

Female Athlete Issues for the Team Physician: A Consensus Statement

DEFINITION

Female athletes experience musculoskeletal injuries and medical problems, resulting from and/or impacting athletic activity. Team physicians must understand the gender-specific implications of these issues.

GOAL

The goal is to assist the team physician in providing optimal medical care for the female athlete.

SUMMARY

This document provides an overview of select musculoskeletal and medical issues that are important to team physicians who are responsible for the medical care of female athletes. It is not intended as a standard of care and should not be interpreted as such. This document is only a guide and, as such, is of a general nature, consistent with the reasonable, objective practice of the healthcare professional. Individual treatment will turn on the specific facts and circumstances presented to the physician. Adequate insurance should be in place to help protect the physician, the athlete, and the sponsoring organization.

This statement was developed by a collaboration of six major professional associations concerned about clinical sports medicine issues; they have committed to forming an ongoing project-based alliance to bring together sports medicine organizations to best serve active people and athletes. The organizations are American Academy of Family Physicians, American Academy of Orthopaedic Surgeons, American College of Sports Medicine, American Medical Society for Sports Medicine, American Orthopaedic Society for Sports Medicine, and the American Osteopathic Academy of Sports Medicine.

EXPERT PANEL

Stanley A. Herring, M.D., Chair, Seattle, Washington
John A. Bergfeld, M.D., Cleveland, Ohio
Lori A. Boyajian-O'Neill, D.O., Kansas City, Missouri
Timothy Duffey, D.O., Columbus, Ohio

0195-9131/03/3510-1785

MEDICINE & SCIENCE IN SPORTS & EXERCISE®

Copyright © 2003 by the American College of Sports Medicine, American Academy of Family Physicians, American Academy of Orthopaedic Surgeons, American Medical Society for Sports Medicine, American Orthopaedic Society for Sports Medicine, and American Osteopathic Academy of Sports Medicine.

Letha Yurko Griffin, M.D., Ph.D., Atlanta, Georgia
Jo A. Hannafin, M.D., Ph.D., New York, New York
Peter Indelicato, M.D., Gainesville, Florida
Elizabeth A. Joy, M.D., Salt Lake City, Utah
W. Ben Kibler, M.D., Lexington, Kentucky
Constance M. Lebrun, M.D., London, Ontario, Canada
Robert Pallay, M.D., Hillsborough, New Jersey
Margot Putukian, M.D., University Park, Pennsylvania

THE FEMALE ATHLETE AND ANTERIOR CRUCIATE LIGAMENT (ACL) INJURIES

It is essential the team physician understand:

- The female is at increased risk of ACL injury in multiple sports and activities
- The anatomy, biomechanics, and mechanisms of injury of the ACL
- Treatment strategies including surgical indications

It is desirable the team physician:

- Understand current prevention strategies
- Coordinate a network to identify risk factors and implement treatment
- Understand the potential long-term sequelae of ACL injury

Epidemiology

- Noncontact ACL injury rate is 2–10 times higher in female athletes than in their male counterparts
- Examples of high-risk sports include basketball, field hockey, lacrosse, skiing, and soccer

Physiology/Pathophysiology

- Causes of noncontact ACL injuries may be multifactorial; proposed risks include environmental, anatomical, hormonal, biomechanical, and neuromuscular factors
- Noncontact ACL injuries occur commonly during deceleration, landing or cutting. At-risk positions during these maneuvers include knee extension, flat foot, and off-balance body position

Evaluation and Treatment

It is essential the team physician:

- Delineate the mechanism of the injury
- Conduct a comprehensive physical examination of the knee, including ACL assessment
- Know the indications for and utility of imaging techniques
- Know the indications for surgical consideration
- Facilitate early rehabilitation to improve strength, flexibility, and neuromuscular control

It is desirable the team physician:

- Review the results of imaging studies
- Understand the principles of the surgical management of the ACL injury

Prevention

It is essential the team physician:

- Understand that neuromuscular factors may contribute to increased risk of noncontact ACL injuries and may be amenable to prevention with specific conditioning programs
- Recognize that conditioning programs may need to be gender specific [see “*The Team Physician and Conditioning of Athletes for Sports: A Consensus Statement*” (2001)]

It is desirable the team physician:

- Identify proposed risk factors during the preparticipation evaluation
- Coordinate a prevention program
- Educate athletes, parents, coaches, and other healthcare providers, including information about at-risk positions and game situations that are associated with ACL injury

