

Non–Time-Loss and Time-Loss Softball Injuries in Secondary School Athletes: A Report From the National Athletic Treatment, Injury and Outcomes Network (NATION)

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Context: Most studies of injury trends associated with softball focus on injuries requiring at least 24 hours of missed participation time (time-loss [TL] injuries), with little focus on those that do not (non–time-loss [NTL] injuries). A better understanding of injury trends associated with softball will improve athlete care.

Objective: To describe NTL and TL injuries experienced by secondary school girls' softball players.

Design: Descriptive epidemiology study.

Setting: Secondary school athletic training clinics.

Patients or Other Participants: Secondary school girls' softball players.

Main Outcome Measure(s): Aggregate data were collected from schools participating in the National Athletic Treatment, Injury, and Outcomes Network surveillance program during the 2011–2012 through 2013–2014 academic years. Frequencies and rates of injuries (NTL and TL) according to time of season, event type, body part injured, and diagnosis were analyzed.

Results: In total, 1059 injuries were reported during 140 073 athlete-exposures (AEs): overall injury rate = 7.56/1000 AEs. Of these injuries, 885 (83.6%) were NTL (NTL rate = 6.32/1000

AEs) and 174 (16.4%) were TL (TL rate = 1.24/1000 AEs). Of the NTL and TL injuries, the largest numbers occurred during the regular season (NTL: $n = 443$ [50.1%]; TL: $n = 131$ [75.3%]). Injuries sustained during practices accounted for the majority of NTL and TL injuries (NTL: $n = 631$ [71.3%]; TL: $n = 104$ [59.8%]). The NTL injuries occurred most often at the shoulder ($n = 134$ [15.1%]) and hand/fingers ($n = 109$ [12.3%]) and were diagnosed as contusions ($n = 316$ [35.7%]), strains ($n = 157$ [17.7%]), and abrasions ($n = 151$ [17.1%]). The largest numbers of TL injuries were to the head/face ($n = 71$ [40.8%]) and diagnosed as concussions ($n = 50$ [28.7%]) and strains ($n = 28$ [16.1%]).

Conclusions: Secondary school softball players sustained a larger proportion of NTL injuries than TL injuries. Although NTL injuries may be less severe, they are numerous. Efforts are needed to ensure that injury-prevention programs are incorporated into the care of softball athletes to promote health and reduce injury occurrence.

Key Words: injury surveillance, females, athletes, epidemiology

Key Points

- Secondary school softball players sustained a larger portion of non–time-loss (NTL) injuries than time-loss injuries.
- Injuries sustained during practices accounted for nearly three-fourths of NTL injuries.
- Most NTL injuries were to the shoulder and hand/fingers and were diagnosed as contusions, strains, and abrasions.

According to the National Federation of State High School Associations' annual participation survey, 7.8 million secondary school students participated in athletics during the 2014–2015 season.¹ Of those, roughly 365 500 were females participating in softball.¹ This number is increasing throughout the United States because softball has become a year-round sport. During the 2014–2015 season, softball was the fifth most played sport

by secondary school girls.¹ With increases in participation, competition, and volume of play, the number of injuries in girls' softball is also likely to increase.

Although baseball and softball are comparable sports, softball players have a higher injury incidence and are more likely to be injured during a game than baseball players.^{2–4} This evidence suggests unique differences in injury epidemiology between baseball and softball. Extensive

investigations have addressed the epidemiology of baseball injuries at all levels of play.^{2,5-9} Conversely, epidemiologic studies of girls' softball injuries, particularly at the secondary school level, are lacking. Given the paucity of data on softball injuries, research is needed to expand our understanding of the epidemiology of softball injuries, especially at the secondary school level, when athletes typically begin to specialize in a sport.^{10,11} Authors have described the body location,^{2,12,13} injury type,^{2,12,13} and position^{2,12} of softball injuries, but most of these data are more than 10 years old.^{3,4,12} Further, most reports on softball injuries focused on injuries that resulted in time lost from play and included only injuries that resulted in ≥ 1 day of missed participation in practices or games.^{2,5,14-16} Shanley et al² reported that the injury rates for softball were low. However, their data only involved injuries that resulted in time loss (TL), which subsequent authors¹⁷ estimated encompassed only a small proportion of injuries (16.1%). The remaining injuries were non-time-loss (NTL) injuries, which included those injuries resulting in < 24 hours of participation-restriction time.

