Journal of Athletic Training 2010;45(3):238–242

www.nata.org/jat

Soccer Injuries in Female Youth Players: Comparison of Injury Surveillance by Certified Athletic Trainers and Internet

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Context: Few authors have evaluated sports injury-surveillance systems that use parental, Internet-based surveys for data collection.

Objective: To determine whether certified athletic trainers (ATs) and parental, Internet-based surveys provided comparable data for identifying soccer injuries.

Design: Prospective feasibility cohort study.

Setting: A soccer association in Seattle, Washington.

Patients or Other Participants: Eighty female youth soccer players, ages 12 to 14 years.

Main Outcome Measure(s): We compared the data provided by ATs attending 1 soccer practice per week with a weekly soccer-parent, Internet-based system. We measured athlete-exposure hours (AEHs) for each player. We compared injury rates reported by ATs only, Internet-based surveys only, and both systems combined. We evaluated the 2 surveillance systems for agreement on injured body region and laterality of injury using the κ statistic.

Results: For ATs only, Internet-based surveys only, and both systems combined, we found acute injury rates of 3.0 per 1000 AEHs, 3.9 per 1000 AEHs, and 4.7 per 1000 AEHs and overuse injury rates of 1.0 per 1000 AEHs, 2.9 per 1000 AEHs, and 2.9 per 1000 AEHs, respectively. Players sustained 27 acute injuries (44% ankle, 11% knee, 11% hip) reported by at least 1 of the 2 systems, with 63% reported by ATs and 85% by Internet-based survey. Players sustained 17 overuse injuries (35% knee, 29% lower leg) reported by either system, with 35% reported by ATs and 100% by Internet-based survey. Among players for whom we had both ATs' and Internet-based survey injury data, body region injured and laterality had very good agreement ($\kappa = 0.73$ to 1.0).

Conclusions: The injury rate based on the weekly parental, Internet-based survey was similar to the rate based on the ATs' reporting and had comparable classifications of injured body region and laterality of injury.

Key Words: adolescent athletes, sports injuries, epidemiology, electronic surveys

Key Points

- Injury rates, injured body regions, and laterality of injury were similar when reported by parents (on a weekly Internet-based survey) and by certified athletic trainers.
- Internet-based injury-surveillance systems that rely on parents for reporting may be useful for youth populations when athletic trainers are not available, such as at the middle school level and for non–school-based sport clubs.

Soccer is one of the most popular sports worldwide[1] and is increasing in popularity in the United States among youth players.[2] Despite the perception that soccer is a relatively safe sport, it is one of the most common causes of sport injuries among youths. Numerous authors have described incidence rates of soccer injuries among youth ranging from 2.3 to 6.4 injuries per 1000 athlete-exposure hours.[3–7]

One important methodologic consideration in studying the epidemiology of sport-related injuries is the type of injury-surveillance system used. Most authors of studies on youth sports injuries have called on physicians, certified athletic trainers (ATs), or other medical personnel such as physical therapists to report on the number of injuries,[4,5,7–11] with most focusing on high school players. The use of medical personnel to report on injuries is relatively expensive, is typically available for high school-aged athletes who participate at school rather than in community-based sports clubs, and might not be necessary if players, parents, or team designees can be relied upon as an alternative injury-surveillance system. Several investigators[12,13] have recently evaluated the use of nonmedical personnel for sports injury surveillance and have noted good reliability of reporting.

In recent years, the Internet also has facilitated sports injury-surveillance systems in the United States, with the National Collegiate Athletics Association[14] and the Reporting Information Online (RIO)[15] collecting sports injury and athlete-exposure data at the collegiate and high school levels, respectively. An alternative method of injury surveillance among youth soccer players is the use of a weekly parental e-mail with a brief Internet-based, structured survey. We performed a feasibility pilot study to compare 2 soccer injury-surveillance systems among young female soccer players: ATs' injury reporting and an Internet-based system.

METHODS

Participants

We performed a 1-year prospective feasibility cohort study and enrolled 92 female youth soccer players, ages 12 to 14 years, from 4 randomly selected elite (higher-skill) teams from a total of 17 and 4 recreational (lower-skill) soccer teams from a total of 59 from the Seattle Youth Soccer Association, a soccer club in Washington state. All of the teams contacted (100%) agreed to participate, and 75% of the players on the teams agreed to participate. At the end of the study, we excluded 1 recreational team because they did not provide athlete-exposure time for any of their soccer games. For the remaining 7 teams, all 80 players were followed throughout their soccer season to determine soccer injury rates using 2 injury-surveillance systems. At the start of the season, all participants provided baseline data, including age, grade, length of soccer career, handedness and footedness, and any history of soccer injuries. We measured their heights and weights. All those who agreed to participate provided assent, and their parents provided informed consent before the study began. This study was approved by the University of Washington Institutional Review Board.