THE FEMALE ATHLETE AND THE PATELLOFEMORAL JOINT

It is essential the team physician understand:

- The anatomy and biomechanics of the patellofemoral joint
- The mechanisms of patellofemoral pain and dysfunction

It is desirable the team physician:

- Coordinate the evaluation and treatment of athletes with patellofemoral problems
- Understand the potential long-term sequelae of patellofemoral pain and dysfunction

Epidemiology

- Patellofemoral problems occur frequently in female athletes
- Patellofemoral pain and dysfunction result from macrotrauma and microtrauma

Physiology/Pathophysiology

- Normal patellofemoral mechanics involve a balance between bone alignment, articular cartilage, soft tissue (ligaments, muscles, tendons, fascia), and coordinated neuromuscular activation
- Patellofemoral pain and dysfunction are multifactorial, including malalignment, articular cartilage lesions, instability, soft tissue factors, and psychosocial issues
- Patellofemoral pain may occur in what appears to be a normal knee joint
- Risk factors include:
 - Static and/or dynamic malalignment of the pelvis, hip, knee, ankle, and foot
 - Muscle weakness and/or imbalance and inflexibility
 - Altered patellar position and/or morphology
 - Trauma, overuse and/or training errors

Evaluation and Treatment

It is essential the team physician:

- Delineate key points relating to the history of the patellofemoral problem
- Conduct a specific examination for the patellofemoral problem
- Know the indications for and utility of imaging techniques
- Understand nonoperative management of patellofemoral problems, including patient education, activity modification, rehabilitation, bracing, orthoses, and medications

It is desirable the team physician:

- Review the results of imaging studies
- Understand the principles of and indications for surgical management

Prevention

It is essential the team physician:

- Know the risk factors for patellofemoral problems

It is desirable the team physician:

- Identify risk factors during the preparticipation evaluation
- Implement a screening program for risk factors
- Educate athletes, parents, coaches, administrators and healthcare providers

THE FEMALE ATHLETE AND SHOULDER CONDITIONS

It is essential the team physician understand:

- The anatomy and biomechanics of the shoulder
- The mechanisms of shoulder injury and dysfunction

It is desirable the team physician:

- Recognize that shoulder conditions may result from strength and flexibility imbalances or injuries elsewhere in the body
- Identify risk factors associated with shoulder conditions

- Coordinate the evaluation and treatment of shoulder conditions

Epidemiology

- Examples of high-risk sports include diving, gymnastics, swimming, tennis, throwing sports, and volleyball
- Shoulder conditions result from macrotrauma and microtrauma

Physiology/Pathophysiology

- The integration of coordinated neuromuscular activation, capsular/ligament stiffness, and glenohumeral and scapulothoracic positioning is key to shoulder function
- The female athlete's shoulder is at-risk for injury due to increased biomechanical load, resulting from specific risk factors, including:
 - Increased joint laxity (translation)
 - Increased muscle and joint flexibility (range of motion)
 - Decreased upper-body strength and poor posture
 - Acquired internal rotation deficits

Evaluation and Treatment

It is essential the team physician:

- Delineate key points relating to the history of the shoulder condition
- Conduct a comprehensive examination for the shoulder condition, including assessment of range of motion, instability, rotator cuff pathology, and scapular dysfunction
- Know the indications and utility of imaging techniques
- Understand the principles of shoulder rehabilitation

It is desirable the team physician:

- Evaluate strength and flexibility imbalances or injuries elsewhere in the body that may contribute to shoulder conditions
- Review the results of imaging studies
- Understand the principles of and indications for surgical management

Prevention

It is essential the team physician:

- Know the risk factors for shoulder conditions

It is desirable the team physician:

- Identify risk factors during the preparticipation evaluation
- Implement a screening program for risk factors
- Educate athletes, parents, coaches, administrators, and healthcare providers

THE FEMALE ATHLETE AND STRESS FRACTURES

It is essential the team physician understand:

- A stress fracture in a female athlete can be an isolated injury or may indicate underlying medical and psychos-

ocial problems. Therefore, evaluation and treatment must take into account the etiology of the stress fracture

- Certain stress fractures are at high-risk for complications and long-term sequelae

It is desirable the team physician:

- Coordinate, when necessary, multidisciplinary evaluation and treatment

Epidemiology

- Stress fractures occur frequently in female athletes
- Some studies suggest a higher incidence of stress fractures in females, but there is little evidence to support a gender difference in stress fractures among trained athletes
- Common anatomical areas include the foot, tibia, fibula, femur, and pelvis

