

Chapter 1

THE CONCEPT OF SPORTS INJURY

Annually 6.7 million public high school children are involved in sports activities, and approximately 30 million school-age children are involved in community-based sports. Since the Title IX Education Assistance Act of 1972 became law, there has been a 700% increase in female sports participation.

Historically females have been discouraged from sports participation because it was believed they were not tough enough to play sports. Negative stereotypes still persist within some sports organizations. Recent research on injuries and gender has shown that sports injuries are sport specific, not gender specific. Overall, females are at no greater risk for injury than males.

Injuries involving the *anterior cruciate ligament (ACL)* of the knee occur more frequently in female high school athletes who participate in basketball and soccer than in males involved in the same sports. The same trend has been observed in college athletes. In a study of injuries among collegiate basketball players, the majority of ACL injuries were *noncontact*, that is, they did not result from a collision with another player or inanimate object. Noncontact ACL injuries are associated with sports that involve rapid directional changes or deceleration when running, or repeated jumping and landing.

In a study of sports in one Honolulu school, Beachy et al. found that football yielded the highest injury rate for boys, while soccer was the highest for girls. In a study of high school athletic injuries, Grollman et al. found almost 3070 reportable injuries from ten sports (boys and girls) across 40 high schools in Pennsylvania during the 1994-95 school year. Tackle football had the highest percentage of injuries (46.7%), followed by boys' basketball (10%), and wrestling (9.7%).

Among girls, basketball participation resulted in the highest percentage of injuries (7.5%).

In a study of emergency room admissions at 4 hospitals during a one-month period, 1275 young people ranging from 5 to 21 years of age were treated for over 1400 injuries. Of these injuries, 41% were attributed to sports participation. Sprains, contusions, and fractures were the most common injuries. Males sustained more injuries to the musculoskeletal system than females.

In a two-year study of injuries sustained by children involved in a community sports program, soccer participation had the highest rate of injury, followed by baseball, football, and softball. More injuries occurred during games than practices, and contusions were the most common injury.

I. Definition of Sports Injury

A. No universally acceptable definition of sports injury

1. Majority of current definitions use “time lost” as the major determinant. For example, an injury results in the athlete being forced to discontinue play and/or practice for a predetermined length of time.

B. In 1982 the NCAA established the Injury Surveillance System (ISS) that established a common set of injury and risk definitions for tracking collegiate injuries. To qualify, an injury must meet the following criteria:

1. Occurs as a result of participation in an organized intercollegiate practice or game.

2. Requires medical attention by a team athletic trainer or physician.

3. Results in restriction of the student athlete’s participation or performance for one or more days beyond the day of injury.

4. Time lost does not accurately reflect severity of injury. Severity of injury determinations may be made by a variety of people, including the athlete. Additionally, there is no

standard length of time that must be lost to qualify as a specific level of injury severity.

C. Once identified, an injury can be further described in terms of type of tissue(s) involved, injury location, and time frame of injury (acute or chronic).

D. Accepted definitions of acute and chronic injury

1. **Acute injury** - “injury characterized by rapid onset, resulting from a traumatic event.”

a. Acute injuries typically involve significant trauma followed immediately by pain, swelling, and loss of function.

b. **Critical force** is the “magnitude of a single force for which the anatomical structure of interest is damaged.” Potential for critical force is clearly seen in tackle football. Forces generated in a tackle can exceed the critical force of the cervical spine.

2. **Chronic injury** is an “injury characterized by a slow, insidious onset, implying a gradual development of structural damage.”

a. Chronic injuries develop over time and are often associated with repetitive, cyclic activities, such as running. Such injuries are commonly called *overuse injuries*. See Table 1.1 for factors that contribute to overuse injuries.

b. Overuse injuries occur when workload exceeds the ability of the musculotendinous tissues to recover, causing a progressive breakdown of tissue, leading to failure. Common sites for overuse injuries include the Achilles tendon, patellar tendon, and rotator cuff tendon in the shoulder.

c. Chronic injuries are often associated with **eccentric contraction**, a type of contraction identified as a causative factor in tendon injury. These can be related to repeated overhead movements of the arms, such as those that occur in tennis.

d. Overuse injuries may be caused by intrinsic factors: immature cartilage, lack of flexibility, lack of proper conditioning, or psychological factors; or extrinsic factors: excessive training, lack of adequate recovery, incorrect technique, or playing on uneven/hard surfaces.

