA [energy availability], menstrual function and bone health, but rather a syndrome resulting from relative energy deficiency that affects many aspects of physiological function including metabolic rate, menstrual function, bone health, immunity, protein synthesis, cardiovascular and psychological health.”

The IOC consensus group determined a more accurate moniker for this clinical phenomenon is “relative energy deficiency in sport” (RED-S), which they wrote, “refers to impaired physiological function including, but not limited to, metabolic rate, menstrual function, bone health, immunity, protein synthesis, cardiovascular health caused by relative energy deficiency.”

As this niche of sports nutrition continues to expand with more understanding, opportunities may abound to help female (and male) athletes who rigidly sustain very low body fat for athletic achievement to also stave off effects such as low energy availability. ✦



Lisa Schofield is a veteran writer and editor who got her start interviewing rock stars for national music magazines. She now writes and edits content for B2B media and suppliers in the natural health product industry. Schofield has served as editor for *Vitamin Retailer* and *Nutrition Industry Executive*, and prior to that as associate editor for *Whole Foods Magazine*.

References

- Nattiv A et al. “American College of Sports Medicine position stand: The female athlete triad.” *Med Sci Sports Exerc.* 2007;39(10):1867-1882.
- Motkin E, Curry EJ, Whitlock K. “Female Athlete Triad: Past, Present, and Future.” *J Am Acad Orthop Surg.* 2015;23(7):424-432.
- Tenforde AS et al. “Association of the Female Athlete Triad Risk Assessment Stratification to the Development of Bone Stress Injuries in Collegiate Athletes.” *Am J Sports Med.* 2017;45(2):302-310.
- Bierz K, McCambridge T. “Amenorrhea in the Female Athlete: What to Do and When to Worry.” *Pediatric Annals.* 2016;45(3):e57-61-2.
- Rush MJ, Nichols JF, Barrack ML. “Relationships among injury and disordered eating, menstrual dysfunction, and low bone mineral density in high school athletes: a prospective study.” *J Athl Train.* 2010;45(3):243-252.
- Rush MJ, Barrack M, Nichols JF. “Associations between the female athlete triad and injury among high school runners.” *Int J Sports Phys Ther.* 2014;9(7):948-958.
- Quah YW et al. “The female athlete triad among elite Malaysian athletes: prevalence and associated factors.” *Asian Pac J Clin Nutr.* 2009;18(2):200-208.
- Krapen MHU et al. “Three-year low-dose menaquinone-7 supplementation helps decrease bone loss in healthy postmenopausal women.” *Osteoporos Int.* 2013;24(9):2499-2507.
- Van Summeren MGH et al. “The effect of menaquinone-7 (vitamin K2) supplementation on osteocalcin carboxylation in healthy prepubertal children.” *Br J Nutr.* 2009;102(8):1171-1178.
- Medelli J et al. “Is Osteopenia a Health Risk in Professional Cyclists?” *J Clin Densitom.* 2009;12(1):28-34.
- Kneifel HC, Mueller-Autz M. “Improved bone healing after oral application of specific bioactive collagen peptides.” *Nutraceuticals.* 2018;17:185-188.
- Barraki S et al. “Effect of methylsulfonylmethane supplementation on exercise-induced muscle damage and total antioxidant capacity.” *J Sport Med Phys Fit.* 2012;52:170-174.
- Van der Merwe M, Bloomer RJ. “The Influence of Methylsulfonylmethane on Inflammation-Associated Cytokine Release before and following Strenuous Exercise.” *J Sports Med.* 2016;2016:7498359.
- Henkel FR et al. “Tongkat Ali as a Potential Herbal Supplement for Physically Active Male and Female Seniors.” *Phytother Res.* 2014;28(4):544-550.
- Mountjoy M et al. “The IOC consensus statement: beyond the Female Athlete Triad—Relative Energy Deficiency in Sport (RED-S).” *Br J Sports Med.* 2014;48:491-497.