Physiology/Pathophysiology

- Stress fractures occur when bone is subjected to repetitive loads beyond its physiologic capacity
- An imbalance between bone resorption and deposition creates bone that may not withstand repetitive loads
- Risk factors associated with stress fractures include:
 - Extrinsic factors (exercise [type, volume, and intensity], footwear)
 - Intrinsic musculoskeletal factors (muscle strength and balance, limb alignment)
 - Medical factors (osteopenia, osteoporosis, menstrual dysfunction, poor nutrition, disordered eating, and other psychosocial issues)

Evaluation and Treatment

It is essential the team physician:

- Delineate key points relating to the history of the stress fracture
- Conduct a specific physical examination pertinent to the suspected stress fracture
- Identify potential underlying risk factors
- Know the indications for and utility of imaging techniques
- Identify stress fractures at high-risk of complication and long-term sequelae
- Know the indications for surgical consideration
- Understand nonoperative management and rehabilitation

It is desirable the team physician:

- Review the results of the imaging studies
- Understand the principles of and indications for surgical management
- Coordinate, when necessary, a multidisciplinary team approach to treatment

Prevention

It is essential the team physician:

- Recognize there can be multiple risk factors for stress fractures

It is desirable the team physician:

- Recognize risk factors during the preparticipation evaluation
- Implement a screening program for risk factors
- Educate athletes, parents, coaches, administrators, and healthcare providers

THE FEMALE ATHLETE AND OSTEOPENIA AND OSTEOPOROSIS

It is essential the team physician understand:

- Osteopenia and osteoporosis can exist in the young female athlete
- These conditions have implications for athletic performance and long-term sequelae
- Disordered eating and menstrual dysfunction are common risk factors

It is desirable the team physician understand:

- The evaluation and treatment of osteopenia and osteoporosis
- The importance of educating athletes, parents, coaches, administrators and healthcare providers
- The value of prevention and early detection of osteopenia and osteoporosis

Epidemiology

- The incidence of osteopenia and osteoporosis in the female athlete is unknown
- Several studies have demonstrated osteopenia and osteoporosis in young female athletes with menstrual dysfunction and/or eating disorders
- The major determinant of adult bone mineral density (BMD) is bone mass achieved during adolescence and young adulthood. Osteoporosis-related fractures in later life are associated with significant morbidity and mortality

Physiology/Pathophysiology

- Bone mass depends on the overall balance between resorption and deposition
- Ninety percent of total bone mineral content (BMC) is accrued by the end of adolescence, creating a window of opportunity to maximize BMD
- Eighty percent of variance in BMD is attributed to genetic factors. Lean body mass, estrogen, exercise, and calcium intake are other important influences
- Tobacco use, excessive alcohol consumption, certain medical conditions (e.g., renal disease, hyperparathyroidism), and medications (e.g., glucocorticoids) can negatively affect bone density
- Athletes involved in impact sports and/or strength training routinely have higher site-specific BMD than athletes in nonimpact sports and nonathletes
- The effect of impact activities and/or strength training is most pronounced during puberty and dependent

upon intensity and volume of conditioning [see “*The Team Physician and Conditioning of Athletes for Sports: A Consensus Statement*” (2001)]

Evaluation and Treatment

It is essential the team physician:

- Recognize risk factors for low BMD
- Know the indications for and the utility of imaging techniques
- Facilitate treatment for osteopenia and osteoporosis once identified

It is desirable the team physician:

- Understand criteria for osteopenia (1–2.5 standard deviations [SD] below young adult mean BMD) and osteoporosis (greater than 2.5 SD below young adult mean BMD)
- Coordinate a screening process to identify athletes at-risk
- Coordinate a comprehensive evaluation including assessment of menstrual status and nutritional intake, measurement of BMD, and laboratory testing as necessary
- Understand that multidisciplinary treatment may include restoration of normal menstrual cycles, optimization of physical activity and nutrition, psychological therapy, and pharmacological intervention

Prevention

It is essential the team physician understand:

- Optimal BMD is achieved by maintaining physiologic estrogen levels, adequate nutrition, and load-bearing exercise
- The importance of prevention and early detection of osteopenia and osteoporosis

It is desirable the team physician:

- Identify risk factors during the preparticipation evaluation
- Implement a screening program for risk factors, including information regarding strategies for maintaining optimal BMD and the effect of negative behaviors on BMD
- Educate athletes, parents, coaches, administrators, and healthcare professionals

