

Female College Athletes and Osteoporosis: Strategies for Prevention and Treatment

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For some female athletes, a risk exists for the development of one or more of the medical disorders that comprise the female athlete triad: the related conditions of disordered eating, amenorrhea, and osteoporosis. These disorders may lead to significant morbidity and a high rate of mortality. The female college athlete, driven to excel in her sport and pressured to fit a thin athletic image, is at risk for the development of premature osteoporosis. College counselors and advisors can be instrumental in the prevention and treatment of these problems in female college athletes.

Osteoporosis is one of the most prevalent diseases of aging, affecting more than 25 million people in the United States (Tostoi & Leven, 1992). Each year more than 1.3 million people suffer bone breaks in their hips, backs, and wrists due to osteoporosis (National Osteoporosis Foundation, 1995). Women are most often the victims of this type of osteoporosis, six to one over men (Tostoi & Leven). Osteoporosis develops without warning. People cannot tell that they are losing bone tissue until it is too late: then dramatic symptoms suddenly emerge. As hypertension is known as the silent killer, osteoporosis is the silent thief, slowly and insidiously robbing the skeleton of its banked resources.

Osteoporosis often first becomes apparent when someone's hip suddenly gives way. Even the slight shock of stepping down off a curb may be enough to shatter a bone made porous by loss of minerals. The break is not clean; the bone explodes into fragments so numerous and scattered that they cannot be reassembled.

Bone is composed of lacy, calcium-containing crystals. These crystals give up calcium to the blood when the day's supply from the diet runs short, and they take up calcium again when the dietary supply is plentiful. Bone is generously supplied with blood vessels and is metabolically active. It is sensitive to hormones that govern day-to-day deposits and withdrawals of calcium, and it readily gives up minerals whenever blood calcium needs replenishing. Losses of bone start becoming significant for men and women in their 30s, although losses can

occur whenever calcium withdrawals exceed deposits.

A factor that weighs in the balance of bone deposits and withdrawals is calcium nutrition in childhood and young adulthood. Without sufficient calcium, peak bone mass will be less than optimal (Bronner, 1994). Scientists agree that bone strength later in life depends on how well the bones are developed and maintained during youth, and that adequate calcium nutrition during the growing years is essential to achieving optimal peak bone mass (Heaney, 1993). It is this agreement on which the Committee on Dietary Allowances bases its recommendations of 1200 milligrams of calcium per day for everyone 11 through 24 years of age.

A low calcium uptake into bones during childhood and youth leads to susceptibility to osteoporosis later. Nutritional causes of low calcium uptake early in life include deficiencies of vitamin D and calcium. Unfortunately, few females meet the Recommended Dietary Allowance (RDA) for calcium during their bone-forming years. Even if they do meet the RDA, it may not be high enough to achieve the maximum bone mass (Holbrook, Barrett-Conner, & Wingard, 1988). This may mean that most female adolescents start their adult lives with less than optimal bone density. This problem is a special concern for female athletes as they often have insufficient calcium intakes and pronounced nutrient needs.

The Special Problem of the Female Athlete

Many young athletes restrict calcium and energy intakes to improve performance, enhance the aesthetic appeal of their performance, or meet weight guidelines of their specific sports (Wilson, 1994). The increasing incidence of abnormal eating habits among athletes is causing concern, especially for female athletes.

Many female athletes appear healthy but are in fact at risk of developing a potentially fatal triad of medical problems: disordered eating, amenorrhea, and osteoporosis. These three associated disorders are called the female athlete triad (Skolnick, 1993). These disorders may lead to significant morbidity, and even to a high rate of mortality (Palla & Litt, 1988). The young female athlete, driven to excel in her sport and pressured to fit a thin athletic image, is at risk for the development of disordered patterns of eating (Brownell, Steen, & Wilmore, 1987). These patterns often lead to menstrual dysfunction (DeSouza & Metzger, 1991) and subsequent premature osteoporosis (Drinkwater, Bruemner, & Chestnut, 1990). Alone, each disorder is of significant medical concern, but when all three components of the triad are present, there is the potential for a more serious impact on health and mortality. In addition, there may be lifelong psychological problems resulting from any one or combination of the female athlete triad disorders.

