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The First Decade of Web-Based Sports Injury Surveillance (2004–2005 Through 2013–2014): Methods of the National Collegiate Athletic Association Injury Surveillance Program and High School Reporting Information Online

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Objective: To describe the methods of the National Collegiate Athletic Association (NCAA) Injury Surveillance Program (ISP) and High School Reporting Information Online (HS RIO) system as a complement to the sport-specific manuscripts that will follow.

Background: The NCAA-ISP and HS RIO collect injury and exposure data from samples of collegiate and high school sports programs, respectively. The NCAA-ISP, which the NCAA has maintained since 1982, was relaunched as a Web-based platform at the beginning of the 2004–2005 academic year. In 2005, the HS RIO was introduced to capture data on high school athletes and modeled after the NCAA-ISP. Relevant data are shared with the NCAA and high school sport and policy committees to develop evidence-based rules and programs that help protect the health and safety of student-athletes.

Description: The NCAA-ISP and HS RIO monitor participation in school-sanctioned competitions and practices that occur from the first preseason practice to the final postseason contest for more than 25 sports. For this series of publications in the *Journal of Athletic Training*, injury information on 13 sports at the collegiate level during the 2004–2005 through 2013–2014 academic years and the high school level during the 2005–2006 through 2013–2014 academic years was evaluated.

Conclusions: Athletic trainers have been a vital source of data collection over the past decade to help produce the largest datasets of collegiate and high school sports injuries. Such data have helped various sport and policy committees advance protocols that aim to increase sports safety. This series of publications will aid by continuing to provide data to stakeholders in the sports community.

Researchers[1,2] have documented the health benefits of increased physical activity, including weight management; reduced risks of cardiovascular disease, type 2 diabetes, and cancer; and improved mental health. However, participation in athletics also places individuals at risk for sport-related injuries.[3–5] As a result, it is imperative to identify the sport-related risk factors that can be modified in order to increase the well-being and safety of athletes.

The term *epidemiology* originates from 3 Latin roots—(1) *epi* (Latin for "on," "upon," and "against"), (2) *demos* ("people"), and (3) *logos* ("study of")—and roughly translates to "the study of what is against people." Today, *epidemiology* is defined as the "study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the control of health problems."[6(p61)] Sports injury epidemiology in particular aims to examine the incidences and risk factors of and the preventive measures for injury occurring during sport-related activities.

Sports injury epidemiology findings are integral to injury-prevention efforts, as described by multiple theoretical frameworks. For example, the van Mechelen et al[7] "sequence of prevention" framework proposes that injury-prevention research is a cyclical process that includes examining the incidence, exploring causes, creating preventive measures, and assessing the effectiveness of these measures on incidence through longitudinal examination. Accurate sports injury epidemiologic data play a central role in this model. The Translating Research into Injury Prevention Practice (TRIPP) framework[8] extends the van Mechelen et al model[7] to include translation to practice but retains epidemiology and surveillance as an essential first step that describes the at-risk population and its injury incidence and burden.

Injury surveillance has been of the utmost importance for numerous sports organizations, including those at the high

school[9–11] and collegiate[12–14] levels, where student-athlete populations are large. High school sports participation has grown annually over the past 25 years, with an estimated 7.8 million participants during the 2013–2014 academic year.[15] A proportion of these students continue their sport participation when they enter college; a small subset may begin their athletic careers in college. Similar to what was seen at the high school level, the National Collegiate Athletic Association (NCAA)[16] reported steadily increasing participation numbers, with more than 460 000 student-athletes estimated to have participated in the 2012–2013 academic year. With such large populations of student-athletes, data can be generated to develop injury-prevention efforts.

The NCAA Injury Surveillance System (NCAA-ISS) was created in 1982 as a pen-and-paper surveillance program with the aim of collecting injury and exposure data from a sample of NCAA institutions.[14] These data facilitate evidence-based decision making by the NCAA and its health, rules, and policy committees as they assess and resolve health and safety concerns. Originally, the NCAA-ISS collected data from a small number of sports; by 1988, the NCAA-ISS had expanded to 16 sports. Data from the 1988–1989 through 2003–2004 academic years, before the advent of Web-based data collection, were published in a special issue of the *Journal of Athletic Training* (2007:42[2]). These data were collected using a pen-and-paper system, in which athletic trainers (ATs) completed hard-copy injury and exposure forms that were faxed or mailed to the NCAA, whose staff then hand entered or scanned the data.