THE FEMALE ATHLETE AND DISORDERED EATING

It is essential the team physician understand:

- The importance of adequate nutrition in sports
- The spectrum of disordered eating and how it affects the female athlete
- Disordered eating can occur in any sport

It is desirable the team physician understand:

- The evaluation and treatment of the athlete with disordered eating

- The importance of educating athletes, coaches, parents, administrators, and other healthcare providers
- The value of prevention and early detection of disordered eating

Epidemiology

- Disordered eating occurs on a spectrum. This ranges from calorie, protein and/or fat restriction and pathogenic weight control measures (e.g., diet pills, laxatives, excessive exercise, self-induced vomiting) to classic eating disorders, such as anorexia nervosa and bulimia nervosa
- Athletes in sports involving aesthetics, endurance, and weight classifications are at particular risk for the spectrum of disordered eating
- Fifteen to 62% of college female athletes report a history of disordered eating
- Eating disorders are psychiatric disorders with distortion of body image, and significant nutritional and medical complications, including a mortality rate of 12–18% for untreated anorexia nervosa
- Female athletes are at higher risk for developing eating disorders than the general population

Physiology/Pathophysiology

- Nutritional and medical consequences of the spectrum of disordered eating include:
 - Nutritional deficiencies and electrolyte disturbances
 - Decreased BMD
 - Gastrointestinal problems (e.g., bleeding, ulceration, bloating, constipation)
 - Cardiovascular abnormalities (e.g., arrhythmias, heart block)
 - Psychiatric problems (e.g., depression, anxiety, suicide)
- Risk factors include:
 - Pressure to optimize performance and/or modify appearance
 - Psychological factors, such as low self esteem, poor coping skills, perceived loss of control, perfectionism, obsessive compulsive traits, depression, anxiety, and history of sexual/physical abuse
 - Underlying chronic diseases related to caloric utilization (e.g., diabetes)

Evaluation and Treatment

It is essential the team physician:

- Recognize risk factors for the spectrum of disordered eating
- Facilitate treatment once identified with a multidisciplinary approach as needed
- Understand the necessity of mental health treatment for eating disorders

It is desirable the team physician:

- Coordinate a screening process to identify athletes at risk

- Understand a comprehensive evaluation includes assessment of nutrition, exercise behaviors, pathogenic weight control measures, and psychosocial factors; additional laboratory and other diagnostic testing as necessary
- Understand treatment may involve a multidisciplinary approach (medical, mental health, and nutritional management), including parents, coaches, certified athletic trainers, physical therapists, and administrators

Prevention

It is essential the team physician understand:

- The importance of prevention and early detection of the spectrum of disordered eating

It is desirable the team physician:

- Identify risk factors during the preparticipation evaluation
- Implement a screening program for risk factors, including information to dispel misconceptions about body weight, body composition, and athletic performance
- Educate athletes, parents, coaches, administrators, and healthcare providers

THE FEMALE ATHLETE AND SELECTED MENSTRUAL DYSFUNCTION

It is essential the team physician understand:

- The normal menstrual cycle and the spectrum of menstrual dysfunction
- The consequences of menstrual dysfunction on bone density and fertility

It is desirable the team physician understand:

- The evaluation and treatment of the athlete with menstrual dysfunction
- The importance of educating athletes, parents, coaches, administrators, and healthcare providers about menstrual dysfunction
- The value of prevention and early detection of menstrual dysfunction

Epidemiology

- Menstrual dysfunction occurs in different forms:
 - Delayed menarche (onset of menstrual cycles after 16 yr of age)
 - Secondary amenorrhea (absence of menses for three or more months after regular menses has been established)
 - Oligomenorrhea (six to nine cycles per year; cycle length greater than 35 d or less than 3 months)
 - Anovulation (absence of ovulation; may have regular menstrual bleeding)
 - Luteal phase deficiency (cycle length may be normal, but there are decreased progesterone levels)

- In the athlete, menstrual dysfunction is at least two to three times more common than in the nonathlete; 10–15% have amenorrhea or oligomenorrhea

