21. SPECIAL CONCERNS OF THE FEMALE ATHLETE

Aurelia Nattiv and Mary Lloyd Ireland

I. Introduction

A. History of women in sports

1. For centuries, women participated very little in sports and athletic competition. In fact, in the early 1900s women were excluded from the modern Olympic games because participation in sports was thought to be too stressful for them.

2. The adoption of Title IX to the Education Amendments Act in 1972 led to a dramatic increase in female sports participation and had a great impact on women in sport. Title IX states that men and women should have the same opportunities for participation in sports and exercise.

II. Physiological Differences in Females and Males

A. Pre- and postpubertal differences

1. There is no significant difference in the physical capabilities of prepubertal boys and girls (controlling for body size and composition).

2. With puberty, girls show a relative increase in body fat and boys a relative increase in lean body mass (mostly due to hormonal influences). This inequality of muscle mass after puberty in women is reflected in their decreased muscle strength, power, and speed, as compared with that of men.

B. Muscle strength

1. Strength differences between women and men are more apparent in the upper extremity. Upper extremity strength in women averages 40% to 75% that of men, while lower extremity strength in women averages 60% to 80% that of men. However, women have the same capacity for strength gains as men (controlling for body composition and size). This is because strength gains are the result of both neuromuscular recruitment and muscle hypertrophy. Women do not experience the same degree of increased muscle hypertrophy as men, primarily because their testosterone levels are lower.

C. Aerobic capacity: Maximum oxygen uptake ($V_{\text{O}_{2}\text{MAX}}$)

1. Women have a lower maximal level of aerobic capacity (after puberty) than men, due to several factors: lower oxygen-carrying capacity, lower hemoglobin content, lower blood volume (relative to lean body mass), smaller hearts (relative to lean body mass), lower stroke volume, higher percentage of body fat, and smaller muscle fiber area.

2. Athletic training programs produce similar increases in aerobic capacity in males and females (controlling for body composition and size).

D. Endurance performance

1. Endurance performance is 6% to 15% lower in women in most endurance events. This can be partially explained by the larger muscle fibers in men (both fast- and slow-twitch muscle fibers), although the actual muscle fiber composition is similar in men and women.

2. Athletic training programs (interval and continuous) produce similar improvements in endurance performance in men and women.

E. Menstrual cycle and performance

1. Although there is a lack of research regarding menstrual cycle and performance, most studies have shown no significant difference in athletic performance in females during the different phases of the cycle. Similarly, most studies report no significant benefit or detriment to athletic performance in women taking oral contraceptive pills.
III. Musculoskeletal Considerations
A. Common musculoskeletal problems
1. Injury rates
   a. Few true epidemiologic studies have compared male and female injury rates. The rates of injury documented by the military studies are about equal.
   b. Each year, the National Collegiate Athletic Association (NCAA) sends injury surveys to its member institutions. There are two true sex-comparable sports, basketball and soccer. The additional women's sports included in the injury surveys are gymnastics, volleyball, softball, lacrosse and field hockey. Men's sports included in the injury survey are ice hockey, wrestling, gymnastics, lacrosse, spring football, baseball and football.
      (1) A comparison of the rates of injury with number of injuries per 1,000 athletic contests, averaged over a 3-year period, demonstrated that there was no significant change in the rate of injuries in each sport in the 3 years.
   c. More studies comparing differences in injury patterns need to be conducted at many levels.
2. Specific sport demands
   a. In female sports, there are fewer traumatic collision mechanisms and more repetitive axial loading microtraumatic overuse problems.