Another factor affecting this situation is the illusion of immortality held by many young, healthy individuals, including college students. Young people often do not feel vulnerable to even dangerous health problems (see Butki, Andersen, & Heyman, this volume). This indifference creates a barrier that may interfere with educational efforts as these students are likely to regard osteoporosis as a distant issue. One study of young women demonstrated that they were, indeed, aware of the risks of osteoporosis; however, they were unconcerned about the specific potential harm to them as individuals (Anderson, Auld, & Schiltz, 1996).

Disordered Eating

Disordered eating refers to the spectrum of abnormal patterns of eating, including behaviors such as bingeing, purging, or both; food restriction; prolonged fasting; use of diet pills, diuretics, or laxatives; or other abnormal eating behaviors; thought patterns such as preoccupation with food; dissatisfaction with body; fear of becoming fat; and a distorted body image (Ratnasuriya, Eisler, & Szmakler, 1991). At the extreme, disordered eating includes both anorexia nervosa and bulimia nervosa, but not all athletes with abnormal or pathological eating behaviors meet the official criteria for these disorders. Still, their eating behaviors and thought patterns are abnormal enough to incur the risk of developing osteoporosis and the other serious endocrine, metabolic, skeletal, and psychiatric disorders observed in these conditions (Nelson, Fisher, & Catsos, 1986; Warren, Stanton, & Blessing, 1990).

Some authorities have suggested that at least part of the reason many athletic women engage in self-destructive eating behaviors is because they and their coaches have adopted unsuitable weight standards. These harmful weight standards often result from a "win-at-all-cost" attitude held by many coaches and often reinforced by parents. Coaching strategies using strict weight standards, such as daily or frequent weigh-ins, seem to be common themes in the history of the athlete who develops disordered eating patterns. The use of punitive measures or negative reinforcement for weight gain or poor performance is also a common predisposing factor to the development of pathogenic forms of eating or food restriction (Nattiv, Agostini, Drinkwater, & Yeager, 1994). Society also contributes to the occurrence of disordered eating by supporting and rewarding athletes who excel and who fit the image of what it thinks the athlete should look like. The image is often a small, thin, petite athlete in certain sports.

The prevalence of disordered eating in young female athletes has been reported at 15% to 62% (Sundgot-Borgen, 1994), and it is believed that this reported risk underestimates the actual risk. Much of what is available is from self-report questionnaires. Sundgot-Borgen has identified some of the risk factors for eating disorders in young women athletes. Dieting at an early age is one risk factor. Many young women begin dieting because their coaches recommend they lose weight. These women may perceive weight loss to be a requirement for peak performance, and are therefore driven to lose as much weight as possible. Unsupervised dieting is another risk factor: The restrictive diets many athletes adopt fail to meet the high energy needs of athletes in training.

Amenorrhea

Amenorrhea (secondary) refers to the absence of at least three to six consecutive menstrual cycles in women who have already begun menstruating. A spectrum of menstrual irregularities often is seen in the female athlete. Contrary to previous notions, amenorrhea is not a normal adaptation to strenuous physical training; it is a symptom of a problematic situation (Skolnick, 1993). Amenorrhea is characterized by low blood estrogen, infertility, and often bone mineral losses.

Bone swindles rapidly when the hormone estrogen diminishes and menstruation ceases. When young women experience reduced estrogen secretion and cease

menstruating, they too, lose bone rapidly. The combination of irregular or absent menstrual periods and low body weights explains much of the bone loss seen in young athletes (Drinkwater et al., 1990).

The prevalence of amenorrhea among premenopausal women in the United States is about 2 to 5 percent overall, but among female athletes, it may be as high as 66 percent (Ottis, 1992; Yeager, 1993). Some research seems to indicate that decreased energy intake and depleted body fat contribute to amenorrhea (Benson, 1989). Other studies indicate that percentage of body fat is not critical for normal menstruation in athletes (Baer & Taper, 1991). However amenorrhea develops, amenorrheic athletes are more likely to suffer bone loss than other women. The female athlete seems to be most vulnerable to developing these problems during adolescence and young adulthood. This time-sensitive period is crucial because skeletal integrity is at risk, as the most rapid growth and development of the skeleton occurs during this time (Recky, Davies, & Hindus, 1992).