Physiology/Pathophysiology

- Normal menstrual cycle depends on intact hypothalamic-pituitary-ovarian (HPO) axis and normal pelvic organ function
- The etiology of menstrual dysfunction is multi-factorial, including body weight and body composition, nutrition, training, previous menstrual function, and psychosocial factors
- The energy drain hypothesis states that energy expenditure exceeds stored and consumed energy, leading to disruption of the HPO axis
- Intense exercise alone does not necessarily cause menstrual dysfunction, provided there is adequate caloric intake for the energy needs
- Consequences of menstrual dysfunction may include lower levels of estrogen and/or progesterone, lower BMD, and higher incidence of stress fractures and infertility
- Effects of lower levels of estrogen on BMD are not completely reversible; therefore, early detection and treatment of menstrual dysfunction is important

Evaluation and Treatment

It is essential the team physician:

- Understand menstrual dysfunction related solely to exercise is a diagnosis of exclusion
- Recognize risk factors for and implications of menstrual dysfunction
- Facilitate treatment of these conditions once identified, with a multidisciplinary approach as necessary

It is desirable the team physician:

- Coordinate a screening program to identify athletes at risk
- Understand that a comprehensive evaluation includes assessment for other causes of menstrual dysfunction; detailed menstrual, nutrition, and medication history; laboratory testing; and additional diagnostic testing as necessary
- Understand that treatment may include increasing caloric intake, decreasing energy expenditure, hormone supplementation, and psychotherapy as necessary

Prevention

It is essential the team physician understand:

- The importance of prevention and early detection of menstrual dysfunction

It is desirable the team physician:

- Identify risk factors during the preparticipation evaluation
- Implement a screening program for risk factors, including information about the importance of normal menstrual function

- Educate athletes, parents, coaches, administrators, and healthcare providers

THE FEMALE ATHLETE AND PREGNANCY/ CONTRACEPTION

The majority of team physicians do not provide obstetrical care for female athletes, nor do they offer specific contraceptive counseling. Prenatal and postpartum care in the United States is generally carried out by an obstetrician/gynecologist and/or family medicine physician. Team physicians may defer to the specific expertise of the physician(s) providing primary obstetric care but can coordinate and collaborate in the management of sports-related injuries and illnesses

It is essential the team physician:

- Recognize the signs and symptoms of pregnancy
- Understand that absolute and relative contraindications to exercise throughout pregnancy exist
- Understand the importance of family planning and contraception

It is desirable the team physician understand:

- Basic physiologic changes associated with pregnancy and the postpartum period
- Sport-specific risks and benefits of exercise in pregnancy and exercise prescription
- The effects of certain medications on maternal and fetal health
- Medical and obstetrical conditions affecting participation and performance
- Specific considerations in the pregnant athlete, including nutritional needs, environmental risks, appropriate use of imaging, and contraindications for physical therapy modalities
- Contraceptive methods and alternatives, at-risk behaviors for unplanned pregnancy, as well as sexually transmitted diseases (STDs)

Epidemiology

- Exercise throughout pregnancy is generally safe but must be carefully monitored and limitations applied as necessary
- Benefits of exercise throughout pregnancy include:
 - Avoidance of excessive weight gain, improved balance, and decreased back pain
 - Improved well-being, energy levels, and sleep patterns
 - Improved labor symptoms and facilitation of postpartum recovery
- Risks include environmental exposure, dehydration, hypoxia, and uterine trauma
- Contraceptive methods have different efficacies, potential side effects, and risks for STDs
 - In certain populations, there may be a positive association between oral contraceptive use and BMD

- Use of injectable depot medroxyprogesterone acetate may lead to amenorrhea, lower estrogen levels, and decreased BMD
- Unplanned pregnancy and/or presence of STDs indicates high-risk behavior

Physiology/Pathophysiology

- Physiological changes that may affect exercise throughout pregnancy include:
 - Musculoskeletal changes including weight gain
 - Medical changes including increased heart rate, cardiac output, blood volume, and respiratory rate
- The goals of exercise throughout pregnancy are to maintain or improve preexisting levels of maternal fitness without undue risk to the mother or the developing fetus
- Pregnancy increases nutritional needs for calories, iron, calcium, and folic acid
- Exercise in the supine position after 16 wk should be avoided due to potential great vessel compression

Evaluation and Treatment

It is essential the team physician understand:

- There are specific issues of the female athlete in terms of pregnancy and contraception

AVAILABLE RESOURCES

Ongoing education pertinent to the team physician is essential. Information regarding team physician-specific educational opportunities can be obtained from the six participating organizations:



- American Academy of Family Physicians (AAFP)
11400 Tomahawk Creek Pkwy
Leawood, KS 66211
800-274-2237
www.aafp.org