However, the pen-and-paper–based system had limitations that burdened those ATs collecting and reporting injury and exposure data. First, ATs had to enter data twice: once for their own records and again for surveillance purposes. Second, having to mail or fax injury and exposure data required time and resources and presented multiple opportunities for data-entry errors. During the 2002–2003 and 2003–2004 academic years, the NCAA transitioned to a Web-based platform to track injury and exposure data. Formal data collection on the Web-based platform began at the start of the 2004–2005 academic year.[13] In 2009, the NCAA partnered with the Datalys Center for Sports Injury Research and Prevention, Inc (Datalys Center, Indianapolis, IN), an independent nonprofit research organization, to (1) provide researchers with access to the data beginning in the 2004–2005 academic year and (2) lead data collection starting in the 2009–2010 academic year. This shift to management by the Datalys Center coincided with the NCAA-ISS program's being renamed the Injury Surveillance Program (ISP). From here on, the NCAA-ISS and NCAA-ISP will be denoted as the *NCAA-ISP*. The 2013–2014 academic year marked the 10th year of Web-based injury surveillance of collegiate sports by the NCAA-ISP.

In 2005, a Web-based sports injury-surveillance system, High School Reporting Information Online (HS RIO), was launched to capture data on athletes from a national random sample of US high schools (Figure).[9] Data collection began in the 2005–2006 academic year. In the following years, a convenience sample was added so that additional schools and sports could be included in data collection. The University of Colorado-Denver is the current home of HS RIO.

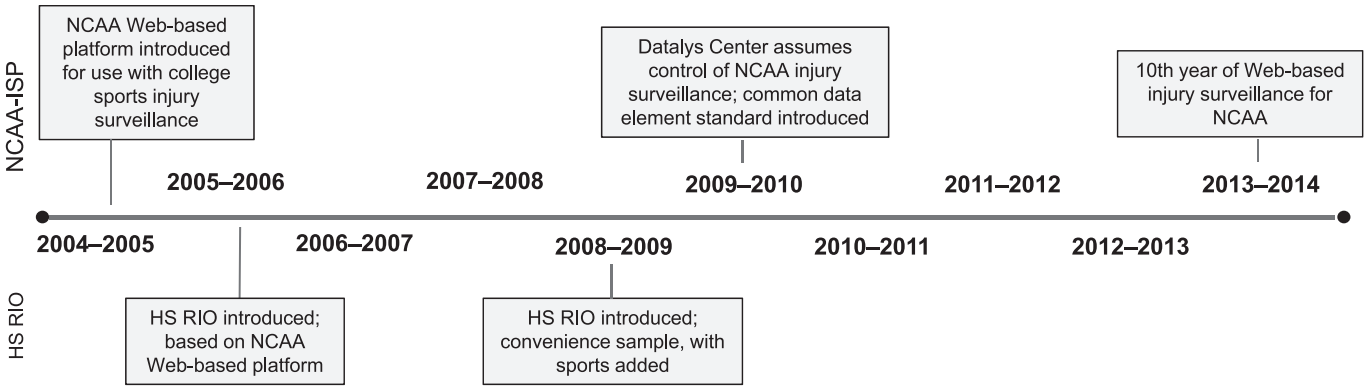
The aim of Web-based surveillance platforms is to ensure more thorough collection and thus more valid estimates of injury incidence in sports-related settings. Further, as denoted in the van Mechelen et al[7] framework, injury prevention benefits from ongoing monitoring of injury incidence, and updated descriptive epidemiology is needed. Finally, with the advent of Web-based high school sports injury surveillance, it is important to document methods and injury incidence at both the high school and collegiate levels and, where applicable, compare findings between them. The high school level has a greater number of student-athletes than the collegiate level, and if differences in injury incidences exist, level-specific prevention recommendations may be warranted.[15,16] In this article, we summarize the methods of the NCAA-ISP and HS RIO over the first decade of Web-based sports injury surveillance. Included data began with the 2004–2005 academic year, when the Web-based platform for the NCAA-ISP was first implemented; continue with the 2005–2006 academic year, when HS RIO was introduced; and conclude with the 2013–2014 academic year. We then describe how data from these 2 surveillance systems were analyzed for the subsequent sport-specific publications presented in this series of publications. Previous articles have also described the methods of the NCAA-ISP[13] and HS RIO[9,11] in depth.

SAMPLING AND DATA COLLECTION

The 2004–2005 through 2013–2014 NCAA-ISP data and 2005–2006 through 2013–2014 HS RIO data were collected on injuries and exposures that occurred in school-sanctioned practices and competitions from the first day of the preseason through the final postseason competition. These injury and exposure variables yielded injury proportions and rates.