![Fig. 21-1. Lower-extremity alignment: Q-angle is a measure of patellofemoral alignment. It is measured as the angle formed by the intersection of a line from the anterior superior iliac spine to the center of the patella and a line from the center of the patella to the tibial tubercle. Normal is less than 12 degrees. Quadriceps muscles are labeled with their force vectors (VI, vastus intermedius; RF, rectus femoris; VMO, vastus medialis obliquus; VL, vastus lateralis).](image1)

![Fig. 21-2. Lower extremity alignment of miserable malalignment syndrome: Changes in patellar alignment and muscle force vectors are shown in miserable malalignment syndrome. Increased femoral anteversion, external tibial torsion, and foot pronation, along with the increased Q-angle and VMO hypoplasia/dysplasia, all create forces that laterally subluxate and tilt the patella (VL, vastus lateralis; VMO, vastus medialis oblique).](image2)
Special Concerns of the Female Athlete

Fig. 21-3. Female lower extremity: Wider pelvis, increased femoral anteversion, external tibial torsion, forward foot/planus, less thigh development, less developed rectus femoris (VMO), and less range of motion of knee joint.

Fig. 21-4. Male lower extremity: More narrow pelvis, less femoral anteversion, narrower femoral notch, neutral (or slight internal) tibial torsion, genu vara, more thigh musculature development, more developed rectus femoris (VMO), and more range of motion of knee joint.

1. Unique and specifically applied stresses are used in gymnastics.
2. Frequent fractures are common in certain locations.
3. Stress fractures (see Chapter 37)

4. Patellofemoral disorders (see Chapter 53)

- Assess level of risk of completion of fracture
  - Stress fracture at risk of progression
    - More aggressive treatment
    - At-risk locations:
      - Hip—Distraction side—lateral femoral neck
      - Mid-tibial—vastus medialis obliquus (VMO) dysplasia, external tibial torsion
      - Tarsal navicular
      - Fifth metatarsal—Jones’ type
      - Proximal second metatarsal
      - Sesamoids—great toe
      - Intraarticular—unusual
  - Not at risk of progression
    - Non-Jones
    - Nonproximal second metatarsal

5. After second stress fracture, bone density study should be considered.
tion, and forefoot pronation, all of which create forces which laterally sublux and tilt the patella (Fig. 21-2).

3. Increased valgus and patellar hypermobility are more common in the female.

b. Anterior knee pain

1. Anterior knee pain is the most common complaint of the young female athlete.

2. Make a specific diagnosis (Table 21-1). Only when a specific diagnosis is made can appropriately directed treatment be instituted.

5. Anterior cruciate ligament tears (ACL) (see Chapter 50)

a. Epidemiology

1. At the Olympic level, in women’s basketball and team handball, there is a significantly greater risk of noncontact ACL tears. Estimates are four to six times greater in females.

2. Collegiate level: ACL tears occur at a more frequent rate: 4.1 times more in females in basketball and 2.4 more in women in soccer. Noncontact increased rate in females was 5.3 in basketball and 3.4 in soccer.

3. High school level: The need for knee surgery was greater in girls’ basketball than in boys’ football. The overall injury rate per athlete per season was similar in both girls’ basketball and boys’ football, but for severe injuries was greater in girls’ basketball than in boys’ football.

b. Anatomic differences between females and males play a role. Female alignment is shown (Fig. 21-3). Alignment differences include wider pelvis, femoral anteversion, external tibial torsion, pes planus, less thigh development, and less developed VMO, causing female athletes to have more of a ligament-dominant knee; increased flexibility, range of motion (ROM), and genu valgum are more common in female athletes. In male athletes, alignment of a more narrow pelvis, less femoral anteversion, wider femoral notch, internal or neutral tibial torsion, and genu varum are common, as are a more muscle-dominant structure of more developed thigh musculature, VMO hypertrophy. Less flexibility results in a muscle-dominant, less ligament-dominant knee in males (Fig. 21-4).

c. Factors contributing to ACL injuries

1. Intrinsic factors

(a) Physiologic rotatory laxity
(b) Size of ACL
(c) Valgus alignment
(d) Hyperextension
(e) Proprioception
(f) Neuromuscular firing order
(g) Hormonal influences

2. Extrinsic factors

(a) Strength
(b) Conditioning
(c) Shoes
(d) Motivation
(e) Deceleration forces

3. Both

(a) Skill
(b) Coordination

4. The most important factors in the increased incidence of noncontact injuries in the female athlete are physiologic rotatory laxity, proprioception and neuromuscular firing patterns. Improvement is needed in the level of youth physical education and movement patterns, strength, and balance. Teaching a basketball athlete to land on both feet and to use posterior directed forces should help. Screening for high-risk factors should reduce incidence of injury.