- American Medical Society for Sports Medicine (AMSSM)
11639 Earnshaw
Overland Park, KS 66210
913-327-1415
www.amssm.org



- American Academy of Orthopaedic Surgeons (AAOS)
6300 N River Rd
Rosemont, IL 60018
800-346-AAOS
www.aaos.org



- American Orthopaedic Society for Sports Medicine (AOSSM)
6300 N River Rd, Suite 200
Rosemont, IL 60018
847-292-4900
www.sportsmed.org



**AMERICAN COLLEGE
of SPORTS MEDICINE**

- American College of Sports Medicine (ACSM)
401 W Michigan St
Indianapolis, IN 46202
317-637-9200
www.acsm.org



- American Osteopathic Academy of Sports Medicine (AOASM)
7611 Elmwood Ave, Suite 201
Middleton, WI 53562
608-831-4400
www.aoasm.org

It is desirable the team physician:

- Facilitate obstetric care and treatment, including referral
- Understand evaluation includes a medical examination, nutritional assessment, and ongoing assessment of absolute and relative contraindications to exercise throughout pregnancy and the postpartum period
- Understand treatment may include the limitation of physical activity as pregnancy progresses and that discussion with others (i.e., healthcare providers, parents, coaches, and certified athletic trainers) may be necessary

Prevention

It is essential the team physician understand:

- The importance of family planning and contraceptive options for the athlete
- The implications of pregnancy and postpartum for training and competition

It is desirable the team physician:

- Implement a screening and education program for athletes at risk for pregnancy, including information regarding safe sexual practices, family planning, and contraceptive options
- Educate athletes, parents, coaches, administrators, and healthcare providers as to the benefits and risks of exercise throughout pregnancy and the postpartum period

SELECTED READINGS

ACL

- ANDERSON, A. F., D. C. DOME, S. GAUTAM, M. H. AWH, and G. W. RENNIRT. Correlation of anthropometric measurements, strength, anterior cruciate ligament size, and intercondylar notch characteristics to sex differences in anterior cruciate ligament tear rates. *Am. J. Sports Med.* 29:58–66, 2001.
- ARENDT, E., and R. DICK. Knee injury patterns among men and women in collegiate basketball and soccer: NCAA data and review of the literature. *Am. J. Sports Med.* 23:694–701, 1995.
- CHAPPELL, J. D., B. YU, D. T. KIRKENDALL, and W. E. GARRETT. A comparison of knee kinetics between male and female recreational athletes in stop-jump tasks. *Am. J. Sports Med.* 30:261–267, 2002.
- GRIFFIN, L. Y., J. AGEL, M. J. ALBOHM, et al. Noncontact anterior cruciate ligament injuries. *J. Am. Acad. Orthop. Surg.* 8:141–150, 2000.
- HEWETT, T., T. N. LINDENFELD, J. V. RICCOBENE, and F. R. NOYES. The effect of neuromuscular training on the incidence of knee injury in female athletes. A prospective study. *Am. J. Sports Med.* 27:699–706, 1999.
- HUSTON, L., and WOJTYNS, E. M. Neuromuscular performance characteristics in elite female athletes. *Am. J. Sports Med.* 24:427–436, 1996.
- ROZZI, S. L., S. M. LEPHART, W. S. GEAR, and F. H. FU. Knee joint laxity and neuromuscular characteristics of male and female soccer and basketball players. *Am. J. Sports Med.* 27:312–319, 1999.
- WOJTYNS, E. M., L. J. HUSTON, M. D. BOYNTON, K. P. SPINDLER, and T. N. LINDENFELD. The effect of the menstrual cycle on anterior cruciate ligament injuries in women as determined by hormone levels. *Am. J. Sports Med.* 30:182–188, 2002.

PATELLOFEMORAL JOINT

- ARROLL, B., E. ELLIS-PELGER, A. EDWARDS, et al. Patellofemoral pain syndrome: a critical review of the clinical trials on non-operative therapy. *Am. J. Sports Med.* 25:207–212, 1997.
- BAKER, M. M., and M. S. JUHN. Patellofemoral pain syndrome in the female athlete. *Clin. Sports Med.* 19:315–320, 2000.
- CROSSLEY, K., K. BENNELL, S. GREEN, S. COWAN, and J. MCCONNELL. Physical therapy for patellofemoral pain: a randomized, double-blinded, placebo-controlled trial. *Am. J. Sports Med.* 30:857–865, 2002.
- KOWALL, M. G., G. KOLK, G. W. NUBER, et al. Patellar taping in the treatment of patellofemoral pain: a prospective randomized study. *Am. J. Sports Med.* 24:61–66, 1996.
- MALONE, T., G. DAVIES, and W. M. WALSH. Muscular control of the patella (Review). *Clin. Sports Med.* 21:349–362, 2002.
- NATRI, A., P. KANNUS, and M. JARVINEN. Which factors predict the long term outcome in chronic patellofemoral pain syndrome? A prospective follow-up study. *Med. Sci. Sports Exerc.* 30:1572–1577, 1998.

