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

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Context: The popularity of National Collegiate Athletic Association (NCAA) men's lacrosse has been steadily increasing since the early 1980s.

Background: Injury surveillance is an important tool to aid in identifying emerging patterns of sport-related injury in NCAA men's lacrosse.

Methods: Injury data collected from a sample of men's lacrosse teams through the NCAA Injury Surveillance Program for the academic years 2014–2015 through 2018–2019 were analyzed. Athlete exposures were estimated and computed based on collected exposure data. Injury counts, rates, and proportions were used to describe injury characteristics, and injury rate ratios (IRRs) with 95% confidence intervals (CIs) were calculated to estimate differences in injury rates.

Results: The overall injury rate was 4.90 per 1000 athlete exposures (AEs), and the competition injury rate was higher than the practice injury rate (IRR = 2.59; 95% CI = 2.35, 2.84). The overall preseason injury rate was higher than the regular and postseason injury rates. The most reported injuries were concussions (8.0%), ankle sprains (7.7%), and hamstring tears (6.9%).

Conclusions: Study findings were comparable with existing epidemiological evidence. The overall burden of concussions and lower extremity injuries warrant further attention in this population.

Key Words: collegiate, descriptive epidemiology, injury surveillance

Key Points

- The competition injury rate was consistently higher than the practice injury rate across the study period; there was a marked decrease in the rate of competition-related injuries in the final year of the study.
- Lower extremity injuries both combined and individually (hip or groin, thigh, knee, lower leg, ankle, foot) accounted for the greatest proportion of reported injuries; most reported injuries were classified as sprains and strains.
- The most commonly reported specific injuries were concussions, lateral ligament complex (ankle sprain), and hamstring tears (partial or complete); the rate of concussions followed an increasing trajectory until the last year of the study period.

Lacrosse in its current form has been steadily increasing in popularity across all levels of play (youth, high school, collegiate, and professional) in the United States since the inception of US Lacrosse nearly 20 years ago.[1,2] Although new participation has slowed in recent years, overall, lacrosse has been regarded as one of the fastest-growing team sports in the United States.[3,4] College lacrosse in particular has followed this upward trajectory in popularity; from 2013 to 2018, annual participation in National Collegiate Athletic Association (NCAA) men's lacrosse increased from 21 478 to 25 588 student-athletes.[2] During the same time, the number of institutions sponsoring men's lacrosse increased from 319 to 380, a 19.1% increase, and second highest for men's sports in the NCAA.[3,5] Given the continued growth of NCAA men's lacrosse and the enforcement of rule changes over the last decade, such as the modification of the 2011 NCAA rule change beginning in the summer of 2016 to prohibit and include unintentional targeting,[6,7] an updated investigation into the epidemiology of injury among NCAA men's lacrosse is warranted. These findings can assess the current health and safety of these student-athletes and inform the development of targeted strategies to prevent injuries.

To monitor injuries within collegiate athletics, the NCAA began operating an injury surveillance system in the early 1980s.[8] This project has evolved into an electronic platform (currently known as the NCAA Injury Surveillance Program [ISP]) and has captured men's lacrosse exposure

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and injury information for over 2 decades. Previous studies using these data identified the overall rate of injury in men's lacrosse as approximately 5 injuries per 1000 athlete exposures (AEs); however, nontime loss (NTL) injuries were not consistently included in analyses and reported until recent years.[7,9,10] In addition, these studies have reported that the most commonly injured body parts in this group are hip, thigh, or upper leg; ankle; and knee; and the most common injury diagnoses are ligament sprains and muscle or tendon strains.[9] Furthermore, these studies have found the injury rate in competition to be higher than in practice and preseason injury rate to be higher than regular and postseason.[7–10] To capture the associations between dynamic evolutions in this sport and burden of injury on athletes, it is necessary to follow up this work and provide an update on the nature and incidence of injury in this population. Therefore, the purpose of this article was to summarize the descriptive epidemiology of injuries in men's lacrosse in a sample of NCAA teams captured within the NCAA ISP during the 2014–2015 through 2018–2019 athletic seasons.