Injury-Surveillance Systems

At the beginning of the soccer season for the elite (April 2006) and recreational players (September 2006), we implemented 2 injury-surveillance systems that used 2 types of data recorders, so we could compare the records for the number of injuries and agreement on injury rates, location, and laterality. At the time of enrollment into the study, all parents were given a refrigerator magnet with printed definitions of acute and overuse injuries, along with the telephone number and e-mail address for the study center. For the first surveillance system, we sent a weekly e-mail to each soccer player's parent or guardian with a link to an Internet-based, brief, structured survey to identify players who had experienced an acute or overuse injury. Parents were required to respond to the Internet-based survey every week, with 1 reminder e-mail sent 2 days later if no response was received at the study center. Study personnel contacted all parents who did not respond to the reminder and surveyed them by telephone. Parents could not report on multiple weeks at 1 time, nor could they modify their report after it was submitted to the study center. The Internet-based survey obtained information on the player's type, location, and laterality of injury; the date of the injury; whether the injury occurred in a practice or game; and number of minutes spent practicing with her club soccer team during the prior week. Each athlete was assigned a study number that was linked to the weekly Internet-based survey. Participants were provided two $25 gift certificates during the season, and their parents were provided a $25 participation payment at the end of the season for their assistance with data collection.

The second system consisted of the assignment of an AT to each soccer team. Before the investigation began, the principal investigator and the sports medicine physician for the study trained the 2 ATs on injury definitions and data collection procedures. Each AT attended 1 soccer practice per week and interviewed all players who experienced an acute or overuse injury during the prior week. Parents and coaches were not interviewed by the AT. For each injured player, the AT completed a brief, structured soccer injury-assessment form that collected information on type, location, and laterality of injury; the date of the injury; and whether the injury occurred in a practice or game, with questions and response choices identical to those on the Internet-based survey. Each athlete was assigned a study number that was used on the injury form. The ATs did not have access to the weekly Internet-based injury data, and study personnel did not communicate with the ATs about injuries reported in the Internet-based system because we wanted the 2 systems to be independent.

We used the Fédération Internationale de Football Association consensus statement[16] as the basis for our injury definitions. We defined an *acute soccer injury* as a new, sudden-onset injury resulting from participation in club soccer that resulted in time loss from club soccer. *Time loss* was defined as missing a subsequent game or practice after the occurrence of an injury. We defined an *overuse injury* as the development of new onset of pain in a specific body region that persisted for 2 weeks or more and did not result from an acute event during soccer participation. An overuse injury diagnosis did not require time loss from soccer participation. These injury definitions were specifically described on the AT's injury form and in the weekly Internet-based survey.

Athlete-Exposure Time

We collected information on athlete-exposure hours (AEHs) for all players. For practice sessions, in the first week of the study we attempted to collect times using attendance sheets that were distributed to coaches. Because this procedure was difficult for the teams to implement, after the first week of AEH data collection we used the weekly parental Internet-based survey and included a question to collect the number of minutes each soccer player spent in practice for the week, with 100% of parents reporting practice AEHs each week. For AEHs during games, we trained the team manager and several parent volunteers on each team to use the playing-time log sheet to collect the number of minutes each player played in each game. For analysis, minutes were transformed into AEHs. During the midpoint of the elite soccer season, study personnel attended 1 game for each team to record AEHs for each player in the study to evaluate the reliability of the team-reported game playing time. Each team was given a monetary participation payment at the end of the season for helping to collect AEHs during games.