Previous authors have described the sampling and data collection of the NCAA-ISP[13] and HS RIO[9,11] in depth. Both surveillance systems rely on ATs who work in the collegiate and high school settings, respectively, and volunteer to participate in data collection. These ATs provide information regarding injury events and the number of athletes participating in each school-sanctioned practice or competition. The samples reflected in these systems are limited to those schools in which ATs are available and willing to report data. We briefly summarize the data collection for both the NCAA-ISP and HS RIO in the following paragraphs.

The sports included in this special series were high school boys' and collegiate men's baseball, basketball, football, ice hockey, lacrosse, soccer, and wrestling and high school girls' and collegiate women's basketball, field hockey, lacrosse, soccer, softball, and volleyball (Figure). These sports were included because both the NCAA-ISP and HS RIO collected injury and exposure data for these sports; older data from these sports at the collegiate level were also included in the previously published special issue of the *Journal of Athletic Training* (2007:42[2]). Although HS RIO did not collect data on high school girls' ice hockey, we included data on collegiate women's ice hockey from the NCAA-ISP. Also, HS RIO data collection of girls' gymnastics stopped after the 2011–2012 academic year; however, collegiate women's gymnastics data are available.[17]



Men's/Boys' Sports	NCAA-ISP	HS RIO	Women's/Girls' Sports	NCAA-ISP	HS RIO
Baseball	2004–2005—2013–2014	2005–2006—2013–2014	Field hockey	2004–2005—2013–2014	2008–2009—2013–2014
Basketball	2004–2005—2013–2014	2005–2006—2013–2014	Ice hockey	2004–2005—2013–2014	2008–2009—2013–2014
Football	2004–2005—2013–2014	2005–2006—2013–2014	Lacrosse	2004–2005—2013–2014	2008–2009—2013–2014
Ice hockey	2004–2005—2013–2014	2008–2009—2013–2014	Soccer	2004–2005—2013–2014	2005–2006—2013–2014
Lacrosse	2004–2005—2013–2014	2008–2009—2013–2014	Softball	2004–2005—2013–2014	2005–2006—2013–2014
Soccer	2004–2005—2013–2014	2005–2006—2013–2014	Volleyball	2004–2005—2013–2014	2005–2006—2013–2014
Wrestling	2004–2005—2013–2014	2005–2006—2013–2014			

Figure. History of the National Collegiate Athletic Association (NCAA) Injury Surveillance Program (ISP) and the High School Reporting Information Online (HS RIO), 2004–2005 through 2013–2014.

Participation for each sport at each level of play is noted in each sport-specific article. We acknowledge that both the NCAA-ISP and HS RIO have collected data on additional sports that were not included in this special series (eg, track and field).

The NCAA-ISP

The NCAA-ISP depends on a convenience sample of teams with ATs voluntarily reporting injury and exposure data.[13] Participation in the NCAA-ISP, while voluntary, is available to all NCAA institutions.

During the 2004–2005 through 2008–2009 academic years, ATs used a Web-based platform launched by the NCAA to track injury and exposure data.[13] The Web-based platform provided several benefits over the previous paper-based data collection. Web-based reporting offered secure and streamlined delivery of data from the ATs to the NCAA. In an effort to incentivize participation, the developers of the Web-based surveillance system integrated some of the functional components of an electronic medical record (EMR), such as athlete demographic information and preseason injury information. Although this Web-based surveillance system lacked all the functional capabilities of an EMR, ATs could consider using it as a feasible alternative, thereby eliminating the need to double-enter data (ie, once for their own records and again for surveillance purposes). When data were supplied for external use, any information that could potentially identify athletes or programs was removed.

When the Datalys Center introduced new components to the Web-based surveillance system to improve process flow in 2009, a common data element (CDE) standard was implemented.[13] The CDE standard allowed data to be gathered from different EMR and injury-documentation applications, including the Athletic Trainer System (Keffer Development, Grove City, PA), Injury Surveillance Tool (Datalys Center), and Sports Injury Monitoring System (FlanTech, Iowa City, IA). As opposed to asking ATs to report injuries solely for the purpose of participation in an injury-surveillance program, the CDE export standard allowed ATs to document injuries as they normally would as part of their daily clinical practice. Also, the different options of EMR and injury-documentation applications allowed ATs the flexibility to choose the system that was the most compatible with their individual school's needs. After they were entered into the system, the de-identified and Health Insurance Portability and Accountability Act (HIPAA)–compliant data were exported to an aggregate database, where they passed through a verification process. During this process, data quality-control staff reviewed the data, flagged invalid entries, and worked with participating ATs to resolve any concerns. When the Datalys Center began to oversee data-collection efforts, a verification engine process was introduced, in which an automated system reviewed data for valid values, flagged those data that were invalid, and notified data quality-control staff and participating ATs, who would work together to resolve any problems.[13]

