Epidemiology of Injuries in National Collegiate Athletic Association Men’s Baseball: 2014–2015 Through 2018–2019

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Context: The National Collegiate Athletic Association has supported men’s baseball championships since 1947. Since its inception, the number of participating teams and athletes has considerably expanded.

Background: Frequently conducting injury surveillance of collegiate baseball athletes is essential for identifying developing temporal patterns.

Methods: Exposure and injury data collected in the National Collegiate Athletic Association Injury Surveillance Program during 2014–2015 through 2018–2019 were analyzed. Injury counts, rates, and proportions were used to describe injury characteristics; injury rate ratios were used to examine differential injury rates.

Results: The overall injury rate was 3.16 per 1000 athlete-exposures. The preseason injury rate was significantly higher than the regular season injury rate. The most commonly injured body parts were shoulder (16.1%), arm or elbow (16%), and hand or wrist (13.9%). The most reported specific injury was hamstring tear (7.9%).

Conclusions: The findings of this study aligned with previous studies—most injuries were due to noncontact and overuse mechanisms, less than one-half of injuries were related to upper extremity body parts, and one-third of all injuries were reported among pitchers.

Key Words: collegiate, sport-related, surveillance

Key Points
• Across the study period, the competition injury rate was consistently higher than the practice injury rate in NCAA Men’s Baseball.
• The overall preseason injury rate was higher than the regular season injury rate despite fluctuations of preseason and regular season injury rates across the study period.
• A majority of injuries were attributed noncontact and overuse mechanisms; moreover, the most reported specific injuries were hamstring tears (partial or complete) and lateral ligament complex tears (partial or complete) of the ankle.

Baseball is a popular sport in the United States, is well-participated in across all ages, and is among the most popular sports both at the high school and collegiate levels.1 Particularly at the collegiate level, the National Collegiate Athletic Association (NCAA) reported 954 teams with 36,011 total athletes participating men’s baseball in the 2018-2019 season.1 Baseball routinely requires its participants to perform rapid acceleration in both the upper and lower extremities. Specifically, the overhead throw involves high-velocity shoulder internal rotation, causing significant stress on the glenohumeral joint2 with ensuing stress on the medial anatomy of the elbow.3 Furthermore, the lower extremities are also subjected to precipitously accelerate and decelerate in different directions.4 Together, these movements place baseball athletes at high risk of various types of injury. Given the prominent popularity of baseball at the NCAA level, coupled with the aforementioned injury risk, routine monitoring of injuries sustained by baseball athletes is warranted to assess the effects of acute and long-term outcomes after injury.

Health surveillance systems have universally used tools to observe injury incidence and outcomes across a variety of diseases and are efficient techniques with which to study athlete population subtleties. The NCAA recognized the importance of monitoring injury characteristics (exposures, mechanisms, and details) among collegiate athletes and established the injury surveillance system in 1982,5 which is now called the “Injury Surveillance Program” (ISP).6 Although many researchers have examined injuries sustained by professional baseball players (for example, hamstring strains and ulnar collateral ligament injuries),7-9

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studies in which investigators examined the injury profile of collegiate baseball players remain comparatively limited. Wasserman et al\textsuperscript{10} and Dick et al\textsuperscript{11} have separately reported findings from epidemiological investigations of NCAA men’s baseball injuries from different eras. Similar patterns, such as a higher incidence of competition injuries than practice injuries, were observed in both studies. Furthermore, it has been previously reported that the most commonly observed NCAA men’s baseball injuries were upper extremity-related (shoulder, arm, or elbow) and result of noncontact and overuse mechanisms.\textsuperscript{10} In particular, ulnar collateral ligament injuries are among the most prevalent injuries among baseball athletes and are associated with notable time loss (TL).\textsuperscript{12–14} Conversely, hamstring strain injuries are among the most prevalent lower extremity injuries observed in this population and are also associated with notable TL.\textsuperscript{15,16} Thus, it is imperative to continuously examine injury rates and trends across NCAA men’s baseball-related injuries to inform athletic trainers (ATs) and other sports medicine staff. The purpose of this study was to describe the epidemiology of men’s baseball-related injuries captured by the NCAA ISP between the 2014–2015 and 2018–2019 academic years.