E. Terms for differentiating tissues

1. Soft tissue includes: muscles, fascia, tendons, joint capsules, ligaments, blood vessels and nerves. Majority of soft tissue injuries involve bruises, sprains, and strains.

2. Skeletal tissues include any bony structure within the body.

F. Catastrophic injury

1. **Catastrophic injuries** involve damage to the brain and/or spinal cord and are potentially life threatening or permanent.

a. In the context of school/college sports, a catastrophic injury has been defined as “sport injury that resulted in a brain or spinal cord injury or skull or spinal fracture.”

2. A catastrophic injury can occur as either a *direct* result of participation such as spinal fracture that occurs when a football player is tackled or an *indirect* result of participation such as heat stroke that a runner develops during a cross-country event.

3. In the 2004 season, high school–level football participation resulted in the highest number of catastrophic injuries. Wrestling, ice hockey, baseball, and track (specifically pole vaulting) are also high-risk sports for catastrophic injury.

II. Injury Classifications. In 1968, the Committee on the Medical Aspects of Sports of the American Medical Association published *Standard Nomenclature of Athletic Injuries (SNAI)*, a text that provided standardized terminology associated with sports injuries that affect connective tissue.

A. **Sprains** are injuries to ligaments with three levels of severity

1. **First-degree sprains** are mild with little/no swelling
2. **Second-degree sprains** involve ligament damage, pain, moderate swelling, and dysfunction.
3. **Third-degree sprains** involve a complete tear of ligament(s), pain, swelling, and dysfunction leading to a loss of stability.

B. **Strains** are injuries to the tendon, muscle or musculotendinous junction (tissue between tendon and muscle)

1. **First-degree strains** are mild with little/no swelling; pain is most noticeable during use.
2. **Second-degree strains** involve more extensive soft tissue damage, with pain, swelling, spasms, and moderate loss of function.
3. **Third-degree strains** involve a complete rupture of structure. Damage may occur in a variety of locations in the region and may include avulsion fracture of bone. Defect may be visible through skin, and significant swelling and loss of function occur.

C. **Contusions** (bruises) are the most common sports injury and occur from direct blows to the body surface. Such blows compress the underlying tissue. Contusions can occur in any sport, but contact sports are more likely to blame for these injuries, which can be life threatening when a vital organ is damaged.

1. Contusions are associated with pain, stiffness, swelling, **ecchymosis**, and **hematoma**.
2. If not properly treated, contusions can result in **myositis ossificans**, the development of bonelike formations in muscle tissue.

D. **Fractures** are breaks or cracks in a bone. Refer to Figure 1.8 on page 9 for illustrations

of types of fractures.

1. In a *closed fracture*, the bone ends do not break through the skin.

2. In an *open* or *compound fracture*, the bone ends break through the skin. Infection and serious bleeding can result.

3. First aid is essential to prevent shock, blood loss, and permanent damage.

4. Symptoms include swelling, deformity, pain and tenderness, loss of use, grating sensation. Suspect a fracture when severe forces cause an injury.

5. **Stress fracture** is a break or crack in bone that develops over a relatively long time.

a. Stress fractures are associated with pain and tenderness, an absence of trauma, history of repetitive activity, and symptoms that developed over a period of days, weeks, or months.

b. Stress fractures are difficult to diagnose, in part, because in the early phase they may not be seen on a standard X-ray.

6. **Salter-Harris Fractures** involve the epiphyseal growth plate. There are five types of these fractures; fractures are typed according to severity. Refer to Figure 1.10 on page 10.

E. Dislocations are defined as “the displacement of contiguous surfaces of bones comprising a joint”. There are two types: **subluxation** (partial displacement) and **luxation** (joint is totally displaced). Dislocations are a severe type of sprain.

