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Guidance for the Clinician in Rendering Pediatric Care

Clinical Report—Injuries in Youth Soccer

abstract

Injury rates in youth soccer, known as football outside the United States, are higher than in many other contact/collision sports and have greater relative numbers in younger, preadolescent players. With regard to musculoskeletal injuries, young females tend to suffer more knee injuries, and young males suffer more ankle injuries. Concussions are fairly prevalent in soccer as a result of contact/collision rather than purposeful attempts at heading the ball. Appropriate rule enforcement and emphasis on safe play can reduce the risk of soccer-related injuries. This report serves as a basis for encouraging safe participation in soccer for children and adolescents. *Pediatrics* 2010; 125:410–414

INTRODUCTION

Soccer (known as football outside the United States) is one of the most popular team sports in the world and continues to provide healthy exercise for many young people. Participation in soccer is an effective way for children to increase their level of physical activity and fitness, because it requires intensive physical effort over an extended period of time through practice and games.[1] In the United States, an estimated 15.5 million[2] people participate in soccer. Two national youth organizations have registered 650 000[3] and 3.2 million[4] participants younger than 19 years, with a 7% increase in female adolescent players from 2001 to 2007.[2] More than 700 000 girls and boys played soccer in US high schools in 2008–2009,[5] placing soccer among the top sports for increased participation.[5] With this growing participation comes a greater number of injuries, leading to an increasing prevalence of soccer-related cases presenting to the pediatrician.

INJURY RISK

Soccer has a higher injury rate than many contact/collision sports such as field hockey, rugby, basketball, and football, although in 1 community study of 7- to 13 year-old players, football did have a higher percentage of serious injuries and higher frequency of injury per team per season.[6,7] The US Consumer Product Safety Commission (CPSC), through its National Electronic Injury Surveillance System, estimated that there were 186 544 soccer-related injuries in 2006.[8] Approximately 80% of these injuries affected participants younger than 24 years, and approximately 44% occurred in participants younger than 15 years. It is unfortunate that there is a wide variation in the reported incidence of soccer injuries as a result of study differences in factors such as level of competition, intensity of exposure, definition, classifications, and reporting of injuries. Because of difficulties with interstudy com-

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KEY WORDS
soccer, concussion, knee injury, anterior cruciate ligament tear

ABBREVIATIONS
CPSC—Consumer Product Safety Commission
ACL—anterior cruciate ligament
AAP—American Academy of Pediatrics

The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of care. Variations, taking into account individual circumstances, may be appropriate.

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parisons, standard definitions and methodology have been proposed to ensure consistent and comparable results in the future.[9]

With respect to age, participants younger than 15 years tend to have a higher relative injury risk and greater prevalence of injuries compared with older players.[6,10–14] According to the National Electronic Injury Surveillance System, soccer injuries among young athletes in the United States occur at a peak of 2 injuries per 1000 participants.[10] For soccer players older than 12 years, rates of 4 to 7.6 injuries per 1000 player-hours have been reported.[11,13,14] Over an entire soccer season, girls' and boys' teams may expect 4.0 and 3.5 injuries per season, respectively.[15] It is notable that the risk of injury is greater during competition than during practice sessions.[6,11,13–17]

Although suffering a previous injury within the past year confers a 1.74 relative risk of a new injury,[11] there have been no consistent findings to support a higher risk to any position on the field. Some have reported overall injury rates to be similar between boys and girls,[18] but others have found higher prevalence of injuries in female players, with girls having an increased risk of anterior cruciate ligament (ACL) tears and concussions and being more likely than boys to be injured in training situations. In contrast, boys have a greater relative risk of injury during competition.[12,17]

Indoor and outdoor soccer environments have a similar relative risk of injury, including contact injury across age groups; however, knee injuries are more prevalent in outdoor soccer.[11] Field surface and shoe characteristics can affect injury risk, especially in outdoor soccer. Appropriate monitoring of field conditions, specifically holes or other irregularities, can reduce lower-extremity injuries. More specifically, uneven playing surfaces can result in excessive loading of ligaments and muscles and may contribute to improper landing after jumping. Inappropriate footwear can lead to either too little or too much frictional force, which can increase the risk of lower-extremity injury.[6] A common overuse injury in skeletally immature players, especially during peak growth velocity, is calcaneal apophysitis (Sever disease), attributable in part to play on hard fields with cleats that have insufficient heel/arch support.[19]

TYPES OF INJURIES

Soccer is classified as a high- to moderate-intensity contact/collision sport,[19] with most injuries overall occurring from either player-to-player or player-to-ground/ball/goalpost contact rather than overuse.[14–16] Contact injuries occur primarily when the player is tackling the ball, being tackled, or heading the ball as 1 or more defenders are impeding the play.[6] The mechanisms of noncontact injury include running, twisting/turning, shooting, and landing. Most injuries are classified as minor and require nothing more than basic first aid or a maximum of 1 week's absence from soccer participation.[6,14,18]