Statistical Analysis

We analyzed the acute and overuse injury data separately because these types of injuries differed with regard to pathophysiology and injury definition. We compared the baseline demographic and soccer data among the uninjured (no acute or overuse injuries) with those of athletes who experienced an acute injury as reported by either surveillance system. We also separately compared the characteristics of the uninjured players with those of the players with overuse injuries as reported by either surveillance system. Categorical variables were

Table 1. Demographic and Soccer Information for Female Youth Soccer Players 12–14 Years Old, Seattle Youth Soccer Association, 2006, n (%)

	Players With Acute Injuries (n = 22)	Players With Overuse Injuries (n = 17)	Uninjured Players (n = 49)
Age, y[a]			
11	2 (9)	1 (6)	2 (4)
12	8 (36)	8 (47)	11 (22)
13	5 (23)	6 (35)	14 (29)
14	7 (32)	2 (12)	22 (45)
Onset of menarche	17 (77)	8 (47)	36 (73)
Length of soccer career, y			
1–4	2 (9)	0 (0)	5 (10)
5–6	4 (18)	1 (6)	7 (14)
7–8	10 (46)	12 (71)	21 (43)
9+	6 (27)	4 (23)	16 (33)
Play on school team	8 (36)	6 (35)	21 (43)
Position[a,b]			
Defender	4 (18)	6 (35)	15 (31)
Forward	11 (50)	9 (53)	9 (18)
Midfielder	6 (27)	2 (12)	23 (47)
Goalie	1 (5)	0 (0)	2 (4)
Level of play[a]			
Elite	17 (77)	14 (82)	26 (53)
Recreational	5 (23)	3 (18)	23 (47)
Number of other sports played			
1	7 (32)	5 (29)	14 (29)
2	6 (27)	5 (29)	14 (29)
3	5 (23)	3 (20)	10 (20)
4+	4 (18)	4 (22)	11 (22)
Ever injured[b]	15 (71)	9 (53)	21 (43)
Using a personal trainer[b]	7 (32)	4 (24)	5 (10)
Participating in injury-prevention program	2 (9)	1 (6)	6 (12)

[a] Comparing players with overuse injuries with uninjured players: $P < .05$.

[b] Comparing acutely injured players with uninjured players: $P < .05$.

compared using the Fisher exact test, and ordinal variables were compared using the Wilcoxon rank sum test.

We calculated injury incidence rates by dividing the number of injuries by the AEHs accrued during the course of the study, and we calculated 95% confidence intervals (CIs) using the Poisson distribution. These rates were calculated for both acute and overuse injuries as reported by the weekly Internet-based surveillance system only and the ATs' surveillance system only and for injuries using both systems combined, in which an injury could be reported by the parent, the AT, or both the parent and AT. We calculated acute injury rates using the 2 surveillance systems for games and practices separately. For the total injuries reported by the AT, the Internet-based system, or both systems combined, we calculated the proportion captured uniquely by each system and the proportion of injuries captured in both systems combined. These proportions are reported separately for acute and overuse injuries. We evaluated the amount of agreement beyond chance between the surveillance systems for reporting on location of injury, laterality of injury, and date of injury using the κ statistic and 95% CIs for those acute and overuse injuries reported by both systems. We described the body regions affected by the acute and overuse injuries sustained by the players. We also evaluated the reliability of the collection of AEHs by comparing the game AEHs collected by study personnel attending 1 game with the AEHs collected by the team designee using the intraclass correlation coefficient (ICC). In this adaptation of the ICC, the 2 playing times for each athlete—1 recorded by study personnel and 1 recorded by the team designee—were considered repeats for the purpose of calculating the ICC.

Table 2. Acute and Overuse Injury Rates of Female Youth Soccer Players 12–14 Years Old, Seattle Youth Soccer Association, 2006, According to Weekly Parent, Internet-Based and Certified Athletic Trainer Injury-Surveillance Systems, per 1000 Athlete-Exposure Hours (95% Confidence Interval)

	Injury Surveillance		
Injury Rates	Parent, Internet Based	Certified Athletic Trainer	Both Internet Based and Certified Athletic Trainer Combined
Acute injuries			
Total injuries	3.9 (2.4, 5.8)	3.0 (1.4, 4.8)	4.7 (3.1, 6.8)
Game injuries	9.4 (5.4, 15.3)	6.4 (3.2, 11.6)	10.6 (6.3, 16.7)
Practice injuries	1.6 (0.6, 3.4)	1.4 (0.5, 3.1)	2.1 (1.0, 4.0)
Overuse injuries			
Total injuries	2.9 (1.7, 4.6)	1.0 (0.4, 2.2)	2.9 (1.7, 4.6)

RESULTS

When we compared players with acute injuries with those who were uninjured, we found no differences in age, menarchal status, length of soccer career, soccer participation on a school team, level of play, number of other sports played in addition to soccer, or participation in an injury-prevention program (Table 1). Players with acute injuries were more likely to play forward and less likely to play defender or midfielder positions. Those with acute injuries were also more likely to have had a prior injury and to use a personal trainer during the soccer season. Athletes with overuse injuries were more likely to be younger, to play at the elite level, and to play forward and were less likely to play midfielder positions than uninjured athletes.