METHODS

Study Data

Men’s baseball-related exposure and injury data collected in the NCAA ISP during 2014–2015 through 2018–2019 were analyzed in this study. The methods of the NCAA ISP have been reviewed and approved as an exempt study by the NCAA Research Review Board. The methods of the surveillance program are detailed separately within this special issue. Briefly, ATs at participating institutions contributed relevant injury and exposure data by using their clinical electronic medical record systems. A reportable injury was one that occurred due to participation in an organized intercollegiate practice or competition and required medical attention by a team certified AT or a consultant (regardless of TL). Scheduled team practices and competition-related TL injury rates increased from 2014–2015 to 2015–2016 and then slightly decreased and leveled off during 2016–2017 to 2017–2018 (Figure B). The overall Division I injury rate (rate = 3.62 per 1000 AEs) was higher than the Division II (rate = 2.82 per 1000 AEs) and Division III (rate = 3.12 per 1000 AEs) injury rates. Statistically significant differences were observed in comparisons between Division I and II (IRR = 1.28; 95% CI = 1.15, 1.44), and Division I and III (IRR = 1.16; 95% CI = 1.04, 1.30). Notably, no significant differences were observed between Division II and Division III injury rates.

Injuries by Season Segment

During the study period, 488 preseason injuries (national estimate: 19,646), 1269 regular season injuries (national estimate: 42,842), and 36 postseason injuries (national estimate: 1564) were reported in men’s baseball (Table 2). The preseason injury rate was significantly higher than the regular season (IRR = 1.32; 95% CI = 1.19, 1.47) and postseason (IRR = 3.16; 95% CI = 2.25, 4.43) injury rates. Preseason injury rates increased sharply between 2014–2015 to 2015–2016 and then slightly decreased and leveled off during 2016–2017 to 2017–2018, and increased again during the last year of the study (Figure B). Regular season injury rates increased between 2014–2015 and 2015–2016 and decreased thereafter (Figure B). Postseason was not included due to low injury frequency counts in select years.

Time Loss

Approximately one-third (33.6%) of all reported injuries resulted in TL of greater than or equal to 1 day (TL was not recorded in approximately 34% of all reported injuries), and NTL injuries accounted for a similar proportion. TL injuries accounted for similar proportions of both practice (33.1%) and competition (34%) injuries. Temporal patterns in TL injury incidence were comparable across event types. Competition- and practice-related TL injury rates increased during 2014–2015 to 2015–2016 (Figure C). Thereafter

RESULTS

A total of 1793 men’s baseball injuries from 567,926 AEs were reported to the NCAA ISP during 2014–2015 through 2018–2019 academic years (rate = 3.16 per 1000 AEs). This equated to a national estimate of 64,053 injuries overall (Table 1). Markedly, 1016 injuries were sustained in competition during the study period, and the competition injury rate was higher than the practice injury rate overall (IRR = 1.58; 95% CI = 1.44, 1.75). Competition injury rates increased from 2014–2015 to 2015–2016 and then considerably decreased between 2015–2016 and 2017–2018 (Figure A). Likewise, the practice injury rate increased steadily between 2014–2015 and 2016–2017 and then slightly decreased and leveled off during 2017–2018 to 2018–2019 (Figure A). The overall Division I injury rate (rate = 3.62 per 1000 AEs) was higher than the Division II (rate = 2.82 per 1000 AEs) and Division III (rate = 3.12 per 1000 AEs) injury rates. Statistically significant differences were observed in comparisons between Division I and II (IRR = 1.28; 95% CI = 1.15, 1.44), and Division I and III (IRR = 1.16; 95% CI = 1.04, 1.30). Notably, no significant differences were observed between Division II and Division III injury rates.
lateral ligament complex tears (ankle sprains) (3.8%). The complete hamstring tears (7.9%) and partial or complete specific injuries during the study period were partial or practice injuries (7.2%). The most commonly reported greater proportion of competition injuries (17.8%) than injuries (12.8%). Shoulder (20.3%) injuries and arm or elbow (16%) accounted for a larger proportion of practice injuries (16.1%) and base running (10.3%) injuries accounted for noteworthy proportions of all practice-related injuries. Injuries to the hand or wrist accounted for a greater proportion of competition injuries than practice injuries. A notable proportion of practice injuries was attributed to throwing (16.2%). Overall, most injuries reported during the study period were among pitchers (31.1%), outfielders (16.5%), and corner infielders (11%). Injuries to pitchers accounted for a larger proportion of practice injuries (35.7%) than competition injuries (27.6%). Injuries to outfielders and corner infielders accounted for comparable proportions of practice- and competition-related injuries (Table 4).