Osteoporosis

Osteoporosis in this group of young female athletes causes premature bone loss and inadequate bone formation, resulting in low bone mass, microarchitectural deterioration, increased skeletal fragility, and an increased risk of fracture (Cann, Martin, & Genant, 1984; Loucks, 1990). Once menstrual dysfunction develops, estrogen levels drop to a postmenopausal level and there is a rapid loss of bone in the spine (Feicht & Johnson, 1978). The spinal density of some young female athletes is similar to that of women in their 70s and 80s and may never return to normal (Nattiv et al., 1994). These athletes are at increased risk for all stress fractures including serious fractures of the pelvis, hip, and spine (Lloyd & Triantafyllon, 1986). Studies suggest that premature osteoporosis that occurs in the young female athlete and may be irreversible even with calcium supplementation, resumption of menses, or estrogen replacement therapy (Cann et al., 1984; Prior, Vigna, Schechter, & Burgess, 1990).

Osteoporosis increases susceptibility to stress fractures and bone breakage during physical activity. In general, weight-bearing activity, dietary calcium, and the hormone estrogen protect against bone loss (Edelstein & Barrett-Conner, 1993), but in women with disordered eating and amenorrhea, strenuous activity may impair bone health. The combination of a too-slender body, severely restricted energy intake, extreme daily exercise, and the absence of menstruation reliably predict bone loss (Drinkwater et al., 1990). One study found that dancers with recent stress fractures had low body weights, a high incidence of eating disorders, and ate diets low in fat and energy (Frusztajer, 1990). Vigorous training combined with low food energy intakes and other life stresses seem to trigger amenorrhea and promote bone loss.

Proposed Strategies

The significant health problems occurring as a result of the female athlete triad have led to the definition of the scope of the problem on national and international levels. Through national educational forums and communication with members of the United States Congress, problems of the female athlete triad have

been recognized. Legislation in the area of disordered eating has been instituted as part of the Women's Health Equity Act of 1993, making this a priority item regarding women's health issues. The Eating Disorders Information and Education Act has been incorporated with the purpose of providing information and education on the prevention and treatment of eating disorders and subsequent medical problems (American College of Sports Medicine, 1992).

The American College of Sports Medicine's (1992) Ad Hoc Task Force on Women's Issues in Sports Medicine and the Women's Health Equity Act have designed a global prevention and treatment plan to address strategies for future prevention and treatment of the female athlete triad disorders. Proposed strategies for prevention include widespread education of health care professionals, athletes, coaches, parents, and members of society about this triad of disorders and the harmful consequences that result; and identification of those at risk of developing the female athlete triad. Proposed treatment strategies include:

1. Screening of athletes to facilitate early treatment of these problems before they escalate to a point of causing excessive physical and emotional harm.
2. Encouraging amenorrheic athletes to consume at least 1500 milligrams of calcium each day and multivitamin-mineral supplements at RDA levels.
3. Encouraging athletes to consume well-balanced diets that contain sufficient food energy to support activities.
4. Encouraging athletes to modify activity so that they expend no more energy than they consume.
5. Encouraging athletes to use liquid supplementation when they cannot achieve adequate intake with solid food.
6. Encouraging athletes to engage in interactive nutrition counseling as an ongoing process.
7. Encouraging female amenorrheic athletes to begin hormone replacement therapy (if deemed appropriate by the physician).

Implications for Counselors

Counselors and advisors working with student athletes can be valuable in addressing this problem. They need to be aware that the key to the diagnosis of any one or all components of the female athlete triad is an increased awareness of the existence of the problem and of the presenting signs and symptoms (Nattiv et al., 1994). Counselors and advisors can play key roles in identifying and educating those at risk. They should consider all female athletes to be potentially at risk for the development of the female athlete triad of disorders (Nattiv et al.; Yeager, 1993). Women involved in sports in which low body weight and a lean physique is considered an advantage (gymnastics, figure skating, ballet dancing, distance running) appear to be most at risk, especially in the elite or highly competitive levels. Judging for some sports can be subjective and may be influenced by height, weight, age, and body type. Athletes in individual sports seem to be at higher risk than athletes in team sports. In addition, some athletes do not have the genetics to attain the presumed "ideal" body type of their sport. This sport-athlete mismatch can place an athlete at tremendous risk for problems of the athlete triad. (Risk factors for this triad of disorders are summarized in Table 1.)