The findings from previous epidemiology studies provided important information on the types of injuries experienced by girls' softball players that resulted in lost playing time (> 24 hours). However, a limitation was that these studies did not include the large number of NTL injuries experienced by softball players; thus, a significant gap exists in what we know about the totality of injuries experienced as a result of playing softball. A better understanding of these injuries is necessary because they capture the breadth of care and management that athletic trainers (ATs) provide to support the health care of student-athlete populations. The larger breadth of data would increase ATs' knowledge of the epidemiology of injury and inform strategies for ensuring that quality health care is provided to these athletes, including where to prioritize injury-prevention efforts. Therefore, the purpose of our study was to describe NTL and TL injuries experienced by girls' softball players in the secondary school setting.

METHODS

A descriptive epidemiologic study design was used to report NTL and TL injuries in secondary school girls' softball players. Data were obtained from the Datalys Center for Sports Injury Research and Prevention, Inc (Indianapolis, IN), which manages the National Athletic Treatment, Injury and Outcomes Network (NATION). The NATION project received approval by the Western Institutional Review Board, and the current study was also reviewed and approved by the local institutional review board.

Data Collection

The methods of the NATION surveillance program have been previously reported.^{17,18} We used NATION data from the 3 softball seasons during the 2011–2012 through 2013–2014 academic years. During this period, data were collected from a convenience sample of softball teams that were part of the NATION surveillance program. By the 2011–2012, 2012–2013, and 2013–2014 academic years, data from 30, 39, and 49 secondary school girls' softball

programs, respectively, were included, resulting in 118 team-seasons of data.¹⁷

Injury data were reported by the ATs who worked with the participating teams and attended school-sanctioned practices and competitions. The ATs used an electronic medical record to report injuries and exposures as part of their normal clinical documentation practices. When an injury occurred, the ATs reported on a number of characteristics related to the injury, including event type (ie, competition, practice), time in season (ie, preseason, regular season, postseason), body part injured, diagnosis, and participation-restriction time. Once an event was recorded, the AT could access and modify the file as needed throughout the course of patient care. The AT also tracked the number of student-athletes participating in each practice and competition during the season.

The NATION program uses technology to deidentify, recode, and export injury and exposure data to an aggregate database. Variables and values that are verified automatically in the system with a series of consistency checks are retained in the aggregate database.^{17,18} The AT is notified of any invalid values and asked to review the event data to resolve the inconsistency before the values are added to the data set. After these processes, a series of manual checks and cleaning-up processes are performed to create the final aggregate database.

Definitions

To be included in the current study, a reportable *injury* must have occurred during a school softball practice or competition and required evaluation from an AT, physician, or another health care professional. An injury was classified as an *NTL injury* if it restricted participation for < 24 hours after injury.¹⁷ In contrast, an injury was designated a *TL injury* if it prevented student-athlete participation for ≥ 24 hours after the injury.¹⁷ A reportable *athlete-exposure* (AE) was defined as 1 student-athlete participating in 1 school-sponsored softball practice or competition in which she was exposed to the risk of injury. Exposures were not limited by the duration of participation. Only athletes who participated in a practice or competition were included in the number of AEs.

Statistical Analysis

Data were analyzed to assess injury rates and patterns of overall, NTL, and TL injuries in softball athletes. Frequencies and percentages were reported for all injuries according to the time of season, event type, body part injured, and diagnosis. Injury rates were calculated as the number of injuries per 1000 AEs with associated 95% confidence intervals (CIs). Competition and practice injury rates were compared using incidence rate ratios (IRRs) and 95% CIs. An example of an IRR calculation follows:

IRR Competition Versus Practice

$$= \frac{\text{No. of Injuries in Competition/No. of AEs in Competition}}{\text{No. of Injuries in Practice/No. AEs in Practice}}$$

All IRRs with 95% CIs that did not include 1.00 were considered statistically significant. Data were analyzed using SPSS (version 23; IBM Corp, Armonk, NY) and

Table 1. Injury Rates by Time of Season and Activity in Which the Injury Occurred for NTL and TL Injuries in Secondary School Girls' Softball^a