IV. Female Athlete Triad: Disordered Eating, Amenorrhea, and Osteoporosis

A. Definition of the triad

1. The female athlete triad represents the interrelationship and often coexistence of disordered eating patterns, amenorrhea, and osteoporosis. These problems represent a growing concern in sports medicine. Each component of the triad is defined in sections V and VI. The constant focus on achieving and/or maintaining an “ideal” body weight and/or “optimal” body fat often is the underlying theme.

B. Prevalence of the triad in athletes

1. The true prevalence of the female athlete triad is unknown and difficult to determine, but a triad profile has become apparent. The female athlete triad appears to be more prevalent among athletes competing in appearance or endurance sports: gymnasts, figure skaters, dancers, runners (distance), and swimmers, although athletes of all sports are potentially at risk. It is also more common in adolescent and young adult age groups.

2. The prevalence of amenorrhea and disordered eating in athletes is noted in sections V. B. and VI. B. The prevalence of osteoporosis in young female athletes is unknown.

C. Health consequences of the female athlete triad

1. The potential exists for short- and long-term health consequences as well as psychological, medical, and orthopaedic repercussions of disordered eating, amenorrhea, and premature osteoporosis. (Refer to sections V. C. and VI. D.)

V. Menstrual Dysfunction and Bone Concerns in the Female Athlete

A. Introduction

1. Hormonal status has a significant effect on bone in young as well as in older persons who exercise. The various types of menstrual dysfunction most common in premenopausal female athletes and their effects on bone are summarized below:

a. Luteal phase dysfunction: Inadequate levels of progesterone; normal or shortened cycle length; may be an adaptive response to exercise. Effect on bone mass is still controversial.

Table 21-1. Differential diagnosis of anterior knee pain

<table>
<thead>
<tr>
<th>Mechanical</th>
<th>Inflammatory</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patella</td>
<td>Burntis</td>
<td>Reflex sympathetic</td>
</tr>
<tr>
<td>Subluxation</td>
<td>Prepatellar</td>
<td>Dystrophy</td>
</tr>
<tr>
<td>Dislocation</td>
<td>Retropatellar</td>
<td>Tumor</td>
</tr>
<tr>
<td>Fracture</td>
<td>Semimembranous</td>
<td></td>
</tr>
<tr>
<td>Stress</td>
<td>Tendinitis</td>
<td></td>
</tr>
<tr>
<td>Acute (transverse)</td>
<td>Patellar</td>
<td></td>
</tr>
<tr>
<td>Bipartite</td>
<td>Pes anserinus</td>
<td></td>
</tr>
<tr>
<td>Fibrous nonunions</td>
<td>Semimembranous</td>
<td></td>
</tr>
<tr>
<td>Acute fracture</td>
<td>Synovitis</td>
<td></td>
</tr>
<tr>
<td>Quadriceps rupture</td>
<td>Arthritis</td>
<td></td>
</tr>
<tr>
<td>Patella tendon rupture</td>
<td></td>
<td></td>
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<tr>
<td>Inferior avulsion</td>
<td></td>
<td></td>
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<tr>
<td>Interstitial</td>
<td></td>
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<tr>
<td>Patellofemoral stress syndrome</td>
<td></td>
<td></td>
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<tr>
<td>Pathologic plica</td>
<td></td>
<td></td>
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<tr>
<td>Osteochondral fracture</td>
<td></td>
<td></td>
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<tr>
<td>Trochlear groove</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patella</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loose bodies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Osteochondritis dissecans</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

178 21. Special Concerns of the Female Athlete

b. Oligomenorrhea: Menstrual cycle greater than 36 days; may be mena­

low bone density and skeletal development if due to low estrogen state; may contribute to an increased risk of stress fractures and scoliosis.

c. Primary amenorrhea: The lack of menarche by 16 years of age; may

primary amenorrhea. Multiple studies have shown that decreased bone mineral density is generalized throughout the skeleton and can be quite severe. The majority of studies have not

d. Secondary amenorrhea: Absence of three to six consecutive men­

than 3 cycles per year in a woman who has previously had her menarche. Significant negative effects on bone mineral density can be seen in axial and appendicular skeletal sites.