SHOULDER

- CHANDLER, T. J., W. B. KIBLER, T. L. UHL, B. WOOTEN, A. KISER, and E. STONE. Flexibility comparisons of junior elite tennis players to other athletes. *Am. J. Sports Med.* 18:134–136, 1990.
- GRIFFIN, L. Y. The female athlete. In: *The IOC Book on Sports Injuries: Principles of Prevention and Care*, P. Renstrom (Ed.). London: Blackwell, 1993.
- HANNAFIN, J. A. Upper extremity injuries: shoulder. In: *Women's Health in Sports and Exercise*, W. E. Garrett (Ed.). Rosemont, IL: AAOS, 2001.
- KIBLER, W. B., T. J. CHANDLER, T. UHL, and R. E. MADDUX. A musculoskeletal approach to the preparticipation physical examination: preventing injury and improving performance. *Am. J. Sports Med.* 17:525–531, 1989.
- KIBLER, W. B. Rehabilitation of shoulder and knee injuries. In: *Women's Health in Sports and Exercise*, W. E. Garrett (Ed.). Rosemont, IL: AAOS, 2001.

STRESS FRACTURES

- BARROW, G. W., and S. SAHA. Menstrual irregularity and stress fractures in collegiate female distance runners. *Am. J. Sports Med.* 16:209–216, 1988.

- BENNEL, K. L., S. A. MALCOLM, S. A. THOMAS, et al. Risk factors for stress fractures in track and field athletes: a twelve-month prospective study. *Am. J. Sports Med.* 24:810–818, 1996.
- BODEN, B. P., D. C. OSBAHR, and C. JIMENEZ. Low-risk stress fractures. *Am. J. Sports Med.* 29:100–111, 2001.
- MYBURGH, K. H., J. HUTCHINS, A. B. FATAAR, et al. Low bone density in an etiologic factor for stress fractures in athletes. *Ann. Int. Med.* 113:754–759, 1990.
- NATTIV, A., and T. D. ARMSEY, Jr. Stress injury to bone in the female athlete. *Clin. Sports Med.* 16:197–224, 1997.

DISORDERED EATING

- BEALS, K. A., and M. M. MANORE. Disorders of the female athlete triad among collegiate female athletes. *Int. J. Sport Nutr.* 12:281–293, 2002.
- BILLER, B. M. K., V. SAXE, D. B. HERZOG, D. I. ROSENTHAL, S. HOLZMAN, and A. KLIBANSKI. Mechanisms of osteoporosis in adult and adolescent women with anorexia nervosa. *J. Clin. Endocrinol. Metab.* 68:548–554, 1989.
- RIGOTTI, N. A., R. M. NEER, S. J. SKATES, et al. The clinical course of osteoporosis in anorexia nervosa. *JAMA* 265:1133–1138, 1991.
- ROSENBLUM, J., and S. FORMAN. Evidence-based treatment of eating disorders. *Pediatrics* 14:379–383, 2002.
- SUNDGOT-BORGEN, J. Risk and trigger factors for the development of eating disorders in female elite athletes. *Med. Sci. Sports Exerc.* 26:414–419, 1994.
- SUNDGOT-BORGEN, J. Eating disorders. In: *Women in Sport*, B. Drinkwater (Ed.). London: Blackwell, 2000, pp. 364–376.
- WALSH, J. M. E., M. E. WHEAT, and K. FREUND. Detection, evaluation and treatment of eating disorders: the role of the primary care physician. *J. Gen. Intern. Med.* 15:577–590, 2000.