Outcome Variable	Overall			NTL			TL		
	Injuries, No. (%)	AEs	Injury Rate/1000 AEs (95% CI)	Injuries, No. (%)	AEs	Injury Rate/1000 AEs (95% CI)	Injuries, No. (%)	AEs	Injury Rate/1000 AEs (95% CI)
Time of season									
Preseason	442 (41.7)	43 913	10.07 (9.13, 11.00)	402 (45.4)	43 913	9.16 (8.26, 10.05)	40 (23.0)	43 913	0.91 (0.63, 1.19)
Regular season	574 (54.2)	89 769	6.39 (5.87, 6.92)	443 (50.1)	89 769	4.93 (4.48, 5.39)	131 (75.3)	89 769	1.46 (1.21, 1.71)
Postseason	43 (4.1)	6391	6.73 (4.72, 8.74)	40 (4.5)	6391	6.26 (4.32, 8.20)	3 (1.7)	6391	0.47 (0.00, 1.00)
Total	1059 (100)	140 073	7.56 (7.10, 8.02)	885 (100)	140 073	6.32 (5.90, 6.73)	174 (100)	140 073	1.24 (1.06, 1.43)
Event type									
Practice	735 (69.4)	102 154	7.20 (6.67, 7.72)	631 (71.3)	102 154	6.18 (5.69, 6.66)	104 (59.8)	102 154	1.02 (0.82, 1.21)
Competition	324 (30.6)	37 919	8.54 (7.61, 9.47)	254 (38.7)	37 919	6.70 (5.87, 7.52)	70 (40.2)	37 919	1.85 (1.41, 2.28)
Total	1059 (100)	140 073	7.56 (7.11, 8.02)	885 (100)	140 073	6.32 (5.90, 6.73)	174 (100)	140 073	1.24 (1.06, 1.43)

Abbreviations: AE, athlete-exposure; CI, confidence interval; NTL, non-time loss; TL, time loss.

^a Data originated from the National Athletic Treatment, Injury and Outcomes Network of the Datatlys Center for Sports Injury Research and Prevention, Inc, for the academic years 2011–2012 through 2013–2014. The NTL injuries resulted in participation restriction of <24 hours. The TL injuries resulted in participation restriction of ≥24 hours. Sums of AEs may not equal the total AEs because of rounding.

SAS-Enterprise Guide software (version 7.1; SAS Institute, Cary, NC).

RESULTS

Overall Frequencies and Rates

During the 2011–2012 through 2013–2014 academic years, 1059 injuries were reported for girls' softball teams from secondary schools participating in the NATION program (Table 1). The reported injuries occurred during 140 073 AEs, for an overall injury rate of 7.56/1000 AEs. The NTL injuries accounted for 83.6% of all injuries ($n = 885$), for an NTL injury rate of 6.32/1000 AEs. The TL injury rate was 1.24/1000 AEs ($n = 174$; 16.5%).

Time of Season. Overall, 574 (54.2%) injuries were sustained by girls' softball players during the regular season (Table 1). The percentage of NTL injuries that occurred in the regular season was lower than for TL injuries that occurred during the regular season ($n = 443$ [50.1%] and $n = 131$ [75.3%], respectively). Overall, the injury rate was greater during the preseason than during the regular season (IRR = 1.57; 95% CI = 1.39, 1.78) and postseason (IRR = 1.50; 95% CI = 1.09, 2.05). Similarly, the NTL injury rate was greater during the preseason than during the regular season (IRR = 1.86; 95% CI = 1.62, 2.12) and postseason (IRR = 1.46; 95% CI = 1.06, 2.02). However, for TL injuries, the injury rate was lower during the preseason than during the regular season (IRR = 0.62; 95% CI = 0.44, 0.89). No other differences were found by time of season.

Event Type. Overall, girls' softball players experienced 735 (69.4%) injuries during practices (Table 1). Injuries sustained during practices accounted for the majority of NTL and TL injuries ($n = 631$ [71.3%] and $n = 104$ [59.8%], respectively). The overall injury rate was higher during competitions than during practices (8.54/1000 AEs versus 7.20/1000 AEs; IRR = 1.19; 95% CI = 1.04, 1.35). When we compared competitions and practices, the rate of NTL injuries was not higher during the former (6.70/1000 AEs versus 6.18/1000 AEs, respectively; IRR = 1.08; 95% CI = 0.94, 1.25), but the rate of TL injuries was higher (1.85/1000 AEs versus 1.02/1000 AEs, respectively; IRR = 1.81; 95% CI = 1.34, 2.46).

