[Primary Care]

Soccer-Related Injuries in Children and Adults Aged 5 to 49 Years in US Emergency Departments From 2000 to 2012

Amanda O. Esquivel, PhD,*^{†‡} Adrienne Bruder, BS,[†] Kaitlyn Ratkowiak, MS,[†] and Stephen E. Lemos, MD, PhD[†]

Background: An increase in soccer-related injuries occurred in the United States between 2000 and 2012; however, most studies of soccer-related injuries have only examined the pediatric population and not adults.

Hypothesis: The number of soccer injuries is increasing in both the pediatric and adult populations. There are differences in injury types and counts when comparing male and female players within various age groups.

Study Design: Descriptive epidemiology study.

Level of Evidence: Level 4.

Methods: This retrospective analysis surveyed the US Consumer Product Safety Commission's National Electronic Injury Surveillance System (NEISS) database from 2000 to 2012 for soccer-related injuries in children and adults aged 5 to 49 years.

Results: From 2000 to 2012, there were an estimated 2,472,066 soccer-related injuries among 5- to 49-year-olds; 629,994 (25.5%) in adults (aged 20-49 years). The overall estimated pediatric injury count increased significantly over the time period ($R^2 = 0.764$, $P < 0.001$). In the 20- to 49-year age range, there was also a significant increase in the estimated number of injuries over the 13-year period, from 41,292 injuries in 2000 to 55,743 in 2012 ($R^2 = 0.719$, $P < 0.001$). The estimated injury counts for male players were significantly higher than female players in any given year for all age groups ($P < 0.001$). Girls aged 5 to 19 years were more likely to have lower extremity injuries than boys (odds ratio [OR], 1.256; 95% CI, 1.214-1.299; $P < 0.001$). The most common injuries reported were strain/sprains (33.3%), fractures (23.7%), and contusions and abrasions (17.4%) within the 5- to 49-year age category. In both sexes, strains and sprains were significantly lower among 5- to 19-year-olds in comparison with 20- to 49-year-olds (OR, 0.740; 95% CI, 0.714-0.766; $P < 0.001$).

Conclusion: There are age- and sex-related differences in estimated injury count, body part injured, type of injury, and hospital admissions for soccer. Also, estimated injury count increased over the 2000 to 2012 time period.

Clinical Relevance: This study demonstrates that there are differences between pediatric and adult injuries, based on sex, body part, type of injury, and hospital admissions.

Keywords: soccer; injuries; pediatric; adult; National Electronic Injury Surveillance System

More than 13 million Americans play soccer. US Youth Soccer registers more than 3 million youth players between the ages of 5 and 19 years.²³ Since 1990, the

number of high school soccer players has more than doubled, the fastest growth rate among any major sport.² For the 2011-2012 school year, there were 411,757 male and 370,975 female

From [†]Detroit Medical Center Sports Medicine, Warren, Michigan, and [‡]Kinesiology Health and Sport Studies, Wayne State University, Detroit, Michigan

*Address correspondence to Amanda O. Esquivel, PhD, Division of Kinesiology, Health and Sport Studies, Wayne State University, 2339 Eugene Applebaum, Detroit, MI 48201 (e-mail: aoe@wayne.edu).

The authors report no potential conflicts of interest in the development and publication of this article.

DOI: 10.1177/1941738115579854

© 2015 The Author(s)

high school athletes in the United States.¹⁴ The United States Adult Soccer Association includes 250,000 players and has increased in numbers over the past decade.²⁰

Participation in organized and unorganized sports creates an injury risk for players of all ages. A study of pediatric soccer injuries seen in US emergency departments found a significant increase in injuries to girls over time (1990-2003).¹² A study examining data from the year 2000 only reported that boys were more frequently treated for soccer-related injuries.¹ A review of the literature showed that body part injured and type of injury varied based on sex and age.^{1,4,5,8,12,13,15-18} Boys also had double the risk of hospitalization compared with girls.¹²

The purpose of this study was to investigate soccer injuries presenting to the emergency department by age and sex, focusing on number of injuries, type of injury, body part injured, and disposition from the emergency department in patients aged 5 to 49 years.

MATERIALS AND METHODS

This study was approved by our institutional review board and was issued a certificate of exemption. Data were obtained through retrospective analysis of the US Consumer Product Safety Commission's (CPSC) National Electronic Injury Surveillance System (NEISS) of children and adults aged 5 to 49 years.²² The NEISS database provides a probability sample from 100 participating hospitals across the United States and its territories, representing emergency departments of different sizes and including children's hospitals. No distinction was made between injuries occurring during organized or recreational play.