Definition of osteoporosis: Premature bone loss and inadequate bone forma­

2. Low bone density can predispose athletes to stress fractures and potentially devastating osteoporotic fractures later in life. When assessing risk factors for stress fractures, researchers have shown that athletes with stress fractures have lower bone mineral density, calcium intake, and menstrual irregularity, and use fewer oral contraceptives.

3. The prevalence of premature osteoporosis in the premenopausal female athlete is uncertain, but is a significant medical concern in athletes with a history of oligomenorrhea, amenorrhea, and/or disorders of eating.

4. Potential complications of menstrual dysfunction in athletes

b. Amenorrhea: Incomplete or delayed menarche; may be associated with significant decrease in bone density and skeletal development if due to low estrogen state; may contribute to an increased risk of stress fractures and scoliosis.

c. Primary amenorrhea: The lack of menarche by 16 years of age; may

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3 cycles per year in a woman who has previously had her menarche. Significant negative effects on bone mineral density can be seen in axial and appendicular skeletal sites.

1. The prevalence of menstrual dysfunction in the female athlete varies among sports and intensity of training, although other factors are involved. In general, there is an increased prevalence of oligomenorrhea and amenorrhea among athletes, with prevalence rates of secondary amenorrhea between 3-4 and 66% (as compared with the rate of amenorrhea in the general female population of 2-5%).

2. The prevalence of premature osteoporosis in the premenopausal female athlete is uncertain, but is a significant medical concern in athletes with a history of oligomenorrhea, amenorrhea, and/or disorders of eating.

C. Potential complications of menstrual dysfunction in athletes

There are a number of potential complications of menstrual dysfunction in the athletic setting. Problems of some concern include:

1. Exercise-induced amenorrhea. Exercise-induced amenorrhea and to differentiate athletic-associated amenorrhea from amenorrhea due to other causes. Risk factors for athletic-induced menstrual dysfunction include a family history of delayed menarche and irregular menses, excessive training, disordered eating behaviors, abrupt changes in body composition, and stressors. It is important to assess for other apparent etiologies of menstrual dysfunction. Medical history and history of possible associated symptoms (i.e., galactorrhea) are important, as are family history of endocrine disorders or other medical problems.

2. The diagnosis of athletic-associated amenorrhea is a diagnosis of exclusion. A thorough physical examination and pelvic examination are indicated to rule out other causes. Appropriate treatment includes a pelvic examination to assess the potential risk factors in women with athletic-associated menstrual dysfunction who exercise.

3. Laboratory testing may be important to establish the diagnosis of athletic-associated menstrual dysfunction and to rule out other causes. A pregnancy test is essential in sexually active individuals. A thyroid-stimulating hormone (TSH) test to assess for underlying thyroid disease, and a follicle-stimulating hormone (FSH) test to assess hormonal function, and a proestradiol level to assess for a pituitary adenoma, are important screening tests. If the individual complains of hirsutism and acne, or if the findings are noted on examination, assessment of LH and FSH, dehydroepiandrosterone sulfate (DHEA-S), and free testosterone may help in establishing whether polycystic ovarian syndrome exists or is present, excess due to ovarian or adrenal tumors. Indirect testing includes a pregnanediol challenge with medroxy-progesterone acetate (Provera) 10 mg daily for 7 to 10 days. Lack of vaginal bleeding suggests a hypogonadotrophic state, an obstructed outflow tract, or pregnancy.