Body Parts Injured

Overall, the most commonly injured body parts during girls' softball were the shoulder ($n = 150$ [14.2%]), head/face ($n = 129$ [12.2%]), hand/fingers ($n = 124$ [11.7%]), and ankle ($n = 98$ [9.3%]; Table 2). Similar to the overall results, the body parts affected most often by NTL injuries were the shoulder ($n = 134$ [15.1%]), hand/fingers ($n = 109$ [12.3%]), elbow ($n = 84$ [9.5%]), and ankle ($n = 83$ [9.4%]). The body parts that most frequently sustained TL injuries were the head/face ($n = 71$ [40.8%]), shoulder ($n = 16$ [9.2%]), hand/fingers ($n = 15$ [8.6%]), and ankle ($n = 15$ [8.6%]).

Injury Diagnoses

Of all reported injuries in girls' softball, contusions ($n = 335$ [31.6%]), strains ($n = 185$ [17.5%]), abrasions ($n = 152$ [14.4%]), and other ($n = 152$ [14.4%]) were the most common diagnoses (Table 3). The NTL injury diagnoses were similar, with contusions ($n = 316$ [35.7%]), strains ($n = 157$ [17.7%]), abrasions ($n = 151$ [17.1%]), and other ($n = 125$ [14.1%]) most often reported. The most frequently reported TL injury diagnoses were concussions ($n = 50$ [28.7%]), strains ($n = 28$ [16.1%]), other ($n = 27$, 15.5%), and sprains ($n = 23$ [13.2%]).

DISCUSSION

We used NATION data to describe the epidemiology of girls' softball injuries at the secondary school level during the 2011–2012 through 2013–2014 academic years. This large data set contained 1059 injuries sustained during 140 073 AEs and allowed for a comprehensive examination of both NTL and TL injuries. Four in 5 injuries among secondary school girls' softball were NTL. More importantly, the distributions of injuries based on several variables (eg, body part injured, diagnosis) differed between NTL and TL injuries. These findings illustrate how including NTL injuries in the surveillance effort strongly influences the characteristics of injuries overall. The information gained from these epidemiology data should inform the AT's clinical practice in several valuable ways. For example, this information identifies where injury

Table 2. Softball Injuries and Injury Rates by Body Part for NTL and TL Injuries in Secondary School Girls' Softball^a

Body Part	Overall Injuries, No. (%)	Overall Injury Rate/1000 AEs (95% CI)	NTL Injuries, No. (%)	NTL Injury Rate/1000 AEs (95% CI)	TL Injuries, No. (%)	TL Injury Rate/1000 AEs (95% CI)
Head/face	129 (12.2)	0.92 (0.76, 1.08)	58 (6.6)	0.41 (0.31, 0.52)	71 (40.8)	0.51 (0.39, 0.62)
Neck	11 (1.0)	0.08 (0.03, 0.12)	10 (1.1)	0.07 (0.03, 0.12)	1 (0.6)	0.01 (0.00, 0.02)
Shoulder	150 (14.2)	1.07 (0.90, 1.24)	134 (15.1)	0.96 (0.79, 1.12)	16 (9.2)	0.11 (0.06, 0.17)
Upper arm	36 (3.4)	0.26 (0.17, 0.34)	34 (3.8)	0.24 (0.16, 0.32)	2 (1.1)	0.01 (0.00, 0.03)
Elbow	90 (5.5)	0.64 (0.51, 0.78)	84 (9.5)	0.60 (0.47, 0.73)	6 (3.4)	0.04 (0.01, 0.08)
Forearm	28 (2.6)	0.20 (0.13, 0.27)	23 (2.6)	0.16 (0.10, 0.23)	5 (2.9)	0.04 (0.00, 0.07)
Wrist	42 (4.0)	0.30 (0.21, 0.39)	35 (4.0)	0.25 (0.17, 0.33)	7 (4.0)	0.05 (0.01, 0.09)
Hand/fingers	124 (11.7)	0.89 (0.73, 1.04)	109 (12.3)	0.78 (0.63, 0.92)	15 (8.6)	0.11 (0.05, 0.16)
Trunk	69 (6.5)	0.49 (0.38, 0.61)	65 (7.3)	0.46 (0.35, 0.58)	4 (2.3)	0.01 (0.00, 0.06)
Hip/groin	29 (2.7)	0.21 (0.13, 0.28)	27 (3.1)	0.19 (0.12, 0.27)	2 (1.1)	0.01 (0.00, 0.03)
Thigh	62 (5.9)	0.44 (0.33, 0.55)	52 (5.9)	0.37 (0.27, 0.47)	10 (5.7)	0.07 (0.03, 0.12)
Knee	87 (8.2)	0.62 (0.49, 0.75)	79 (8.9)	0.56 (0.44, 0.69)	8 (4.6)	0.06 (0.02, 0.10)
Lower leg	66 (6.2)	0.47 (0.36, 0.58)	58 (6.6)	0.41 (0.31, 0.52)	8 (4.6)	0.06 (0.02, 0.10)
Ankle	98 (9.3)	0.70 (0.56, 0.84)	83 (9.4)	0.59 (0.47, 0.72)	15 (8.6)	0.11 (0.05, 0.16)
Foot	36 (3.4)	0.26 (0.17, 0.34)	33 (3.7)	0.24 (0.16, 0.32)	3 (1.7)	0.02 (0.00, 0.05)
Other	2 (0.2)	0.02 (0.00, 0.03)	1 (0.1)	0.01 (0.00, 0.02)	1 (0.6)	0.01 (0.00, 0.02)

