

## **The Underlying Role of Caloric Restriction in the Female Athlete Triad**

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### **ABSTRACT**

**CLINICAL PRESENTATION & EXAM:** The prevalence of the female athlete triad in sports with emphasis on aesthetics (cheerleading, ballet, gymnastics) or lean body mass (endurance sports) is very high. These athletes, in expense for achieving their best performance, elect to reduce their weight by practicing unhealthy behaviors such as caloric restriction. Such common practices may include increasing energy expenditure via increased training load (overtraining) or lowering their energy intake (EI). Female athlete triad is manifested by disordered eating (DE) or behaviors that may lead to eating disorders (ED), low bone mineral density (BMD), and amenorrhea. Observations of lower than anticipated performance and consecutive injuries, especially stress fractures, may warrant a dietary assessment. Diagnosis of all three components is not required for proper treatment for the syndrome as simply restricting caloric intake may be the principal factor for low BMD or amenorrhea. **ANATOMY & PATHOLOGY:** Athletes require substantial calories due to the excess energy expenditure from high volume training. Low EI will impact the nutrients necessary for metabolic processes through impaired thyroid function. A diet that lacks calcium, iron, and other minerals and cofactors can lead to low BMD. Caloric restriction and reduced fat in the diet can initiate weight loss and the downregulation of estrogen via the hypothalamus. Subsequently, a reduction in weight can elicit a decrease in luteinizing hormone (LH) pulses which triggers lower estrogen levels, causing amenorrhea. Therefore, caloric restriction will logically lead to low estrogen levels (hypoenestrogenism) that can cause reduced bone deposition by lowering osteoblast activity and increasing bone resorption. In addition, caloric restriction can further inhibit estrogen levels through increasing cortisol levels. A caloric imbalance also alters physiological responses including a decrease in insulin, leptin, and triiodothyronine (T3) and an increase in ghrelin which will impact food consumption and digestion of essential macronutrients. **DIAGNOSTIC TESTING & CONSIDERATIONS:** Drastic changes in weight or appearance can first be observed by athletes' social groups to suspect caloric restriction or ED. Requiring athletes to keep food diaries may assist health professionals, coaches, and trainers in determining dietary intake prior to measuring athletes' body mass index (BMI). Diagnosis of DE should be conducted via the Eating Disorder Examination interview (EDE-17) and observing the presence of a low basal metabolic rate measured by O<sub>2</sub> consumption through indirect calorimetry. Low levels of T3 and metabolic hormones can be examined as well. **TREATMENT & RETURN TO ACTIVITY:** The treatment of caloric restriction should involve an increase in EI, reduction in exercise load, or some combination of the two to reestablish undernourished athletes through a balanced caloric intake. A multidisciplinary approach beyond health and nutrition may be supplemented with psychology through cognitive behavioral therapy. Adjustments in caloric restriction usually take at least one year to increase body weight, and those will positively affect amenorrhea and low BMD by increasing estrogen levels and calcium absorption, respectively. Return to activity requires increasing caloric intake for proper healing of injuries and restoration of regular menses. Changes in BMD show marked increases within 3 months of treatment while regular menstruation may return following a year or more.