E. Proposed mechanisms of athletic amenorrhea

There are many theories relating to the mechanisms involved in athletic amenorrhea. The most popular current theories involve an inhibition of the hypothalamic gonadotropin-releasing hormone (GnRH) pulse and reduction in luteinizing hormone (LH) pulse frequency. Low energy availability may disrupt the GnRH pulse. Caloric intake may not be sufficient for the amount of energy being expended in exercise training. A state of negative energy balance exists, resulting in an energy drain manifested by amenorrhea.

F. Decreased bone mineral content in amenorrhea athletes

1. Although exercise can increase bone mineral density in healthy, normally menstruating women, there appears to be a point of diminishing return in women who overtrain and develop athletic-associated amenorrhea and oligomenorrhea. Multiple studies have shown that decreased bone mineral density of bone loss (primarily due to low estrogen) is generalized throughout the skeleton and can be quite severe. The majority of studies have not shown gain in bone density in the premenopausal female athlete, despite estrogen replacement and calcium. Therefore, prevention is important.

2. Low estrogen levels can predispose athletes to stress fractures and potentially devastating osteoporotic fractures later in life. When assessing risk factors for stress fractures, researchers have shown that athletes with stress fractures have lower bone mineral density, calcium intake, and menstrual irregularity, and use fewer oral contraceptives.

G. Stress fractures (See Chapter 37)

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I. Treatment and prevention of menstrual dysfunction in athletes

1. The treatment of menstrual dysfunction in female athletes varies somewhat based on the degree of menstrual dysfunction (see section V.A.). Adequate caloric intake and avoidance of disorders in eating patterns are often key components in the prevention and treatment of menstrual dysfunction. Adequate caloric intake and healthy eating patterns can help prevent the potential negative effects of athletic amenorrhea and oligomenorrhea on bone health. Specific preventive and treatment strategies are outlined, based on the hormonal milieu and type of problem. It must be remembered that the same individual may experience significant hormonal changes throughout her exercising and athletic career and treatment may vary during these times. Luteal-phase dysfunction, oligomenorrhea and amenorrhea in the athletic setting may
to achieve or maintain an ideal body weight and/or optimal body fat, extreme pressure to excel in sport, pressure from coaches (weight standards, mandatory performance expectations), pressure from parents, socioeconomic status, self, low self-esteem, and poor body image. Athletes in sports in which appearance or endurance is important are often at higher risk. A family history of disordered eating or substance abuse and familial dysfunction may also be an underlying factor, as might a history of an eating disorder. Puberty, adolescence, and women's childhood are vulnerable stages of development and it is in these periods of time when most disordered eating problems manifest.

D. Health consequences

1. The health consequences of disordered eating are often lifelong. Psychological and emotional health consequences include the potential for significant morbidity and even mortality with anorexia and bulimia, as well as with disordered eating. Endocrine problems may involve menstrual dysfunction, osteoporosis, and growth and development effects. Nutritional problems may involve pathologic weight loss, high-control techniques, malnutrition, and a starvation state, which can lead to a multitude of problems. Multigland problems of the cardiovascular and gastrointestinal (GI) systems can occur and in the more severe cases these can be a potential negative effect on the entire system.

E. Clinical evaluation

1. History. One must maintain increased awareness of the female athlete triad and potential high-risk groups when screening for these important and often secretive problems. The preparticipation physical examination (PPE) is an ideal time to screen and intervene for both issues of concern. Questions assessing nutritional history, menstrual history and exercise training are important. A 24-hour diet recall, highest and lowest weight in the past 12 months, a list of forbidden foods, and assessment of the athlete's sense of body satisfaction are important. A past or present history should be obtained of laxative use, diet pills, or self-induced vomiting. If a problem is identified, the athlete should be referred for a more detailed assessment and a physical examination can be scheduled at another office visit.

2. Physical examination. A complete physical examination and pelvic examination (if there is menstrual dysfunction) is warranted if there is concern about disordered eating. Some signs/symptoms on physical examination that may be helpful are decreased body temperature, bradycardia, orthostatic hypotension, low blood pressure, edema (anorexia), decreased gastric secretion, swollen parotid glands (bulimia), erosion of tooth enamel, face and extremity edema, ecchymotic areas (bulimia), cardiac arrhythmias, abdominal pain, and delayed gastric emptying in addition to other problems.