Abbreviations: AE, athlete-exposure; CI, confidence interval; NTL, non-time loss; TL, time loss.

^a Data originated from the National Athletic Treatment, Injury and Outcomes Network of the Datalys Center for Sports Injury Research and Prevention, Inc, for the academic years 2011–2012 through 2013–2014. The NTL injuries resulted in participation restriction of <24 hours. The TL injuries resulted in participation restriction of ≥24 hours. Sums of AEs may not equal the total AEs because of rounding.

prevention is most needed, provides insight into the type of care that will be needed to manage common softball injuries, and highlights areas that may benefit from patient education.

Although the epidemiology of girls' softball injuries in the secondary school setting has been investigated, most authors^{2,5,14–16} focused on TL injuries. However, we found that 83.6% of injuries in softball players were NTL. Although NTL injuries may not require an athlete to be removed from participation, these injuries still require athletic training services. Powell and Dompier¹⁹ reported that during the course of a year, ATs provided more treatments for patients with NTL injuries than those with TL injuries, highlighting the time-consuming demand these injuries place on on-site medical personnel. Further, Kerr et al¹⁸ observed that a larger proportion of athletic training facility visits and athletic training services were for NTL compared with TL injuries in sports overall and in several specific sports, including softball. Further, the number of services per athletic training facility visit provided for patients with NTL injuries was higher than for those with

TL injuries for a number of sport teams, including softball.¹⁸ In addition to evaluating and treating athletic injuries, ATs should emphasize injury-prevention strategies in their care programs. A better understanding of the trends of girls' softball injuries according to such factors as time of season, event type, body parts, and diagnoses will allow ATs to be more prepared to prevent and treat patients with NTL or TL injuries. For example, knowing that the shoulder, head/face, and hand/fingers are commonly injured in girls' softball players should encourage an AT who manages the care of these athletes to be prepared to evaluate, treat, and rehabilitate injuries in these body regions. Awareness that girls' softball players are prone to wounds such as abrasions and contusions would help with planning for the supplies needed to care for these patients and may influence the supplies brought when the team is playing at locations away from a health care clinic (eg, during road trips). For example, availability of or access to water and other cleaning solutions should be considered in order to appropriately manage abrasions and prevent infection. Further, knowing that for girls' softball, presea-

Table 3. Softball Injuries and Injury Rates by Diagnosis for NTL and TL Injuries in Secondary School Girls' Softball^a