Injuries to the lower extremities are most common, with the majority of injuries resulting from nonbody contact.[6,10,11,12,16,18] Ankle injuries account for 16% to 29%[15,16] of these injuries and are more frequent in male players.[6,14] Knee injuries occur in 7% to 36% of injured players[16,17] and are seen more frequently in females.[6,14] The lower leg (5%–6%),[14,16] upper leg (9%–22%),[15,16] and groin/torso (5%)[16] are less commonly affected. Contusions and sprains/strains of the lower extremities are the most common injury types[6]; more sprains and strains are seen in the emergency department setting than either contusions/abrasions or fractures.[10] Fractures account for less than 10% of injuries.

One serious lower-extremity injury that presents frequently to physician offices or the emergency department is a rupture of the ACL. This injury is more common in female players than in male players. Arendt et al[20] reported that female collegiate soccer players have a 2.8 times greater risk of ACL rupture than do male players, and other studies have indicated a 4 to 6 times greater risk in female players than in age-matched male counterparts in the same activity.[18,21] Most injuries in female participants are the result of valgus hyperextension of the knee during landing, cutting, or turning.[21] Many contributing factors for this gender-based imbalance have been postulated, including hormonal influences, anatomic differences in lower-extremity alignment, ligament size and laxity, and dissimilar neuromuscular activation patterns.[21] Functional knee braces have proven unsuccessful at preventing ACL injuries.[20,22]

Prophylactic neuromuscular and proprioceptive exercise programs have been designed to train girls how to adopt particular muscle-recruitment strategies that decrease joint movement and protect the ACL from high-impact loading during high-risk athletic maneuvers.[21,23] Statistically significant reductions in ACL ruptures have been demonstrated in adolescent and college-aged females participating in such programs.[23,24] Results of a meta-analysis demonstrated that neuromuscular training decreases the potential biomechanical risk factors for ACL injuries and ACL tears in older adolescent and adult players as a result.[25] Studies indicating knee-injury risk along with potential risks and benefits of prophylactic exercise programs in preadolescent players are lacking. At the time of this writing, 2

TABLE 1 Components of a Knee-Injury Risk-Reduction Program[23,47,48]

1. Warm-up
   a. Jogging, skipping, backward running, and carioca
2. Stretching
   a. Calf, hamstring, quadriceps, inner thigh, and hip flexor
3. Strengthening
   a. Lunges, squats, hamstring-strengthening exercises, and toe raises
4. Plyometrics
   a. Variety of hopping, jumping, and bounding drills
5. Agility exercises
   a. Shuttle and diagonal running

Qualified instructors can reduce injury risk by helping to ensure proper technique (especially with plyometric loading and progression).

knee-injury risk-reduction programs have been studied (Table 1).

Upper-extremity injuries represent 3% to 12%[16,17] of total injuries, with the shoulder (1.1%–1.8% of total injuries) and the wrist/hand/elbow (3%–5% of total injuries) being uncommonly affected.[14]

Direct impact to the abdomen can result in intraabdominal organ damage, and although most cases are relatively minor in severity, life-threatening and even fatal cases of abdominal trauma have been reported.[10,26]

Fatalities Resulting From Goalpost Contact

Fatalities from soccer-related injuries are associated almost exclusively with traumatic contact with goalposts.[10] Since 1979, 28 fatalities have been reported from incidents associated with falling soccer goalposts.[8] These findings have prompted specific recommendations from equipment manufacturers and the CPSC[27] to ensure that soccer goalposts are adequately secured during play and when not in use. Padding of goalposts has also been recommended, but evidence of efficacy of pads in preventing injury is lacking.

Concussion

The concussion rate among soccer players is similar for both elite and recreational athletes to that of American football and ice hockey players.[28] Although some studies have indicated that head/facial injuries, including concussions, account for only 3% of total injuries, there may be significant underreporting.[14] Female high school soccer players have a slightly higher risk of concussion than do their male counterparts.[29] The most frequent cause of concussion in elite college soccer players was found to be contact with another player's head, elbow, or foot (47%), and contact with the ball (24%), ground/goalpost (17%), and combinations of objects (10%) were less frequent causes of concussions.[30] General sport-related concussion management and return-to-play guidelines have been published[31,32]; however, there are currently no postconcussion return-to-play guidelines specific to soccer.