1. Dislocations should not be reduced (put back in place) in the field by non-medical personnel, such as coaches. All dislocations should be diagnosed and reduced by a physician.

III. Injury Recognition. The coaches are most often the first to arrive at the scene of an injury.

Coaches should treat any suspected injury as an actual injury until proven otherwise. Coaching

personnel need to develop the knowledge and skills to discriminate injuries requiring medical referral from those that do not need such attention.

A. The school or agency sponsoring the sports program should hire an athletic trainer who is certified by the Board of Certification (BOC).

IV. Epidemiology of Sports Injury.

A. Scientific studies of sports injury are recent phenomenon. The majority of early studies were *case-series studies*, i.e., conducted by medical personnel at hospitals or clinics.

1. There are problems with data collected by case-series research because usually only athletes with severe injuries go to hospital or clinic and it is difficult to identify the cause(s) of the injury.

B. The epidemiological approach to research is better. **Epidemiology** is the “study of the distribution of diseases, injuries, or other health states in human populations for the purpose of identifying and implementing measures to prevent their development and spread.”

1. Sports injury epidemiology involves determining risk factors that play a causative role in the injury; hypotheses are then developed to test for statistical relationships between risk factors and injury.

a. **Risk factors** may be inherent to the sport, i.e., collisions in tackle football or ice hockey; equipment such as a faulty football helmet; physical attributes of the athlete, i.e., muscle imbalances, obesity, or congenital conditions.

2. In the United States, injury surveillance organizations include the National Athletic Injury/Illness Reporting System (NAIRS), National Collegiate Athletic Association Injury Surveillance System (NCAA/ISS), National High School Injury Registry (NHSIR), and National Sports Injury Surveillance System (NSISS). The National Football League (NFL) and National

Hockey League (NHL) also conduct injury surveillance.

3. The primary goal of organizations involved in sports injury research is to identify risk factors for injuries and to develop and implement strategies to reduce the risk(s).

V. Classification of Sports. Sports can be classified according to comparative risk of injury based on criteria such as the amount of physical contact between participants and relative intensity of the activity.

A. The American Academy of Pediatrics has classified popular sports into three main categories based on the likelihood of collisions between participants. The three categories are contact/collision, limited contact/impact, and non-contact. Refer to Table 1.1 on page 13.

B. Not all injuries are related to the amount of contact between participants, e.g., temperature-related injuries.

VI. Extent of the Injury Problem: Some Examples.

A. Tackle Football. According to recent research funded by the National Athletic Trainers' Association, 34% of players were injured. Offensive players are more at risk of injury than defensive players.

1. Hip, thigh, and leg region is injured most often. Of all injuries, 2.4% required surgery, and of those, 59.4% involved the knee.

2. Contusions, strains, sprains, and fractures are common injuries. Older players have a higher risk of injury than younger ones.

3. Spinal cord and brain injuries are major concerns of tackle football.

4. Game injury rates are more than double the rates seen in practices. Coaching personnel at the youth football level must be trained in first aid and CPR, and, whenever possible, a BOC-certified athletic trainer should be on hand for both practices and games.

B. Basketball. In the United States, almost one million high school students (boys/girls combined) participated in basketball programs during 2004 school year. Participants have a high risk for lower extremity injuries; ankle sprains are the most common injury, followed by hip/thigh/leg injuries.

1. For reasons that are unclear, female players suffer more knee injuries than males, and their injuries are more likely to require surgery.
2. The rate of ACL tears for women during games was three times higher than for men.

C. Baseball and Softball. In 2004, over 450,000 high-school boys participated in baseball programs. Recent injury data show that nearly 12% sustained injuries, often of the forearm/wrist/hand or shoulder/arm. Of these injuries, 50% were strains or sprains.