In general, for each injury event, the AT completed a detailed report on the injury or condition (eg, site, diagnosis) and the circumstances (eg, activity, mechanism, event type [ie, competition or practice]). In addition, ATs provided the number of student-athletes participating in each practice and competition. The ATs were able to view and update previously submitted information as needed during the course of a season. Data included in the special-series manuscripts were collected during the 2004–2005 through 2013–2014 academic years.

National Estimates

All NCAA-ISP datasets include weights that could be applied to data to generate national estimates that adjust for potential underreporting of injuries. Poststratification sample weights, based on sport and division, allowed the NCAA-ISP data to provide national estimates of injury events occurring in collegiate sports from the data supplied by the sampled teams. In addition, because of year-to-year variations in the reporting sample, poststratification sample weights were modified with each academic year. Poststratification sample weights were calculated using the formula:

$$\text{Weight}_{ijk} = \left(\frac{\text{Number of ISP Schools}_{ijk}}{\text{Number of Sponsoring Schools}_{ijk}} \right)^{-1}$$

where weight_{ijk} is the weight for the ith sport of the jth division in the kth year.

In the NCAA-ISP, it is possible that injuries may be underreported by ATs due to competing demands on their time and the dynamic nature of the athletic training facility. The authors[18] of a validation study examined data collected from the first iteration of the Web-based NCAA-ISP. The NCAA-ISP data were matched and compared with data abstracted from other types of clinical records. A sample of 15 universities that provided data on men's and women's soccer to the NCAA-ISP for at least 2 years during 2005–2007 was used. The researchers estimated that the NCAA-ISP captured 88.3% (95% confidence interval [CI] = 85.8%, 90.6%) of all time-loss medical-care injury events. This high level of agreement between the NCAA-ISP and clinical medical records suggested that the NCAA-ISP provided valid injury estimates. Based on these findings, weights were further adjusted to correct for underreporting, by scaling weighted counts up by a factor of (0.883^{-1}). Although Kucera et al[18] studied only the NCAA-ISP data for soccer, the weighting was applied to all NCAA-ISP data under the assumption that underreporting does not vary by sport, year, school, or division.

The HS RIO

The HS RIO was initially modeled after the NCAA-ISP to ensure that epidemiologic comparisons could be made regarding sport-related injuries across the high school and collegiate athlete age continuum. The HS RIO consists of a sample of high schools with 1 or more National Athletic Trainers' Association–affiliated ATs with valid e-mail addresses. The ATs at participating high schools reported injury incidence and athlete-exposure (AE) information weekly throughout the academic year using a secure Web site. For each injury, the AT completed a detailed report on the injured athlete (age, height, weight, etc), the injury (site, diagnosis, severity, etc), and the injury event (activity, mechanism, etc). Throughout each academic year, participating ATs were able to view and update previously submitted reports as needed with new information (eg, time loss).

Two data-collection panels were assembled. The first data-collection panel was a random sample of 100 schools recruited annually since the 2005–2006 academic year that reported data for the 9 original sports of interest (boys' baseball, basketball, football, soccer, and wrestling and girls' basketball, soccer, softball, and volleyball). High schools were recruited into 8 strata based on the school's enrollment ($\leq$1000 or $>$1000) and US Census geographic region.[19] If a school dropped out of the system, a replacement from the same stratum was selected.

The second panel was an additional convenience sample of schools recruited annually since the 2008–2009 academic year that reported data for additional sports of interest (eg, boys' ice hockey and lacrosse and girls' field hockey and lacrosse) as well as any of the original 9 sports of interest. It was impossible to approximate a random sample for the additional sports in the second panel due to strong regional variations in sport sponsorship (eg, ice hockey). As a result, exposure and injury data for the schools in the second panel represent a convenience sample of US high schools. This convenience sample of high schools is separate from that of the first panel (ie, those enrolled in the original random sample). However, it is also possible for ATs at schools from the first panel to report for sports in addition to the original 9 sports of interest.