Diagnosis	Overall Injuries, No. (%)	Overall Injury Rate per 1000 AEs (95% CI)	NTL Injuries, No. (%)	NTL Injury Rate per 1000 AE (95% CI)	TL Injuries, No. (%)	TL Injury Rate per 1000 AEs (95% CI)
Abrasion	152 (14.4)	1.09 (0.91, 1.26)	151 (17.1)	1.08 (0.91, 1.25)	1 (0.6)	0.01 (0.00, 0.02)
Concussion	50 (4.7)	0.36 (0.26, 0.46)	0	0.00	50 (28.7)	0.36 (0.26, 0.46)
Contusion	335 (31.6)	2.39 (2.14, 2.65)	316 (35.7)	2.26 (2.01, 2.50)	19 (10.9)	0.14 (0.07, 0.20)
Dislocation	1 (0.1)	0.01 (0.00, 0.02)	1 (0.1)	0.01 (0.00, 0.02)	0	0.00
Fracture	16 (1.5)	0.11 (0.06, 0.17)	5 (0.6)	0.02 (0.00, 0.07)	11 (6.3)	0.08 (0.03, 0.12)
Inflammatory condition	27 (2.5)	0.19 (0.12, 0.27)	21 (2.4)	0.15 (0.09, 0.21)	6 (3.4)	0.04 (0.01, 0.08)
Laceration	22 (2.1)	0.16 (0.09, 0.22)	18 (2.0)	0.13 (0.07, 0.19)	4 (2.3)	0.03 (0.00, 0.06)
Sprain	112 (10.6)	0.80 (0.65, 0.95)	89 (10.1)	0.64 (0.50, 0.77)	23 (13.2)	0.16 (0.10, 0.23)
Strain	185 (17.5)	1.32 (1.13, 1.51)	157 (17.7)	1.12 (0.95, 1.30)	28 (16.1)	0.20 (0.13, 0.27)
Subluxation	7 (0.7)	0.05 (0.01, 0.09)	2 (0.2)	0.01 (0.00, 0.03)	5 (2.9)	0.04 (0.00, 0.07)
Other	152 (14.4)	1.09 (0.91, 1.26)	125 (14.1)	0.89 (0.74, 1.05)	27 (15.5)	0.19 (0.12, 0.27)

Abbreviations: AE, athlete-exposure; CI, confidence interval; NTL, non-time loss; TL, time loss.

^a Data originated from the National Athletic Treatment, Injury and Outcomes Network of the Datalys Center for Sports Injury Research and Prevention, Inc, for the academic years 2011–2012 through 2013–2014. The NTL injuries resulted in participation restriction of <24 hours. The TL injuries resulted in participation restriction of ≥24 hours. Sums of AEs may not equal the total AEs because of rounding.

son NTL injuries occur at a greater rate than during the regular season and postseason may spark review and modification of the approach to preseason preparation and training for the purposes of preventing injury and lowering injury rates during the season.

Previous researchers^{2,3,15,20} who investigated the epidemiology of girls' softball injuries in secondary schools recorded rates of injury that ranged from 0.95/1000 to 5.6/1000 AEs. Our greater overall injury rate of 7.56/1000 AEs is likely because of the large proportion of injuries that were NTL. When we considered only TL injuries, our injury rate was 1.24/1000 AEs, which is less than most of the previously reported estimates for injuries resulting in time loss. Marshall et al¹² noted that the TL injury rate in collegiate softball during preseason practices (3.65 injuries per 1000 AEs) was higher than during regular season practices (1.68 injuries per 1000 AEs). This result is consistent with our findings for overall and NTL injury rates. However, the TL injury rate in our study was greater during the regular season than during the preseason. Further work is warranted to investigate offseason conditioning, time off from sport, and preparation for return to sport to explore possible factors related to preseason injuries and whether opportunities exist to include injury-prevention strategies in training. Injury-prevention programs that primarily focus on the lower extremities are available. Our results demonstrate a need for evidence-based upper extremity injury-prevention programs. If available programs are not being used clinically, efforts to educate ATs on their value to injury prevention may be needed.

Marshall et al¹² found that the collegiate softball injury rate was higher during competitions (4.3 injuries per 1000 AEs) than during practices (2.7 injuries per 1000 AEs). Our results also indicated that competition injury rates were higher than practice injury rates for overall injuries and TL injuries. Because previous authors considered only TL injuries, we expected that our TL injury rate would be similar to their rates. However, our NTL injury rates were not higher during competitions than during practices; this may be because competitions consist of more aggressive play than practices and so injuries sustained during practices tend not to be as severe. During a regular softball season, the number of practices is typically much greater than the number of competitions. In our study, AEs during practices were 2.7 times those of competitions. Consequently, although the overall rates of injuries were higher during games, more than two-thirds of injuries occurred during practices. Therefore, practice injuries potentially place a greater time and resource burden on ATs. Additional investigation is warranted to identify the activities (eg, types of drills, number of repetitions) during practices that lead to the high incidence of injuries.