During the course of the study, we had no loss to follow-up. We found that 22 participants experienced 27 acute injuries that were reported by 1 or both surveillance methods. Among those injuries, 85% (23/27) were reported by Internet-based survey, 63% (17/27) were reported by AT, and 48% (13/27) were reported by both. In addition, 37% (10/27) of acute injuries were reported by Internet-based survey but not by AT, and 15% (4/27) were reported by AT but not by Internet-based survey. The acute injury incidence rate was 4.7 per 1000 AEHs using reporting from both systems combined, 3.9 per 1000 AEHs using reporting from the Internet-based system, and 3.0 per 1000 AEHs using reporting from the AT system (Table 2). The acute injury incidence rates also were stratified by game and practice sessions. Reporting of acute injuries during games and practice sessions was similar for the 2 systems. Among the 13 acute injuries reported by both Internet-based survey and ATs, agreement was very good for body region injured ($\kappa = 0.89$, 95% CI = 0.64, 1.0) and laterality of

injury (κ = 0.86, 95% CI = 0.41, 1.0), with less agreement on date of injury (κ = 0.66, 95% CI = 0.5, 0.82). The most common acutely injured body regions were the ankle (n = 12, 44%), the knee (n = 3, 11%), and the hip (n = 3, 11%).

We found that 17 players experienced 17 overuse injuries, with 100% (17/17) reported by the Internet-based survey, 35% (6/17) reported by AT, and 35% (6/17) reported by both. In addition, 65% (11/17) of the overuse injuries were reported by the Internet-based survey but not AT, and none were reported by AT but not Internet-based survey. The overuse injury incidence rate was 2.9 per 1000 AEHs using reporting from both the Internet-based survey and AT system combined, 2.9 per 1000 AEHs using reporting from the Internet-based survey system, and 1.0 per 1000 AEHs using reporting from the AT system. Among the 6 overuse injuries reported by both the Internet-based survey and AT, agreement was good for body region injured (κ = 0.74, 95% CI = 0.17, 1.0) and excellent for laterality of injury (κ = 1.0, 95% CI = 0.40, 1.0) with poor agreement on date of injury (κ = 0.29, 95% CI = 0.12, 0.46). The most common body regions for overuse injuries were the knee (n = 6, 35%) and lower leg (n = 5, 29%).

Eight athletes sustained both an acute and an overuse injury during the soccer season. None of the parents mislabeled an acute injury as an overuse injury or an overuse injury as an acute injury. We found excellent consistency between study personnel and the designated parent in the recording of game playing time for the elite teams (ICC = 0.98 to 1.0 across 1 game per team).

DISCUSSION

In our feasibility study, we found that our injury rates were similar for the 2 injury-surveillance systems. The weekly Internet-based system and ATs had very good to excellent agreement on body region and laterality for acute and overuse injuries. Including injury data reported by both systems combined, we found an acute soccer injury rate of 4.7 per 1000 AEHs and an overuse injury rate of 2.9 per 1000 AEHs.

In comparing our 2 soccer injury-surveillance systems, we noted no differences in rates of acute and overuse injuries reported by the weekly parental Internet-based system and the AT system, although these results were limited by our small sample size and the evaluation of soccer players in 1 soccer association. Several previous groups have compared different injury-surveillance systems for identifying acute sports and recreational injuries. Emery et al[12] compared injury reporting using paper forms completed by a soccer team designee with forms completed by ATs and noted that the ATs reported a greater percentage of the injuries. Grimmer et al[17] compared reporting of recreational injuries among parents via telephone interviews and adolescents via paper forms and noted excellent agreement. To our knowledge, no other investigators have evaluated injury-surveillance systems for overuse soccer injuries. Our finding that the weekly parental, Internet-based system identified the majority of all reported injuries among 12- to 14-year-old soccer players is encouraging, because players who participate in clubs (in contrast to school-sponsored soccer) typically do not have access to ATs. Also, a weekly parental, Internet-based survey is an inexpensive means of injury surveillance for a large cohort of soccer players.