Data collection for the 13 sports featured in the sport-specific manuscripts included in this special series began during different academic years in HS RIO. Data collected from the randomized sample (the first panel) starting in 2005–2006 will be presented for the original 9 sports of interest, and data collected from both the first and second panels (ie, the original and convenience sample schools) starting in 2007–2008 will be presented for the other 4 sports included in this series of publications (boys' ice hockey, girls' field hockey, and boys' and girls' lacrosse).

National Estimates

In HS RIO, national injury estimates are calculated from only the first sample, the randomly selected sample of 100 high schools reporting data on the original 9 sports of interest. This is due to concerns regarding the validity of national estimates based on data from the convenience sample of schools reporting on sports with strong regional variation. Thus, in this series of publications, national estimates are available for boys' baseball, basketball, football, soccer, and wrestling and girls' basketball, soccer, softball, and volleyball but are not available for boys' ice hockey, girls' field hockey, and boys' and girls' lacrosse. For those sports with available national estimates, a weighting algorithm based on the inverse probability of participant schools' selection into the study (based on geographic location and high school size) was applied to individual case counts to calculate the national injury estimates.

In HS RIO, it is possible that injuries may be underreported by ATs due to competing demands on their time and the dynamic nature of the athletic training facility environment. Annual HS RIO summary reports available on the Internet provide information on reporter demographics and compliance. Additionally, several annual summary reports (2007–2008, 2008–2009, 2009–2010, 2010–2011, and 2012–2013) provide the results of internal validity checks that matched and compared HS RIO data with data abstracted from other types of clinical records maintained by

Table 1. Summary of Variables Included in Special Series of Sports Injury Epidemiology Manuscripts and Differences Between Data Collection for the National Collegiate Athletic Association Injury Surveillance Program (NCAA-ISP) and High School Reporting Information Online (HS RIO)

Variable	Definition	Comparison Between NCAA-ISP and HS RIO
Injury	Injury that (1) occurred as a result of participation in an organized practice or competition; (2) required medical attention by a certified athletic trainer or physician; and (3) resulted in restriction of the student-athlete's participation for 1 or more days beyond the day of injury	Similar definitions. For the 2009–2010 through 2013–2014 academic years only, the NCAA-ISP included injuries with time loss under 1 day as well. The HS RIO captured injuries with time loss under 1 day only if diagnosed as concussions, fractures, or dental injuries. All other injuries captured under HS RIO met the time-loss component of the injury definition.
Academic year	The time period beginning on July 1 and ending on June 30	Same definition
Athlete-exposure	One student-athlete participating in 1 school-sanctioned practice or competition	Same definition
Time in season	(1) Preseason: all formal team practices and exhibition games conducted before the first regular-season contest; (2) regular season: all practices and competitions from the first regular-season competition through the last regular-season competition; (3) postseason: all practices and competitions after the last regular-season competition through the last postseason competition	Same definition. The HS RIO did not capture athlete-exposures by time in season (and cannot calculate injury rates specific to time in season).
Time loss	The number of days between the original injury and return to participation at a level that would allow participation in competition. Athletic trainers select from a choice of time ranges, plus categories noting season-ending injuries due to athlete withdrawal or medical disqualification.	Same definition. The NCAA-ISP also collected a discrete time-loss variable based on date of return to participation minus date of injury.
Event type	The specific event (ie, practice, competition) in which the injury occurred	Same definition. No injuries or exposures occurring outside of defined seasons or activities within seasons not designated as formal team practices or competitions were captured in either system.
Body part injured	The region of the body in which the student-athlete sustained his or her injury	Same definition but with slight variations in response options
Diagnosis	The diagnosis provided to the injured student-athlete based on the medical expertise and education of the athletic trainer	Same definition but with slight variations in response options
Injury mechanism	The manner in which the student-athlete sustained his or her injury	Same definition but with slight variations in response options
Injury activity	The activity in which the student-athlete was engaged when the injury occurred	Same definition but with slight variations in response options
Position	The position at which the student-athlete was playing when the injury occurred	Same definition

participating ATs in the high school setting. These validity checks have consistently demonstrated sensitivity, specificity, and positive and negative predictive values above 95% (see annual summary reports available at http://www.ucdenver.edu/academics/colleges/PublicHealth/research/ResearchProjects/piper/projects/RIO/Pages/Study-Reports.aspx).

DEFINITIONS

In 2004–2005 through 2013–2014 for NCAA-ISP and 2005–2006 through 2013–2014 for HS RIO, data were collected on injuries and exposures that occurred in school-sanctioned practices and competitions from the first day of preseason through the final postseason competition. These injury and exposure variables yielded injury proportions and rates. Definitions for relevant variables in these surveillance systems are presented in the following paragraphs and summarized in Table 1.