METHODS

Study Data

Exposure and injury data collected within the NCAA ISP were used to examine men's lacrosse injuries that occurred during the 2014–2015 through 2018–2019 athletic seasons. The methods of the NCAA ISP have been reviewed and approved as an exempt study by the NCAA Research Review Board. The ISP uses a convenience sample of teams where certified athletic trainers (ATs) at participating institutions submit exposure and injury data through their clinical electronic medical record systems. A reportable injury was defined as one that occurred due to participation in an organized intercollegiate practice or competition and required medical attention by a team certified AT or physician, regardless of time loss (TL). Scheduled team practices and competitions were considered reportable exposures for this analysis. Data from 10 (3% of membership) participating programs in 2014–2015, 8 (2% of membership) in 2015–2016, 12 (3% of membership) in 2016–2017, 19 (5% of membership) in 2017–2018, and 60 (15% of membership) in 2018–2019 qualified for inclusion in analyses. A separate manuscript within this special issue details the methods of the surveillance program and further outlines the qualification criteria.[11]

Statistical Analysis

Injury counts and rates per 1000 AEs were examined overall and by event type (practice, competition), competition level (Division I, Division II, Division III), season segment (preseason, regular season, post season), and TL or NTL. A TL injury was any injury evaluated or treated by an AT or physician in which an athlete returned the day after or beyond with respect to the date of injury. An NTL injury was any injury evaluated or treated by an AT or physician in which an athlete returned to participation on the date of injury. An AE was defined as 1 athlete participating in 1 exposure event (practice or competition). Weighted and unweighted rates were estimated; however, results were presented in terms of unweighted rates due to low frequencies of injury observations across levels of certain covariates, unless otherwise specified. Rate profile plots displayed temporal trends in injury rates across the study period stratified by levels of exposure characteristics, and time trends in rates of most commonly reported injuries were examined across the study period. Stratified injury counts and proportions were presented by TL, body part injured, injury mechanism, injury diagnosis, player position, and activity at the time of injury. Injury rate ratios (IRRs) were used to examine differential injury rates across event types, competition levels, and season segments. Injury rate ratios with associated 95% confidence intervals (CIs) excluding 1.00 were considered statistically significant. All analyses were conducted using SAS 9.4 (SAS Institute).

RESULTS

A total of 1872 men's lacrosse injuries from 381 811 AEs were reported to the NCAA ISP during the 2014–2015 through 2018–2019 athletic seasons (rate = 4.90 per 1000 AEs). This equated to a national estimate of 37 011 injuries overall (Table 1). During the study period, the competition injury rate was higher than the practice injury rate (IRR = 2.59; 95% CI = 2.35, 2.84). Both competition and practice injury rates varied throughout the study period but were highest in 2015–2016 and 2017–2018 (Figure A). This distinction aside, practice injury rates generally centered around the same value across the study period (Figure A). The overall Division I injury rate (rate = 4.34 per 1000 AEs) was higher than the Division II injury rate (rate = 3.68 per 1000 AEs; IRR = 1.18; 95% CI = 1.04, 1.33). The overall Division III injury rate was 6.70 per 1000 AEs; significantly higher than the Division I (IRR = 1.54; 95% CI = 1.39, 1.71), and Division II (IRR = 1.82; 95% CI = 1.62, 2.04) rates.

Injuries by Season Segment

A total of 632 preseason injuries (national estimate: 12 337), 1154 regular season injuries (national estimate: 23 392), and 86 postseason injuries (national estimate: 1282) were reported between 2014–2015 and 2018–2019 (Table 2). The overall rate of injuries during preseason was higher than the regular season (IRR = 1.22; 95% CI = 1.11, 1.34) and postseason (IRR = 2.18; 95% CI = 1.74, 2.73) injury rates. The rate of player contact injuries (practice-related) was higher in preseason than regular season (IRR = 1.68; 95% CI = 1.29, 2.19). The preseason injury rate was highest in 2015–2016 (7.31 per 1000 AEs) and decreased the following year before stabilizing for the remainder of the study period (Figure B). The regular season injury rate was also highest in 2015–2016 (5.85 per 1000 AEs) but fluctuated throughout the remainder of the study period (Figure B). Trends in postseason rates over time were not examined due to the low counts of reported postseason injuries in certain years of the study period.