MENSTRUAL DYSFUNCTION

- ACSM POSITION STAND ON THE FEMALE ATHLETE TRIAD. *Med. Sci. Sports Exerc.* 29:1–9, 1997.
- DRINKWATER, B. L., K. NILSON, C. H. CHESTNUT III, et al. Bone mineral content of amenorrheic and eumenorrheic athletes. *N. Engl. J. Med.* 311:277–281, 1984.
- DRINKWATER, B. L., B. BRUEMMER, and C. H. CHESTNUT III. Menstrual history as a determinant of current bone density in young athletes. *JAMA* 263:545, 1990.
- DRINKWATER, B. L., K. NILSON, S. OTT, et al. Bone mineral density after resumption of menses in amenorrheic athletes. *JAMA* 256:380–382, 1986.
- LOUCKS, A. B., M. VERDUN, E. M. HEATH, et al. Low energy availability, not the stress of exercise, alters LH pulsatility in exercising women. *J. Appl. Physiol.* 84:37, 1998.
- MEDICAL CONCERNS IN THE FEMALE ATHLETE AMERICAN ACADEMY OF PEDIATRICS COMMITTEE ON SPORTS MEDICINE AND FITNESS, 1999–2000. *PEDIATRICS*.
- ZANKER, C. L., and I. L. SWAINE. The relationship between serum oestradiol concentration and energy balance in young women distance runners. *Int. J. Sports Med.* 19:104–108, 1998.

BONE ISSUES

- GIBSON, J. Osteoporosis. In: *Women in Sport*, B. Drinkwater (Ed.). London: Blackwell, 2000, pp. 391–406.
- HAWKER, G. A., S. A. JAMAL, R. RIDOUT, et al. A clinical prediction rule to identify premenopausal women with low bone mass. *Osteoporos. Int.* 13:400–406, 2002.
- KANIS, J. A. Diagnosis of osteoporosis. *Osteoporos. Int.* 7:S108–S116, 1997.
- KANIS, J. A., L. J. MELTON, C. CHRISTIANSEN, C. C. JOHNSTON, and N. KHALTAEV. The diagnosis of osteoporosis. *J. Bone Miner. Res.* 9:1137–1141, 1994.
- KHAN, K., H. MCKAY, P. KANNUS, D. BAILEY, J. WARK, and K. BENNEL. *Physical Activity and Bone Health*. Champaign, IL: Human Kinetics, 2001.
- LINDSAY, R., and P. MEUNIER. Osteoporosis: review of the evidence for prevention, diagnosis and treatment and cost-effectiveness analysis status report. *Osteoporos. Int.* 4(Suppl.):S1–S88, 1998.

- MODLESKY, C. M., and R. D. LEWIS. Does exercise during growth have a long-term effect on bone health? *Exerc. Sport Sci. Rev.* 30:171–176, 2002.
- MYBURGH, K. H., L. K. BACHRACH, B. LEWIS, et al. Low bone mineral density at axial and appendicular sites in amenorrheic athletes. *Med. Sci. Sports Exerc.* 25:1197–1202, 1993.
- RECKER, R. R., K. M. DAVIES, S. M. HINDERS, R. P. HEANEY, M. R. STEGMAN, and D. B. KIMMEL. Bone gain in young adult women. *JAMA* 268:2403–2408, 1992.
- RENCKEN, M., C. H. CHESNUT, and B. L. DRINKWATER. Decreased bone density at multiple skeletal sites in amenorrheic athletes. *JAMA* 276:238–240, 1996.
- SCHOLES, D., A. X. LACROIX, S. M. OTT, L. E. ICHIKAWA, and W. E. BARLOW. Bone mineral density in women using depot medroxyprogesterone acetate for contraception. *Obstet. Gynecol.* 93:233–238, 1999.
- PREGNANCY/CONTRACEPTION
- ARAUJO, D. Expecting questions about exercise and pregnancy? *Physician Sportsmed.* 25(4): April, 1997.
- ARTAL, R., and M. O'TOOLE. Guidelines of the American College of Obstetricians and Gynecologists for exercise during pregnancy and the postpartum period. *Br. J. Sports Med.* 37:6–12, 2003.
- EXERCISE DURING PREGNANCY AND THE POSTPARTUM PERIOD. ACOG TECHNICAL BULLETIN NUMBER 189—FEBRUARY 1994. *INT. J. GYNAECOL. OBSTET.* 45:65–70, 1994.
- KARDEL, K. R., and T. KASE. Training in pregnant women: effects on fetal development and birth. *Am. J. Obstet. Gynecol.* 178:280–286, 1988.
- PENTTINEN, J., and R. ERKKOLA. Pregnancy in endurance athletes. *Scand. J. Med. Sci. Sports* 7:226–228, 1997.