Injury

A *reportable injury* in both the NCAA-ISP and HS RIO was defined as an injury that (1) occurred as a result of participation in an organized practice or competition, (2) required medical attention by a certified AT or physician, and (3) resulted in restriction of the student-athlete's participation for 1 or more days beyond the day of injury. Since 2007–2008, HS RIO has also captured all concussions, fractures, and dental injuries, regardless of time loss. In the NCAA-ISP, multiple injuries occurring from 1 injury event could be included, whereas in HS RIO, only the principal injury was captured (as determined by the AT). For both surveillance systems, if an off day followed the injury event, the AT was asked to assess whether the injured athlete would have been able to participate.

Beginning in 2009–2010, the NCAA-ISP also began to monitor all non–time-loss injuries. A *non–time-loss injury* was defined as any injury that was evaluated or treated (or both) by an AT or physician but did not result in restriction

from participation beyond the day of injury. However, because HS RIO captures only time-loss injuries (to reduce the burden on high school ATs), for this series of publications, only time-loss injuries (with the exception of concussions, fractures, and dental injuries, as noted earlier) were included.

Academic Year

For both surveillance systems, the *academic year* was defined as beginning on July 1 and ending on June 30. As a result, an academic year of data collection spanned 2 calendar years. Exceptions were made at the high school level for those postseason competitions occurring after June 30 (eg, baseball championship playoffs).

Athlete-Exposure

For both surveillance systems, a reportable *AE* was defined as 1 student-athlete participating in 1 school-sanctioned practice or competition in which he or she was exposed to the possibility of athletic injury, regardless of the time associated with that participation. Preseason scrimmages were considered practice exposures, not competition exposures.

The use of AEs to measure at-risk exposure time has been discussed in the literature.[20] This method does not take into consideration the total exposure time in practices or in games but is used to minimize the burden on the ATs collecting the data while completing their normal clinical activities. Additional settings and scenarios outside of practices and competitions are not examined, including individual training or weightlifting sessions that occur outside of formal practice sessions and any other non–sport-related activities. Previous researchers[21,22] have expressed concern regarding the use of AEs in competitions because of potential underestimates of injury rates. This may be of more concern in sports such as football in which athletes play solely offense or defense, substitutions occur at high rates, and squad sizes are large. Thus, caution is necessary when interpreting injury incidence data.

Time in Season

For the NCAA-ISP, sport participation was subdivided into 3 categories as defined by the NCAA: (1) *preseason*: all formal team practices and exhibition games conducted before the first regular-season competition; (2) *regular season*: all practices and competitions from the first regular-season competition through the last regular-season competition; and (3) *postseason*: all practices and competitions after the last regular-season competition through the last postseason competition. All injuries and exposures that did not occur during the preseason, regular season, or postseason (eg, summer conditioning, individual workouts and training) were excluded. The HS RIO also used a similar definition for capturing injury data by time in season. However, unlike the NCAA-ISP, HS RIO did not capture AEs by season. As a result, whereas we could calculate injury rates specific to each time in season for the NCAA-ISP, it was not possible to do the same for HS RIO.

Time Loss

For both surveillance systems, *time loss* was defined as the number of days between the original injury and return to sport at a level that would allow participation in competition. The ATs were instructed that this participation need not be unrestricted. Both the NCAA-ISP and HS RIO provided categorical responses choices (eg, *Prevented participation for 1–6 days*) for ATs. In addition to this variable, ATs contributing to the NCAA-ISP could also provide data on dates of injury and return to participation; this difference in dates yielded a discrete time-loss variable, which was used to help ensure the validity of ATs' responses and identify the appropriate time-loss category when a categorical response was not selected.

It is important to note that some of the category choices related to season- or career-ending injuries. When injuries occurred near the end of the academic year (ie, last week of the season), time loss was still captured in the same fashion as injuries that occurred earlier. For example, a minor ankle sprain would not be coded as "Out for remainder of season" simply because the season ended before the athlete could be cleared to return. Such options for season- or career-ending injuries were used for only those injuries that prematurely ended a student-athlete's season or career.

Event Type

Event type was defined as the specific event (ie, practice, competition) in which the injury occurred. As previously noted, all injuries and exposures that did not occur during practices and competitions during the preseason, regular season, or postseason (eg, summer conditioning, individual workouts and training) were excluded.