TABLE 1
Risk Factors for the Female Athlete Triad

- Being at a young age (adolescence or young adulthood).
- Feeling pressure to excel at a chosen sport.
- Focusing on achieving or maintaining a "ideal" body weight or body fat percentage.
- Adopting unsuitable or strict weight standards from coaches or parents.
- Participating in endurance sports or competitions that judge performance on aesthetic appeal such as gymnastics, figure skating, or dance.
- Participating in individual sports.
- Being involved in a sport on an elite level.
- Possessing a "win-at-all-cost" attitude.
- Experiencing punitive coaching strategies, especially regarding body weight.
- Being involved in a sport that society expects and rewards a thin body image.
- Undertaking medically unsupervised dieting practices.

Counselors and advisors are in a unique position to screen and educate because they have the opportunity to establish rapport with college athletes. During counseling sessions, they can ask questions to screen the athlete for disordered eating, amenorrhea, or other patterns of menstrual irregularity, as well as inquire about history of stress fractures or other potentially pathologic fractures. Because of their frequent and varied interactions with student-athletes, counselors and advisors often hear about, and are in an advantageous position to address other issues such as life stressors, depressive symptoms, dissatisfaction with weight or body shape, training intensity, and other lifestyle behaviors. In addition, formal and informal counseling sessions present excellent educational opportunities.

Counselors and advisors can also play integral roles in informing members of the health care team regarding this problem. They can refer student athletes to appropriate health care providers (physicians, health educators, nutritionists, and psychologists) when they suspect a potential problem. In addition, through the referral process, they can inform administrators, athletic associations, coaches, athletic trainers, and parents regarding risks of the female athlete triad. Screening, referral, and education are key to prevention and treatment of the female athlete triad.

Educational efforts should be designed to communicate the following facts about performance (Nattiv et al., 1994):

1. That it is a fallacy to assume that continued weight loss will ensure improvement in athletic performance.
2. Muscle mass, as well as body fat, is lost during extreme dieting and performance may actually deteriorate.
3. Other side effects of poor nutrition such as fatigue, anemia, electrolyte abnormalities, and depression can also contribute to poor athletic performance.

When educating college athletes about the potential harmful effects of the female athlete triad, the wise counselor will be aware that these young individu-

als are in the midst of a significant developmental period characterized by the illusion of immortality. Educators are likely to encounter indifference as young adults are likely to regard osteoporosis as a distant issue. Focusing on how this harmful condition can impair athletic performance in the present is more likely to be well received than stressing solely the harmful effects of osteoporosis in the future.