1. Less than 2% of reported injuries are to the head; safety equipment for catchers and batters has been effective in protecting players.
 - a. Children between ages 5 and 14 have increased vulnerability to chest impact from balls. Eye injuries that result from pitched balls are also a major concern. Proper safety equipment, including screening around dugout and player benches, is recommended to protect players.
2. Chronic elbow injury continues to be a concern related to adolescent pitching. Two large studies conducted in the late 1970s found no relationship between **Little League elbow** (elbow damage) and pitching. However, Micheli and Fehlandt (1992) found baseball to be associated with the highest occurrence of elbow injury in a population of 445 children.
 - a. In softball, sidearm pitching is associated with a greater risk of elbow problems than overhand pitching.

b. Injuries to softball players are similar to those in baseball players.

D. Wrestling. Over 240,000 youth participated in high school wrestling programs during the 2004 season. Collisions with opponents and mats, takedown, holds, and escape maneuvers result in various injuries. Approximately 27% of participants sustained injuries during the competitive season.

1. The shoulder/arm, knee, and forearm/wrist/hand are injured most often. Over 50% of these injuries are strains or sprains. Other injuries include **friction** burns, skin infections, and irritation to the outer ear, called *cauliflower ear*. Wearing protective gear and cleaning facilities and mat surfaces reduced the incidence of these problems.

2. To achieve a weight category, youthful participants may resort to rapid weight gain or loss, practices that can create problems for them.

E. Volleyball. During the 2004 season, nearly 400,000 high school girls participated in volleyball. According to a NATA study (1995-97), 14.9% of players sustained injuries, 51.5% of which were sprains. The ankle/foot region is injured most often.

F. Soccer. In the United States, over 12 million soccer participants are under the age of 18. During the 2002 season, almost 340,000 boys and 300,000 girls participated in high school soccer programs.

1. Contusions are the most common type of injury; injuries to lower extremities, specifically knee, ankle, and shin, occur most often. The majority of these injuries are not severe.

2. The majority of injuries are in the lower extremity, accounting for about 60% of injuries.

3. The knee and ankle joints are the most commonly injured areas.

4. Female youth players are more likely to suffer ACL injuries than their male counterparts. Females suffer from a higher rate of knee injuries and ACL injuries than male athletes.

5. Heading may result in head injury but research has shown that the majority of concussions have resulted from collisions, and not intentional heading.

6. A number of deaths and severe injuries related to improperly constructed movable soccer goals have been reported. For the period of 1979-1994 at least 21 deaths were reported as well as an additional 120 non-fatal injuries. The majority of fatalities and injuries occurred when goals tipped over and struck victims.

REVIEW QUESTIONS

1. Damore and colleagues recently conducted research on emergency department admissions in a population of patients ranging in age from 5 to 21 years. What percentage of these admissions was attributable to sports injuries?
2. What are the most commonly used criteria for defining a sports injury?
3. Describe briefly two major problems that arise regarding the most commonly used definitions of sports injury?
4. What are the three criteria necessary for an injury to be classified as such under the NCAA's Injury Surveillance System (ISS)?
5. Define and differentiate between acute and chronic forms of injury.
6. What constitutes a catastrophic sports injury?
7. What specific tissue types are involved in sprains and strains? How is the severity of these injuries defined?
8. What makes a stress fracture unique when compared with other types of fractures?

9. Define and differentiate between *subluxation* and *luxation*.
10. What is the science of epidemiology?
11. According to a recent NATA study, what has been the most recent trend with respect to injuries to the head/neck/spine?
12. True or False: Offensive football players sustain fewer injuries when compared to those who play in defensive positions, according to the most recent NATA data.
13. What is the most frequent injury in basketball?
14. What were the conclusions of Micheli and Fehlandt, regarding the relationship between elbow injuries and participation in baseball?
15. What piece of equipment related to soccer has been found to play a direct role in the majority of deaths related to this sport?
16. How many hours per week do some children invest in athletics?
17. In the Beachy et al. study, which sport had the highest injury rate for female athletes?
18. True or False: The coach is most often the first to arrive at the scene of an injury.

19. True or False: Larger fields may have contributed to the increased incidence of spinal cord injuries in football in the early 1970s.

20. What injury location accounts for 60% of all injuries seen in soccer?