The NEISS database provides statistical estimates of the total number of cases that occur across the United States in a given time period. Each case has an associated statistical weight based on the sample design to account for the nonparticipation of other hospitals. The weighted data were used rather than the raw case counts for population estimates, as provided by the CPSC. The database category "soccer," which includes the activity, apparel, or equipment (data code 1267), was used for this study. Soccer-related emergency department visits of male and female patients aged 5 to 49 years that occurred between 2000 and 2012 were analyzed.

This study focused on age, sex, injury diagnosis, body part injured, and disposition from the emergency department. The injury diagnoses were chosen based on prevalence; the top 6 types of injury (concussion, contusion/abrasion, dislocation, fracture, laceration, and strain/sprain) were used to determine the distribution of diagnoses. The body part injured was sorted into 6 categories: trunk (upper, lower, pubic region), upper extremity (arm [lower and upper], elbow, finger, hand, shoulder, wrist), lower extremity (ankle, foot, knee, leg [lower and upper], toe), face/mouth (face, mouth, eye, ear), head/neck, and other (25%-50% of body, all parts of body, not reported).

Statistical Analysis

Data were analyzed using SPSS 17 (IBM). The estimated number of injuries over time and by sex was analyzed using linear regression ($P < 0.05$). Scatter plots of the predicted values versus the studentized residuals were created to evaluate the linearity, independence, and homoscedasticity assumptions of linear regression. Shapiro-Wilk tests were performed on the studentized residuals to evaluate the normality assumption of linear regression analysis. P and R^2 values are reported.

Body part injured, injury diagnosis, and disposition were compared with sex and age group using chi-square tests of independence or the Fisher test, based on expected cell counts ($P < 0.05$). Specific body parts injured were also analyzed over change in age using binary logistic regression ($P < 0.05$). Hosmer-Lemeshow tests were completed to assess the goodness of fit of the logistic regression models. P values, odds ratios (ORs), and 95% CIs for the ORs are reported for the chi-square tests and logistic regression analyses.

RESULTS

Estimated Injury Count

From 2000 to 2012, there were an estimated 2,472,066 soccer-related injuries (Figure 1) presented to US emergency departments among 5- to 49-year-olds (74,069 actual injuries). During the same period, 629,994 (25.5%) of these estimated injuries were from adults aged 20 to 49 years. The overall estimated pediatric injury count increased significantly over the 2000-2012 time period. In the 20- to 49-year age range, there was also an increase in the estimated number of injuries over the 13-year period. The estimated number of injuries for male players was significantly higher than female players in any given year for all age groups (Table 1).

Body Part Injured

For all 5- to 49-year-olds, the most commonly injured body region was the lower extremity, specifically the ankle and knee. This was followed by the upper extremity, most commonly the wrist and finger (Appendix 1, available at <http://sph.sagepub.com/content/by/supplemental-data>). In the 5- to 19-year-old group, boys were more likely to have face/mouth injuries than girls. Girls aged 5 to 19 years were more likely to have lower extremity injuries than boys.

Injury Diagnosis

The most common injuries reported were strain/sprains, fractures, and contusions/abrasions within the 5- to 49-year age category. The prevalence of diagnoses varied by age and sex (Appendix 1). Overall, concussions were significantly more prevalent in female players than male players (Table 1).

Disposition

Male players were hospitalized more frequently than female players in all age categories (Figure 2). In the 5- to 19- and 20- to 29-year age groups, male players were hospitalized significantly more often than female players (Table 1).

Figure 1. Estimated number of soccer-related injuries in people aged 5 to 49 years from 2000 to 2012.

DISCUSSION

In this study, the estimated number of pediatric soccer-related injuries increased from 2002 to 2012. According to the US Youth Soccer Organization, participation in youth soccer did increase more quickly than the estimated number of injuries between 2000 and 2008.²³ However, participation decreased while the estimated number of injuries was still increasing between 2008 and 2012,²³ indicating that the increase in injuries may not be solely related to an increase in participation.

For the adult population, the number of US Adult Soccer Association registrations increased by 17% between 2004 and 2012,²⁰ and this study found an increase of 31.2% in the estimated number of soccer-related injuries in adults during the same time period, which is a much larger increase than the increase in participation.