3. Laboratory testing may be helpful in some instances. Tests obtained depend on clinical assessment of risk. Patterns that may be seen with disordered eating patterns may include a complete blood count with a low white blood cell (WBC) count, low platelets; a chemistry panel with elevated LFTs (liver function tests), elevated cholesterol levels; thyroid function tests; a low \\( T3 \) and normal \\( TSH \); and electrolytes with low \\( K, Na, Cl, Mg, PO4, Ca \). and urine analysis to assess for ketonuria, pyuria, and hematuria. A ferritin level may be helpful to assess for iron deficiency.

4. An electrocardiogram (ECG) should be obtained in athletes with more significant restrictiveness (anorexia) prior to clearing for sport participation. Assess for prolonged QT interval or other abnormalities if disordered eating is significant or if clinically indicated. (Prolonged QT interval and other ventricular arrhythmias have been noted as causes of death in severely ill patients with anorexia nervosa.)

F. Treatment and prevention

1. The treatment for disordered eating should emphasize prevention. A multidisciplinary team (psychologist, nutritionist, physician, others) is essential in both preventive and treatment efforts. Medication may be

occur on a spectrum (see section VI for definitions of menstrual dysfunction common in athletes).

2. For luteal-phase dysfunction, an effect on bone is not certain. Treatment includes assessment of energy needs and optimal weight maintenance, calcium intake. Hormone therapy may be beneficial.

3. Treatment of oligomenorrhea may vary depending on the woman's age and calcium intake. Hormone therapy may be recommended.

4. The hypoestrogenic amenorrheic woman presents the greatest challenge. A multidisciplinary approach is needed to address the many issues that may be contributory. Use of oral contraceptives or cyclic estrogen/progesterone therapy are recommended to prevent further bone loss and possibly to reduce the risk of stress injury. Decreasing exercise training intensity and/or duration should be considered. To optimize nutrition, calcium intake can be increased to 1,500 mg/day (supplement if indicated). Disordered eating patterns can be treated by considering psychological and nutritional counseling and stress reduction techniques. Bone density testing should be considered for amenorrhea that has been manifest for more than 6 months.

VI. Disordered Eating

A. Definition of terms

1. In the athletic setting, a spectrum of eating patterns exists, from normal eating habits to disordered eating, and to development of eating disordered eating. Disordered eating represents abnormal eating behaviors in persons who do not necessarily fit the psychiatric criteria for anorexia or bulimia nervosa. At the extremes of the disordered eating spectrum lie the frank eating disorders of anorexia and bulimia nervosa, which have stringent psychologic criteria. Many athletes who have poor nutritional habits are at an intermediate point on the spectrum of disordered eating. These athletes are at risk for developing serious endocrine, skeletal, and psychiatric disorders.

2. Features of anorexia nervosa include weight 15% below expected weight, feeling fat when really thin, an intense fear of becoming overweight, and amenorrhea. Features of bulimia nervosa include secretive binge eating, twice a week for more than three months, lack of control over eating, purging behavior (laxative use, diuretic use, self-induced vomiting, overexercising, and overeating disorder) and other problems. Anorexia (restrictive eating) and bulimia (binge/purge behavior) often coexist. Many athletes exhibiting these behavior patterns do not fit the DSM IV criteria for an eating disorder, but may have some of the features of anorexia and bulimia and are at risk for significant health problems. The DSM IV classification of Eating Disorders Not Otherwise Specified is sometimes used in these situations.

B. Prevalence of disordered eating in female athletes

1. The true prevalence of disordered eating in athletes is unknown. Based on a series of small studies there is a reported 15% to 62% prevalence in female athletes. A higher prevalence of disordered eating is often noted among participants in certain sports; sports in which subjective judging and aesthetics are important (gymnastics, dance, figure skating, diving). Sports in which peak performance is associated with low body fat (running—especially distance running—and swimming).