Collision, rather than purposeful heading, was found to be the most likely cause for acute head injuries in soccer players treated in emergency departments.[33] The contribution of purposeful "heading" of the soccer ball to both acute and potential long-term concussive effects, such as cognitive dysfunction, seems less controversial today than previously.[28,33] A critical review of the literature does not support the contention that purposeful heading contacts are likely to lead to either acute[34,35] or cumulative brain damage,[36–39] and additional study is necessary to provide confirmatory evidence of neuropsychological consequences of subconcussive soccer-related head contacts.[40]

Efforts to reduce potential injury from heading the soccer ball are warranted. Proper heading techniques, the appropriate age at which to initiate teaching of purposeful heading, and characteristics of the soccer ball have been studied as a means to reduce head injury. The best technique is to contract the neck muscles to hold the head rigidly fixed to the trunk, allowing the ball to contact the hairline of forehead.[39] One large US-based soccer organization does not teach purposeful heading to players younger than 10 years,[3] but other soccer authorities or organizations do not adhere to this rule uniformly. Although proper technique is foremost in reducing the risk of concussion from heading the ball, it is also imperative that soccer balls be water resistant, sized appropriately for age, and not hyperinflated.[3,27,41]

Data currently are insufficient to state that soft helmets prevent head injury, and this absence of prospective data, combined with a lack of uniform safety standards and regulations, makes universal support of soft helmets premature at this time.[39] The authors of 1 retrospective cross-sectional study found that use of soft helmets was associated with a reduction in concussions and soft tissue injuries compared with no helmet, without increasing risk of injury to areas not covered by the head gear.[42]

Eye and Other Facial Injuries in Soccer

Soccer is classified as a sport with low-to-moderate risk of eye injury. The American Academy of Pediatrics (AAP) and American Academy of Ophthalmology strongly recommend protective eyewear for all participants in soccer, whereas on the basis of 1 study on ocular injury in collegiate sports, use of eye protection based on the athlete's past ocular history was recommended.[43,44] Protective eyewear should be mandatory for athletes with only 1 functional eye and for those who have had major eye surgery or trauma.[45] Proper protective eyewear includes

polycarbonate lenses that meet the American Society for Testing and Materials (ASTM) F803 standards.[43] Soccer is also associated with orofacial and dental injuries. Use of protective mouth guards has been advocated to reduce the number of these injuries.

FAIR PLAY

If there is low adherence to fair-play policy, injury risk can be greater. It is notable that foul play has been associated with a significant number of contact-related injuries.[12,18] One study of competitors in 9 different sports in 100 US high schools identified 98 066 injuries over a 2-year period that occurred as a direct result of an illegal activity as ruled by a referee or disciplinary committee. Girls' basketball (14%) and girls' (11.9%) and boys' (11.4%) soccer had the highest rates of such injuries, most of which were concussions or other head/facial injuries.[46] There is consensus that proper rule enforcement and limitation of violent contact can reduce the risk of injury. Officials controlling the physicality of the game and emphasis on safe play with respect for one's opponents[27,37] can both play significant roles in reducing contact injuries in soccer.

CONCLUSIONS AND GUIDANCE FOR CLINICIANS

1. Children, adolescents, and young adults can be encouraged to participate regularly in all forms of physical activity, including youth soccer. Soccer can provide a valuable component of fitness and physical activity strategies for young people.
2. Knee-injury risk-reduction programs seem promising, particularly for adolescent and collegiate female players. Research-validated programs are easily accessible at no cost on referenced Web sites. Pediatricians are encouraged to familiarize themselves with these programs and inform their patients on the availability and potential benefits. Additional research is needed to better define knee-injury risk in younger players (younger than 14 years) and to study potential risks (eg, plyometric leaping and impact on open growth plates) to starting prevention exercises in preadolescent players.
3. To reduce soccer-related fatalities, goalposts should be secured in a manner consistent with guidelines developed by the manufacturers and the CPSC.
4. Violent behavior and aggressive infractions of the rules tend to increase the risk of injury and should be strongly discouraged. Pediatricians are encouraged to advocate for the enforcement of all rules and guidelines while strongly promoting sportsmanship and fair play to ensure maximum safety and enjoyment for the athletes.
5. Data have been insufficient to link repetitive heading with permanent cognitive impairment. However, the AAP encourages heading of the ball to only be taught when the child is willing to learn proper technique and has developed coordinated use of his or her head, neck, and trunk to properly contract the neck muscles and contact the ball with the forehead. This guidance is based on consensus of opinion among members of the AAP Council on Sports Medicine and Fitness Executive Committee, because there is currently no valid evidence to support this conclusion.
6. Physicians are encouraged to be aware of and adhere to guidelines regarding the management of concussion and to help educate coaches and athletic trainers using available resources.
7. Protective eyewear is recommended for all participants in soccer, because there is a risk of eye injury, and should be mandatory for athletes with only 1 functional eye or those with a past history of major eye surgery or trauma.

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