The estimated number of injuries in male players was higher in all age categories with the exception of 10- to 14-year-olds, which is the same trend noted in a pediatric study¹ but contradicts another that found that the general number of injuries is similar between male and female players.¹⁵

The most commonly injured areas were the lower extremity and the wrist and finger, which is consistent with previous findings.^{1,5,6,8,9,11-13} For all players, the most prevalent injury diagnoses align with distributions seen previously.^{1,10-12,18}

Male and female players had a similar number of concussions, which is consistent with previous findings, although female players were more likely to be concussed in all age

categories.^{1,12} A previous study of a youth soccer competition found 1.47 concussions in male players for every 1 concussion in female players.⁷

Male players were more likely to injure the shoulder, and this trend became more apparent as the players increased with age, which was not observed in previous pediatric cohorts.¹² In Spain, shoulder injuries occurred in male players more frequently for 18- to 29-year-olds compared with 30- to 55-year-olds.⁹ In a study of high school athletes, male players were more likely to be injured from player-to-player contact while female shoulder injuries were most likely to result from contact with the playing surface.^{4,13} Shoulder injuries were twice as high on artificial turf compared with grass.¹⁹

Male players were hospitalized on average almost twice as often as female players. There was a large discrepancy in the 40- to 49-year age group; male players were more than 5 times as likely to be hospitalized, suggesting their injuries were more severe.

There are several limitations to this study. The major limitation is that the soccer-related injury rate would have been much more valuable and meaningful in examining the difference between age groups and sex rather than an estimated number of injuries. However, dependable soccer athletic exposure data for each year by age group or sex are not available for all years. Estimated participation was available for 2009.²¹ Second, the use of the NEISS database only represents injuries that present to emergency departments while many soccer-related injuries may be treated by athletic trainers or in other clinical settings. Last, since the NEISS database contains data from multiple

Table 1. Soccer-related injuries among 5- to 49-year-old male and female patients seen in emergency departments from 2000 to 2012

Estimated No. of Injuries	R^2	P Value (Full Model)	P Value (Sex Only)	Result
Age group, y				
5-19	0.694	<0.001*	—	Increase from 2000 to 2012
20-49	0.719	<0.001*	—	Increase from 2000 to 2012
Sex				
5-19 years	0.764	<0.001*	<0.001*	Male > female
20-29 years	0.965	<0.001*	<0.001*	Male > female
30-39 years	0.958	0.014*	<0.001*	Male > female
40-49 years	0.96	<0.001*	<0.001*	Male > female
	Odds Ratio	95% CI	P Value	Result (Odds of Being Injured)
Body part injured				
Face/mouth	1.256	1.214-1.299	<0.001*	Male > female
Lower extremity				
Knee	1.127	1.077-1.179	<0.001*	Female > male
Ankle	1.317	1.267-1.369	<0.001*	Female > male
Age group 20 to 49 years	0.982	0.976-0.988	<0.001*	Decrease with age
Lower leg	1.387	1.299-1.481	<0.001*	Male > female
Upper extremity				
Wrist	1.399	1.324-1.478	<0.001*	Female > male
Shoulder	1.653	1.531-1.786	<0.001*	Male > female
Age group 20 to 49 years	1.011	1.003-1.019	0.007*	Increase with age
Injury diagnosis				
Strain/sprain				
5-19 vs 20-49 years	0.74	0.714-0.766	<0.001*	5-19 < 20-49
Sex				
5-19 years	1.566	1.511-1.624	<0.001*	Female > male
10-14 years	1.705	1.618-1.796	<0.001*	Female > male
20-29 years	1.328	1.199-1.469	<0.001*	Female > male
30-39 years	1.181	1.021-1.365	0.025*	Female > male
Concussion				
5-49 years	1.41	1.310-1.518	<0.001*	Female > male
Disposition (hospitalization)				
Sex				
5-49 years	1.709	1.517-1.927	<0.001*	Male > female
5-19 years	1.587	1.389-1.812	<0.001*	Male > female
20-29 years	2.681	1.653-4.348	<0.001*	Male > female
45-49 years	5.618	0.759-41.667	0.07	Male > female

*Significant ($P < 0.05$).

Figure 2. Percentage of hospitalizations (including transfers to other hospitals) of soccer-related injuries from 2000 to 2012 by sex and age.

emergency departments, differences in injury diagnoses may have occurred based on differences in health care providers between emergency departments.