In addition to identifying the occurrence of injuries, we found good to excellent agreement as measured by the κ statistic of the injury information reported by the 2 surveillance systems, specifically body region and laterality. Shrier et al[13] compared injury reporting by soccer coaches, players, and parents and noted complete concordance on type and laterality of injury and 90% concordance on body region. The agreement for reporting injury type and laterality is important for the descriptions of the injuries the athletes experienced. Our findings showed that the weekly parental, Internet-based system is comparable with reporting by ATs who are specifically trained to evaluate sports injuries.

We relied upon parents of soccer players to collect information on the number of AEHs during games and found these data collectors were very accurate compared with the study personnel. Because injury rates depend upon accurate collection of amount of time at risk of injury (athlete-exposure hours), the reliability of parents' recording of soccer playing time during the season is important. In a prior study[9] of soccer injuries, weekly AEH sheets were collected for more than 95% of the team weeks, although the accuracy of the exposure-time reporting was not described. Our data collectors were reliable in reporting soccer playing time; however, this method of data collection was labor intensive and resulted in missing data for 1 team for the entire season. An alternative to collecting time-based exposure data is the use of event-based exposures, with participation in an athlete-exposure event recorded simply as *yes* (any amount of participation) or *no*. Although this type of collection is less precise, it results in fewer missing data.

The rate of acute injuries as reported by either injury-surveillance system was 4.7 per 1000 AEHs. Our acute injury rate is similar to rates reported among high school-aged soccer players in previous investigations,[4,12] with rates ranging between 2.3 and 5.6 per 1000 AEHs in North America and Europe. Although relatively few authors have evaluated injury rates in soccer players ages 12 to 14 years,[18,19] the rate we report indicates that this age group has a significant risk of injury and should be targeted for future epidemiologic studies and injury-prevention strategies. We also noted an overuse soccer injury rate of 2.9 per 1000 AEHs, somewhat higher than the rates of 0.9 to 2.4 per 1000 AEs reported in previous studies[5,20] of youth soccer players. Overuse injuries have been less well characterized than acute injuries but account for approximately 30% of all soccer injuries. Our rationale for evaluating overuse injuries in this younger population is that in Washington state, soccer players 11 years and older can begin playing soccer year-round on elite-level teams. This increase in the absolute amount of playing time may be associated with an increased rate of injury due to the increased demands and competitiveness of the sport for the elite players.

Our study had several limitations, among them the fact that we enrolled only 75% of the players on each team. The purpose of our study was to evaluate the feasibility of using an Internet-based injury-surveillance system to identify and describe soccer injuries and, therefore, we enrolled a small sample of female youth players. This resulted in a small

number of injuries and a lack of precision in our injury rates. Despite the use of 2 different, independent injury-surveillance systems, we may have missed acute and overuse injuries that were not reported through either system, because we did not have a benchmark or ''gold standard'' to identify all the injuries that occurred. Some of the disparity between parents' and ATs' reporting of injuries may have occurred because parents did not identify all injuries their players sustained due to different interpretations of levels of pain or selective reporting by the athletes. Most parents were not medically trained, so the identification of an injury, especially an overuse injury, might have been more subjective given the different interpretations of this type of injury. This could have resulted in overreporting or underreporting of injuries. We attempted to mitigate this possibility by having specific definitions for acute and overuse injuries included in every Internet-based survey. The attendance of an AT at all soccer games and practices may have provided more complete acute injury reporting, but it would have been expensive and would not have identified injured players who did not attend a soccer practice or game after their injury unless the AT observed the occurrence of the injury. Our method of having team parents collect AE time for games was labor intensive and resulted in the exclusion of all injury data from 1 team due to missing data. Last, our soccer players were selected from teams in soccer clubs around the Seattle area and, thus, our results may not be generalizable to soccer players in other regions of the United States or other countries around the world.

In conclusion, we found that the parent-based Internet survey was a feasible method to collect basic injury data, although additional research is needed among larger and more heterogeneous samples from a variety of sports. Internet-based injury-surveillance systems that rely on parental reporting should be considered for future studies of sports injuries in youth populations when ATs are not available, such as at the middle school level and for non–school-based sports clubs.

ACKNOWLEDGMENTS

We thank the Seattle Youth Soccer Association, all soccer players, and their parents for providing us the opportunity to work with them on this study. We also appreciate the certified athletic trainers who participated. The findings from this study were presented at the 2nd World Congress on Sports Injury Prevention, Tromsø, Norway, in June 2008. This publication was made possible by grant R21AR053371 from the National Institute of Arthritis and Musculoskeletal and Skin Diseases, Bethesda, Maryland.

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