Body Part Injured

Body part injured was defined as the region of the body in which the student-athlete sustained his or her injury. For both surveillance systems, ATs selected from a preset list of options. Slight differences existed between the options available for the 2 surveillance systems (eg, the NCAA-ISP included *lumbar spine/lower back* and *thoracic spine/upper back*, whereas HS RIO had categories such as *lower back/T-spine/pelvis*—all were included in a *trunk* injured body-part category for this series).

Diagnosis

When ATs examined an injured student-athlete, they provided a diagnosis based on their medical expertise. For both surveillance systems, ATs selected from a preset list of options. Slight differences existed between the options available for the 2 systems. Definitions were not provided for each specific diagnosis as we relied on the medical expertise and education of the participating ATs. However, for possible concussions during the 2009–2010 through 2013–2014 academic years, ATs in the NCAA-ISP were encouraged to follow the definition provided by the most recent and available iteration of the "Consensus Statement on Concussion in Sport."[23,24]

Injury Mechanism

Injury mechanism was defined as the manner in which the student-athlete sustained his or her injury (eg, player contact, surface contact, equipment contact, no contact, overuse, other/unknown). For both surveillance systems, ATs selected from a preset list of options. Slight differences existed between the options available for the 2 surveillance systems.

Injury Activity

Injury activity was defined as the activity in which the student-athlete was engaged when the injury occurred. For both surveillance systems, ATs selected from a preset list of options specific to each sport, although in many cases, the same activities were listed across multiple sports. Slight differences existed between the options available for the 2 surveillance systems.

Position

Position was defined as the position the student-athlete was playing when the injury occurred. For both surveillance systems, ATs selected from a preset list of options specific to each sport.

STATISTICAL ANALYSIS

Because the data collected from both iterations of the Web-based NCAA-ISP and HS RIO are similar, we opted to recode data when necessary to increase the comparability between collegiate and high school sports data. Because methodologic variations may lead to small differences in injury reporting between these surveillance systems, caution must be taken when interpreting these results.

To ensure consistency between the 2 surveillance systems, as well as across sport-specific articles, we recategorized variables. Body parts were categorized as *head/face*, *neck*, *shoulder/clavicle*, *arm/elbow*, *hand/wrist*, *trunk* (including chest, abdomen, upper back, and lower back), *hip/thigh/upper leg*, *knee*, *lower leg* (including the Achilles), *ankle*, *foot*, or *other*. Diagnoses were categorized as *concussion*, *contusion*, *dislocation* (including separation), *fracture/avulsion*, *laceration*, *ligament sprain*, *muscle/tendon strain*, or *other*. Time loss was categorized as (1) *1 day to <1 week*, (2) *1 to 3 weeks*, or (3) *>3 weeks* (ie, severe). Severe injuries also included injuries resulting in medical disqualification, the athlete choosing not to continue, the athlete being released from the team, and in rare cases, death; thus, this category included those injuries that caused a premature end to an athlete's season or career. As previously noted, this measure was still susceptible to variability, particularly for injuries that occurred near the end of the year, when time loss had to be projected. When calculating the proportion of injuries that were severe, we included only those injuries with time-loss data provided.

Data were analyzed using SAS-Enterprise Guide software (version 5.4; SAS Institute Inc, Cary, NC). Statistical analyses included calculation of injury rate ratios (IRRs) and linear regression (to analyze linear trends across time of injury rates).

The overall injury rate was calculated as the ratio of injuries per 1000 total AEs. Injury rates were also calculated as the ratio of practice injuries per 1000 practice exposures and the ratio of competition injuries per 1000 competition exposures. The following is an example of an IRR comparing competition and practice injury rates:

$$\mathrm{IRR} = \frac{\left(\frac{\sum \text{Competition Injuries}}{\sum \text{Competition Athlete-Exposures}}\right)}{\left(\frac{\sum \text{Practice Injuries}}{\sum \text{Practice Athlete-Exposures}}\right)}$$

All IRRs with 95% CIs not containing 1.0 were considered statistically significant. For IRRs comparing data between the NCAA-ISP and HS RIO for the sports in which HS RIO had data available only for 2008–2009 through 2013–2014, we considered the NCAA-ISP data from only that time period as well.

Because of the 2 separate data-collection methods for the NCAA-ISP during the 2004–2005 through 2008–2009 and 2009–2010 through 2013–2014 academic years, linear trends were conducted separately for each time period. Linear trends estimated average annual changes (ie, mean differences). All mean differences with 95% CIs not containing 0.0 were considered statistically significant.