References

- American College of Sports Medicine. (1992). The female athlete triad: Disordered eating, amenorrhea, osteoporosis: call to action. *Sports Medicine Bulletin*, 27, 4.
- Anderson, J. E., Auld, G. W., & Schiltz, C. M. (1996). Young women and osteoporosis: Aware but unconcerned. *Journal of Wellness Perspectives*, 12 (2), 63-69.
- Baer, J. T., & Taper, L. J. (1991). Amenorrheic and eumenorrheic adolescent runners: Dietary intake and exercise training status. *Journal of the American Dietetic Association*, 92, 89-91.
- Benson, J. E. (1989). Relationship between nutrient intake, body mass index, menstrual function, and ballet injury. *Journal of the American Dietetic Association*, 89, 58-63.
- Bronner, F. (1994). Calcium and osteoporosis. *American Journal of Clinical Nutrition*, 60, 831-836.
- Brownell, K. D., Steen, N., & Wilmore, J. H. (1987). Weight regulation practices in athletes: Analysis of metabolic and health effects. *Medicine and Science in Sports and Exercise*, 19, 546.
- Cann, C. E., Martin, M. C., & Genant, H. K. (1984). Decreased spinal mineral content in amenorrheic women. *Journal of the American Medical Association*, 251, 626.
- DeSouza, M. J., & Metzger, D. A. (1991). Reproductive dysfunction in amenorrheic athletes and anorexic patients: A review. *Medicine and Science in Sports and Exercise*, 23, 995.
- Drinkwater, B. L., Bruemner, B., & Chestnut, C. H. (1990). Menstrual history as a determinant of current bone density in young athletes. *Journal of the American Medical Association*, 263, 545-548.
- Edelstein, S. L., & Barrett-Connor, E. (1993). Relation between body size and bone mineral density in elderly men and women. *American Journal of Epidemiology*, 138, 160-169.
- Feicht, C. B., & Johnson, T. S. (1978). Secondary amenorrhea in athletes. *Lancet*, 2, 1145.
- Frusztajer, N. T. (1990). Nutrition and the incidence of stress fractures in ballet dancers. *American Journal of Clinical Nutrition*, 51, 779-783.
- Heaney, R. P. (1993). Nutritional factors in osteoporosis. *Annual Reviews of Nutrition*, 13, 287-316.
- Holbrook, T. L., Barrett-Connor, E., & Wingard, D. L. (1988). Dietary calcium and risk of hip fracture: 14-year prospective population study. *Lancet*, 12, 1046-1049.
- Lloyd, T., & Triantafyllon, S. J. (1986). Women athletes with menstrual irregularity have increased musculoskeletal injuries. *Medicine and Science in Sports and Exercise*, 18, 374.
- Loucks, A. B. (1990). Effects of exercise training on the menstrual cycle: Existence and mechanisms. *Medicine and Science in Sports and Exercise*, 22, 275.
- National Osteoporosis Foundation. (1995). *A Status Report on Osteoporosis: The Challenge to Midlife and Older Women*. (Older Women's League, Osteoporosis Fact Sheet).
- Nattiv, A., Agostini, R., Drinkwater, B., & Yeager, R. K. (1994). The female athlete triad: The interrelatedness of disordered eating, amenorrhea, and osteoporosis. *Clinics in Sports Medicine*, 13, 405-417.
- Nelson, M. E., Fisher, E. C., & Catsos, P. D. (1986). Diet and bone status in amenorrheic runners. *American Journal of Clinical Nutrition*, 43, 910.
- Ottis, C. L. (1992). Exercise-associated amenorrhea. *Clinics in Sports Medicine*, 11, 351.
- Palla, B., & Litt, I. F. (1988). Medical complications of eating disorders in adolescents. *Pediatrics*, 81, 613.
- Prior, J. C., Vigna, Y. M., Schechter, M. T., & Burgess, A. E. (1990). Spinal bone loss and ovulatory disturbances. *New England Journal of Medicine*, 323, 1221-1227.
- Ratnasuriya, R. H., Eisler, J., & Szmakler, G. I. (1991). Anorexia nervosa: Outcome and prognostic factors after 20 years. *British Journal of Psychiatry*, 158, 495.
- Recky, R. R., Davies, K. M., & Hindus, S. M. (1992). Bone gain in young adult women. *Journal of the American Medical Association*, 268, 2403.
- Skolnick, A. A. (1993). "Female athlete triad" risk for women. *Journal of the American Medical Association*, 270, 921-923.
- Sundgot-Borgen, J. (1994). Risk and trigger factors for the development of eating disorders in female elite athletes. *Medicine and Science in Sports and Exercise*, 26, 414-419.

- Tostoi, L. G., & Leven, R. M. (1992). Osteoporosis—The treatment controversy. *Nutrition Today (July-August)*, 6-12.
- Warren, B. J., Stanton, A. L., & Blessing, D. L. (1990). Disordered eating patterns in competitive female athletes. *International Journal of Eating Disorders*, 9, 565.
- Wilson, J. H. (1994). Nutrition, physical activity and bone health in women. *Nutrition Research Reviews*, 7, 67-91.
- Yeager, K. K. (1993). The female athlete triad: Disordered eating, amenorrhea, osteoporosis. *Medicine and Science in Sports and Exercise*, 25, 775-777.

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