Injuries by Baseball-Specific Activities and Playing Positions

Most injuries in men’s baseball between 2014–2015 and 2018–2019 occurred during pitching (18.5%), batting (13.4%), and base running (10.3%). Comparable proportions of competition (18.2%) and practice (18.8%) injuries were attributed to pitching, whereas batting (competition: 16.1%, practice: 9.8%) and base running (competition: 12.5%, practice: 7.5%) injuries accounted for larger proportions of competition injuries than practice injuries. A notable proportion of practice injuries was attributed to throwing (16.2%). Overall, most injuries reported during the study period were among pitchers (31.1%), outfielders (16.5%), and corner infielders (11%). Injuries to pitchers accounted for a larger proportion of practice injuries (35.7%) than competition injuries (27.6%). Injuries to outfielders and corner infielders accounted for comparable proportions of practice- and competition-related injuries (Table 4).

SUMMARY

This study aimed to describe the epidemiology of NCAA men’s baseball-related injuries reported to the NCAA ISP between the 2014–2015 and 2018–2019 academic years. Consistent with previously reported findings, the competition injury rate was higher than the practice injury rate across the study period. In comparison with 2005–2006 through 2013–2014, the competition and practice injury rate of hamstring tears fluctuated throughout the study period (Figure D). The overall injury rate of hamstring tears (partial or complete) was 2.5 per 10 000 AEs, and the overall injury rate of lateral ligament complex tears (partial or complete) was 1.23 per 10 000 AEs.
rates observed in the current study were lower. This difference may have been influenced by the implementation of more specialized training regimes, incorporating elements such as workload monitoring, which has been ubiquitously adopted at the professional level to notable success in mitigating practice-related injuries. It would follow that competition-related injury incidence would also decrease as a result of workload monitoring and adjustment in the interest of reducing general and muscle fatigue. Resultantly, players may be better physiologically rested before competition. Data collection within the NCAA ISP, in its current form, does not include training details or workload-related data. Therefore, it remains challenging to truly assess this paradigm by using surveillance data. Future researchers should identify specific training adaptations that mitigate the burden of injury.

Preseason injury rates were significantly higher than regular and postseason injury rates. This may be attributable to the volume of offseason and preseason training involved in collegiate baseball. Preseason functional movement screenings have been observed to detect musculoskeletal inequalities that, if left unaddressed, may become exacerbated during preseason training, leading to injury. As such, describing injury risk factors from preseason injury screenings needs additional attention. Broadly, differences in injury rates across Division I, II, and III programs were observed in the present study and may be due to varied clinician-to-patient ratios, which is associated with patient health outcomes and has been observed to vary across divisions of competition. Targeted, small-sample studies are warranted to further describe factors contributing to the observed results, including the ratio of athletes to ATs across different levels of collegiate baseball membership institutions.