PRESENTATION OF DATA

The methods described in this article are applicable to each of the publications in this series that describe the epidemiology of specific high school and collegiate sports. Throughout this series of publications, all data are presented in aggregate format. Each publication begins with a review of the sport participation in high school and college and then describes the epidemiology of injury at both levels. The following standard tables and figures appear in each of the sport-specific manuscripts.

Table 1: Injury counts, national estimates (if available), AEs, and rates reported by exposure type (ie, practice, competition) and school size for high schools (ie, <1000 students, ≥1000 students) or division for college.

Table 2: Injury counts, national estimates, AEs, and rates reported by exposure type and season (ie, preseason, regular season, postseason). Because HS RIO did not report AEs by season, season-specific injury rates were not computed for high school.

Table 3: Injury counts, national estimates, and rates by time loss and exposure type.

Table 4: Injury counts, national estimates, rates, and proportions of severe injuries by body part injured and exposure type.

Table 5: Injury counts, national estimates, and rates by diagnosis and exposure type.

Table 6: Injury counts, national estimates, and rates by mechanism of injury and exposure type.

Table 7: Injury counts, national estimates, and rates by activity during injury and exposure type.

Table 8: Most common injuries (ie, cross-tabulations of body part injured and diagnosis), proportion of injuries within position, and most frequent mechanism of injury for that injury by position.

Figure: Injury rates by year and exposure type.

Select sport-specific articles may also include additional tables and figures if applicable. These tables and figures highlight sport-specific injuries or mechanisms of interest. For example, men's wrestling includes an additional table

Table 2. Information for External Researchers on Accessing the National Collegiate Athletic Association Injury Surveillance Program (NCAA-ISP) and High School Reporting Information Online (HS RIO) Data

	Surveillance System	
	NCAA-ISP	HS RIO
Are data available to external researchers?	Yes	Yes
Years available	2004–2005 through 2013–2014	2005–2006 through 2016–2017
Application process	Go to http://www.datalyscenter.org/requesting-data/ and complete a DISC NCAA-Researcher Application. Datalys Center staff, an independent review committee of sports injury researchers, and the NCAA will review the application.	Contact HS RIO staff and complete a data-usage agreement form. The HS RIO staff will review the application.
Application fee?	Nonrefundable application fee of $75 if requesting data from the 2009–2010 through 2013–2014 academic years. Fee is waived for students using data for their thesis or dissertation or if primary investigator is from an institution currently providing data to the NCAA-ISP.	No
Contact information	(317) 275-3664 or info@datalyscenter.org	(303) 724-7881 or highschoolrio@ucdenver.edu

summarizing reported skin conditions and infections. In addition, because of coding differences between HS RIO and the NCAA-ISP for football, the *mechanism of injury* and *injury activity* were merged into 1 variable. The final section of each sport-specific manuscript contains expert commentary regarding interpretation of the presented data and their applications to safety and injury prevention in the specific sport.

CONCLUSIONS

The NCAA-ISP and HS RIO have provided and will continue to provide data to help develop evidence-based recommendations for policy makers and clinicians and to further injury-prevention research. The surveillance and research successes of the NCAA-ISP and HS RIO rely heavily on the efforts of hundreds of certified ATs who report injury and exposure data. The series of publications will describe the general epidemiology of 13 popular sports at the high school and collegiate levels.

It is important to consider that although HS RIO and the NCAA-ISP are similar injury-surveillance systems, variations exist between them. For instance, whereas the first data-collection panel of HS RIO used a random sample, the NCAA-ISP used a convenience sample. Furthermore, differences may exist between the high school and collegiate levels in regard to the length of the season in total, as well as the preseason, regular season, and postseason. At the same time, despite the similarities, we carefully examined the data to determine how to recode when necessary to increase the comparability between HS RIO and both iterations of the NCAA-ISP.

Nonetheless, the data presented in this series of publications represent an opportunity to examine populations at risk for sport-related injuries. Given that many data points from these 2 national surveillance systems are not examined in our series, we encourage continued exploration of sports injury-surveillance data. Data from HS RIO and the NCAA-ISP are available to external researchers interested in more in-depth analyses of injuries sustained by student-athletes. Such studies have previously resulted in publications that examine injuries by sport,[25–31] body part,[28,32,33] diagnosis,[25–27,29,34–37] and mechanism of injury.[29,38] Additional information for accessing data from both HS RIO and the NCAA-ISP can be found in Table 2.

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