Overall, the most common injuries affected the shoulder, head/face, hand/fingers, elbow, and ankle. The shoulder was the most frequently injured body part in several softball studies.^{2,12,13} Further, of all the NTL injuries in our study, the highest proportions were to the shoulder (15.1%) and hand/fingers (12.3%). In terms of TL injuries, the highest proportion was to the head/face (40.8%). Although we tended to report higher proportions of injuries to the upper extremities and head/face, other researchers^{12,13} reported higher proportions of injuries (40% to 43%) to the lower extremities. When we consider only TL injuries, our

findings suggest that a smaller proportion of injuries were to the lower extremities than previously described. However, the proportion of lower extremity NTL injuries was just more than 37%. The large proportion of lower extremity NTL injuries warrants further exploration.

Because of their competitive nature or for the sake of winning, many athletes opt to play through injuries and pain rather than miss participation. All the details regarding the clinical presentation of the injuries (eg, range-of-motion limitations, strength losses, and pain) were unknown, but it is interesting that many of the reported injuries did not require lost playing time when the type of injury might have suggested that it would (eg, sprain or strain). Playing through pain is not a new concept for athletes, including softball players.²¹ Soldatis et al²² found that 47% of healthy collegiate softball athletes experienced shoulder pain during midseason but continued to play. In addition, 2 softball studies^{23,24} of pain and nonsteroidal anti-inflammatory drug (NSAID) use among pitchers before or after practices indicated they had pain in mid to late season, which negatively affected their health-related quality of life. These studies^{23,24} also showed that 67% to 72% of National Collegiate Athletic Association softball pitchers took NSAIDs before and after practices, suggesting that the athletes managed pain around their participation in sport. Use of NSAIDs appears high among softball pitchers; use among players in other positions warrants further study, particularly in the context of a high incidence of NTL injuries.

The most common diagnoses for overall and NTL injuries were contusions, strains, and abrasions. Strains and contusions were among the most frequent TL injury diagnoses, but concussions were also typical. Contusions, low-grade strains, and abrasions would not usually necessitate removing an athlete from participation; thus, it is logical that they are frequently recorded as NTL injuries. In contrast, concussions, moderate to severe strains and sprains, and some severe contusions would likely require removal from play. For example, all 50 US states and the District of Columbia have passed laws to protect student-athletes who have concussions from returning to play too quickly,²⁵ largely based on the best practices for the management of concussion.^{26,27} Most concussions require more than 1 day to resolve,^{28,29} which is consistent with our finding that concussions were the most frequently reported diagnosis for TL injuries.

Our study was not without limitations. First, all data were gathered through the documentation practice patterns of the participating ATs. Although training and ongoing support were provided to ATs who contributed to this data set, the documentation habits of contributors may have varied.³⁰ Another limitation was the use of a convenience sample. Our convenience sample, while large, represented only a small number of reporting sites relative to all the secondary school softball programs nationwide and from a defined time frame. The ability to generalize our findings from our sample to other secondary school softball programs may be restricted. Thus, more reporting from a greater proportion of sites over a longer, more recent period may be beneficial for recognizing stable injury trends.

Future researchers should consider investigating the preseason and offseason conditioning of softball athletes in the secondary school setting to understand high

preseason injury rates. Additionally, it would be beneficial to link NTL injuries to treatment data to investigate the proportion of time required to treat NTL injuries versus TL injuries. Investigators should also look at correlations between body part injured and diagnosis to provide better injury-prevention strategies for secondary school girls' softball players.

CONCLUSIONS

Secondary school softball players sustained a substantial number of NTL injuries, far more than TL injuries, which may suggest that although girls' softball athletes experienced injuries, the severity of the injuries may not have necessitated removal from participation. However, even if NTL injuries were less severe, they were frequent and accounted for nearly 84% of injuries experienced by girls' secondary school softball players. The large number of NTL injuries we found is of concern, and further research is needed to better understand the characteristics of an injury that allows for continued participation. Additionally, because the largest proportions of injuries were to the shoulder, head/face, and hand/fingers, ATs should be knowledgeable about the anatomy in these areas and prepared to evaluate and rehabilitate patients with injuries in these areas. Ensuring that ATs are well prepared to manage the care of patients with strains, sprains, or wounds is important as these injuries were more frequent as a result of girls playing softball. Finally, efforts are needed to identify effective prevention strategies to limit the occurrence of NTL injuries throughout softball seasons of play, especially in the off season because the data suggested that a large proportion of injuries occurred during the preseason. Reducing injury and promoting health in athletes is important, and the data from this study provide several areas of potential focus for ATs to incorporate in the care of girls' secondary school softball players.

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