2. The prevalence of anorexia and bulimia in the general female population is an estimated 5% to 5% for bulimia, and 1% to 2% for anorexia.

C. Contributory factors for disordered eating in athletes

1. Although the etiology and pathophysiology of disordered eating is not known, there are some known contributory factors, including the desire
indicated in some cases (SSRIs are promising) along with individual and group therapy. A support network is important, increasing self-esteem often is the focus of therapy sessions. The physician should emphasize optimal health, not disease. Follow/treat the patient if there is menstrual dysfunction (e.g., with ERT, calcium, etc.) for prevention of osteoporosis (dietary approaches, appropriate exercise, possible ERT, or other intervention).

2. Redefining athletic goals is important, if appropriate and removal of at-risk athlete from competition can be considered if medically indicated. Hospitalization may be indicated in some cases.

VII. Nutritional Concerns in the Female Athlete

A. Nutrient requirements
   1. Female athletes have nutrient requirements similar to those of male athletes, with two exceptions: calcium and iron.
   2. Calcium
      1. For hypogonadal amenorrheic women, calcium 1,500 mg/day is needed to maintain calcium balance. For eugonadal women, calcium 1,200 to 1,500 mg/day is needed. Dietary calcium is preferred to supplements.
   3. Iron
      1. Approximately 20% to 30% of female adolescent and young adults (athletes and nonathletes) may be iron deficient. It is important to differentiate iron deficiency anemia from pseudoanemia, which occurs in some athletes (see Chapter 28). Sources of iron loss include menstruation, GI blood loss, sweat, urine and foot strike hemolysis.
      2. It is not cost-effective to screen all female athletes for iron deficiency. Screening high-risk athletes (endurance athletes and others, based on clinical assessment) or those with a previous history of iron deficiency, may be beneficial. Serum ferritin is the most sensitive diagnostic test (more than 12 ng/mL is diagnostic). Because ferritin is an acute-phase reactant, obtaining serum iron studies may be helpful. Iron level is decreased and TIBC level is increased in iron deficiency. Decreased hemoglobin and hematocrit levels may be deceiving and can also be a finding with pseudoanemia of athletes (a physiological dilutional effect).
      3. The effect of anemia on athlete performance is controversial. Mild anemia decreases performance, whereas low ferritin without anemia probably does not.
      4. The treatment of iron-deficiency anemia includes iron supplementation (varying dose depending on severity) and dietary counseling. In iron deficiency anemia without anemia, iron supplementation is controversial.

B. Calcium

C. Iron

D. Treatment includes avoiding excessive fluid ingestion for 2 to 3 hours before an event (tailed to sport and weather conditions to avoid dehydration) and use of a tampon or small sanitary napkin during an event and/or kegel exercises to strengthen muscles of the pelvic floor. Biofeedback and other forms of behavioral therapy may prove beneficial. Physicians should assess such problems and correct menstrual dysfunction if it exists, especially hypogonadal states, which may contribute to stress urinary incontinence (e.g., hormone replacement may be beneficial). Assess and correct for anatomic defects, such as in the posterior urethral angle.

IX. Prevention of Medical and Orthopaedic Problems in the Female Athlete

A. Screening
   1. The PFE is required for many athletes before they participate in organized sports and provides an ideal opportunity to screen athletes and to educate and counsel them. A thorough history is important—be specific in questions and maintain a high index of suspicion for the special concerns of the female athlete. A physical examination should be tailored to the needs of female athletes.

B. Education and counseling
   1. Medical concerns, including endocrine, nutritional, and psychological problems, must be monitored if the athlete is to exercise in a safe and healthy manner.
   2. Orthopaedic concerns include injury prevention—strength and flexibility, correction of biomechanical imbalances, appropriate footwear, and year-round training.

C. Multidisciplinary team
   1. The importance of a multidisciplinary team approach cannot be overemphasized. The primary care physicians ideally should have consultants available in the areas of nutrition, psychology, orthopaedics, and physical therapy/athletic training to assist in medical care of the female athlete when needed.

Suggested Readings