Notably, sports injury surveillance is perhaps not well positioned to reconcile the relationship between risk factors, such as training volume, biomechanical deficiencies, and injury risk. For instance, the NCAA ISP in its current state does not capture unique measures of potential risk exposure, such as pitch count, types of pitches thrown, or number of hits during batting practice. Including the abovementioned exposures may provide a more sensitive
overuse upper extremity injuries in baseball are uniquely related to the sport. With that said, workload management has been utilized for years as a method to reduce the burden of risk. However, few researchers have investigated this subject in youth baseball athletes. Hamstring tears were most commonly reported among infielders (24.3%), outfielders (25.7%), and pitchers (24.3%). This is not surprising given the complex interaction between risk factors, such as early specialization, workload management, and biomechanical factors, prevention and etiological studies of overuse upper extremity injuries in baseball are uniquely difficult.

Intervention may require a multifaceted approach that involves all levels of baseball participation as well as adherence to suggested guidelines, such as pitch counts and rest days to minimize development of these injuries. Future researchers should attempt to ascertain what preventative measures are used in collegiate baseball as well as player history regarding injury prevention measures during their adolescent careers. Therefore, it may be prudent to consider alternative methods of capturing at-risk exposure time that may be best suited for the nuances of this sport. With that said, workload management has been investigated across different levels of baseball. However, few researchers have investigated this subject in collegiate athletes. Although workload management is theoretically logical, the evidence to support their effects on reducing the burden of risk remains mixed as it pertains to all positions other than pitchers (infielders, outfielders, and catchers). This is partly due to heterogeneity across metrics used and outcomes measured.

Among reported injuries, 31% were attributed to pitchers (of which 61.6% were to the upper extremity). Despite obvious differences in athlete characteristics and level of competition, the results observed here are comparable to those observed among youth (25% of youth players ages 9–12 years old) and professional (67% of pitchers to pitchers were to the upper extremity) baseball.

Pitching injuries have been exclusively studied in the context of workload management, including counting pitches thrown during warm-up, between innings, and during gameplay to study their burden of risk. Among NCAA men’s baseball athletes, evidence supporting the effect of workload management on reducing risk of injury has been inconsistent, and as such, studies in which researchers closely monitor baseball player activities during practice and competition are necessary.

The most common injury diagnoses reported in NCAA men’s baseball across the study period were strains, sprains, and contusions; this result was consistent with previous findings within this population. As strains are a hallmark injury in nearly 26% of all reported injuries, further attention should be given to reduce the burden of this deleterious injury. Among collegiate baseball players, the most commonly reported specific injury was hamstring tear (partial or complete), which is consistent with reports from previous researchers investigating professional and youth baseball athletes. Hamstring tears were most commonly reported among infielders (24.3%), outfielders (25.7%), and pitchers (24.3%). This is not surprising given that these athletes repeatedly make split-second reactions using significant explosive movements to cover ground toward a batted ball during gameplay. The increasing incidence trajectory of hamstring tears from 2014–2015 to 2016–2017, followed by a sharp decrease in 2017–2018, should be given further attention. Previous researchers implementing prophylactic injury prevention strategies (among professional baseball players), including increasing range of motion and muscle extensibility, have demonstrated varied degrees of risk reduction.

Athlete-specific muscular injuries such as hamstring tears are observed to be associated with persistent symptoms, lengthy recovery periods, and increased risk of reinjury. Granular athlete-level data may be needed to better understand hamstring tears and associated temporal...
have the capacity to elucidate underlying injury patterns
prevention initiatives. By using surveillance systems, we
can target injured body parts (for example, mechanisms of injury and commonly
injuries) that can be considered for injury
characteristics (for example, mechanisms of injury and commonly
injured body parts) that can be targeted for injury
dynamics. Although the methods of surveillance systems
may be augmented with additional athlete-level measures
to capture this information in the future.

In summary, regular surveillance of NCAA men’s
baseball injuries is crucial, as it offers critical understanding
of injury incidence and related outcomes within this
population. Here, we demonstrate unique injury character-
istics (for example, mechanisms of injury and commonly
injured body parts) that can be targeted for injury
prevention initiatives. By using surveillance systems, we
have the capacity to elucidate underlying injury patterns
among sports that subsequent researchers can use to explain
the etiology of injury risk and sequelae within this group of
student-athletes.

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