This study demonstrates that there are differences between pediatric and adult injuries based on sex, body part affected, type of injury, and hospital admissions. Previous studies have focused on the epidemiology of pediatric or professional athlete injuries seen in the emergency department. Information regarding the incidence and description of soccer-related injuries to all age groups can assist in the direction of training and prevention³ to decrease the rate of injury in this population.

REFERENCES

- Adams AL, Schiff MA. Childhood soccer injuries treated in U.S. emergency departments. *Acad Emerg Med*. 2006;13:571-574.
- Belson K. Soccer's growth in the U.S. seems steady. *New York Times*. 2010:D6.
- Bizzini M, Junge A, Dvorak J. Implementation of the FIFA 11+ Football Warm Up program: how to approach and convince the football associations to invest in prevention. *Br J Sports Med*. 2013;47:803-806.
- Bonza JE, Fields SK, Yard EE, Comstock RD. Shoulder injuries among United States high school athletes during the 2005-2006 and 2006-2007 school years. *J Athl Train*. 2009;44:76-83.
- Ekstrand J, Hagglund M, Walden M. Epidemiology of muscle injuries in professional football (soccer). *Am J Sports Med*. 2011;39:1226-1232.
- Ekstrand J, Hagglund M, Walden M. Injury incidence and injury patterns in professional football: the UEFA injury study. *Br J Sports Med*. 2011;45:553-558.
- Elias SR. 10-Year trend in USA Cup soccer injuries: 1988-1997. *Med Sci Sports Exerc*. 2001;33:359-367.
- Giza E, Micheli LJ. Soccer injuries. *Med Sport Sci*. 2005;49:140-169.
- Herrero H, Salinero JJ, Del Coso J. Injuries among Spanish male amateur soccer players: a retrospective population study. *Am J Sports Med*. 2014;42:78-85.
- Hoff GL, Martin TA. Outdoor and indoor soccer: injuries among youth players. *Am J Sports Med*. 1986;14:231-233.
- Inklaar H. Soccer injuries: I. Incidence and severity. *Sports Med*. 1994;18:55-73.
- Leininger RE, Knox CL, Comstock RD. Epidemiology of 1.6 million pediatric soccer-related injuries presenting to US emergency departments from 1990 to 2003. *Am J Sports Med*. 2007;35:288-293.
- Longo UG, Loppini M, Berton A, Martinelli N, Maffulli N, Denaro V. Shoulder injuries in soccer players. *Clin Cases Miner Bone Metab*. 2012;9:138-141.
- National Federation of State High School Associations. NFHS participation figures. <http://www.nfhs.org/ParticipationStatics/ParticipationStatics.aspx/>. Accessed August 8, 2013.
- Ostenberg A, Roos H. Injury risk factors in female European football. A prospective study of 123 players during one season. *Scand J Med Sci Sports*. 2000;10:279-285.
- Prodromos CC, Han Y, Rogowski J, Joyce B, Shi K. A meta-analysis of the incidence of anterior cruciate ligament tears as a function of gender, sport, and a knee injury-reduction regimen. *Arthroscopy*. 2007;23:1320-1325.
- Schiff MA. Soccer injuries in female youth players. *J Adolesc Health*. 2007;40:369-371.
- Schmikli SL, De Vries WR, Inklaar H, Backx FJ. Injury prevention target groups in soccer: injury characteristics and incidence rates in male junior and senior players. *J Sci Med Sport*. 2011;14:199-203.
- Soligard T, Bahr R, Andersen TE. Injury risk on artificial turf and grass in youth tournament football. *Scand J Med Sci Sports*. 2012;22:356-361.
- United States Adult Soccer Association. Registration stats. http://www.usasa.com/about/registrationstats/index_e.html. Accessed June 18, 2013.
- US Census Bureau. Statistical abstract of the United States. Participation in selected sports activities: 2009. <http://www.census.gov/compendia/statab/2012/tables/12s1249.pdf>. Accessed June 18, 2013.
- US Consumer Product Safety Commission. *National Electronic Injury Surveillance System. Soccer Injuries: Victims 5 Years Old To 49 Years*. Washington, DC: US Consumer Product Safety Commission; 2000-2012.
- US Youth Soccer. US Youth Soccer annual registration of players. http://www.usyouthsoccer.org/media_kit/keystatistics/. Accessed June 18, 2013.

For reprints and permission queries, please visit SAGE's Web site at <http://www.sagepub.com/journalsPermissions.nav>.