Time Loss

Approximately 27.9% of all reported injuries were NTL, half (50.1%) resulted in TL of >1 day, and ~22% were missing or unknown. The prevalence of TL injuries across the study period varied (2014–2015: 60.8%; 2015–2016:

Table 1. Reported and National Estimates of injuries, Athlete Exposures (AEs), and Rates per 1000 AEs by Event Type across Divisions[a]

	Number AEs Rate per 1000 AEs (95% CI)					
	Overall		Practices		Competitions	
Division	Reported	National Estimate	Reported	National Estimate	Reported	National Estimate
I	613	8155	440	5932	173	2223
	141 129	1 927 374	121 608	1 667 551	19 521	259 823
	4.34 (4.00, 4.69)	4.23 (3.89, 4.57)	3.62 (3.28, 3.96)	3.56 (3.22, 3.90)	8.86 (7.54, 10.18)	8.56 (7.24, 9.88)
II	431	2635	296	1829	135	807
	117 017	864 692	94 889	712 236	22 128	152 456
	3.68 (3.34, 4.03)	3.05 (2.70, 3.40)	3.12 (2.76, 3.47)	2.57 (2.21, 2.92)	6.10 (5.07, 7.13)	5.29 (4.26, 6.32)
III	828	26 221	478	14 975	350	11 246
	123 665	3 551 739	99 152	2 850 375	24 512	701 364
	6.70 (6.24, 7.15)	7.38 (6.93, 7.84)	4.82 (4.39, 5.25)	5.25 (4.82, 5.69)	14.28 (12.78, 15.77)	16.03 (14.54, 17.53)
Overall	1872	37 011	1214	22 736	658	14 275
	381 811	6 343 805	315 650	5 230 163	66 161	1 113 643
	4.90 (4.68, 5.13)	5.83 (5.61, 6.06)	3.85 (3.63, 4.06)	4.35 (4.13, 4.56)	9.95 (9.19, 10.71)	12.82 (12.06, 13.58)

[a] Data presented in the order of reported number, followed by athlete exposures (AEs), estimated injury rates, and associated 95% Confidence Intervals (CIs) for each cross-tabulation of division and event types. Data pooled association-wide are presented overall, and separately for practices and competitions. National estimates were produced using sampling weights estimated on the basis of sport, division, and year. All CIs were constructed using variance estimates calculated on the basis of reported data. 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 Athletic Trainer or physician (regardless of time loss). Only scheduled team practices and competitions were retained in this analysis.

57.4%; 2016–2017: 63.0%; 2017–2018: 37.4%; 2018–2019: 49.3%). The prevalence of injuries with missing TL data also varied across the study period (2014–2015: 9.6%; 2015–2016: 8.0%; 2016–2017: 11.2%; 2017–2018: 40.5%; 2018–2019: 21.3%). On average, TL injuries resulted in approximately 11 days (SD = 23.3) and nearly one-third of all TL injuries (29.3%) resulted in TL of 10 or more days. Time loss injuries accounted for comparable proportions of reported practice-related (51.4%) and competition-related injuries (47.7%). The rate of competition-related TL injuries increased between 2014–2015 and 2016–2017 and decreased steadily thereafter (Figure C). Rates of practice-related TL injuries were relatively stable throughout the study period (Figure C).

Injury Characteristics

Knee injuries (15.1%), thigh injuries (12.3%), and ankle injuries (11.6%) accounted for the largest proportions of all reported injuries during the study period. Also commonly reported were head or face injuries (10.5%). Knee injuries, thigh injuries, and ankle injuries also accounted for

Table 2. Reported and National Estimates of injuries, Athlete Exposures (AEs), and Rates per 1000 AEs by Season Segment across Divisions[a]

	Number AEs Rate per 1000 AEs (95% CI)					
	Preseason		Regular Season		Postseason	
Division	Reported	National Estimate	Reported	National Estimate	Reported	National Estimate
I	181	2575	402	5197	30	383
	37 008	523 153	88 199	1 177 712	15 923	226 509
	4.89 (4.18, 5.60)	4.92 (4.21, 5.63)	4.56 (4.11, 5.00)	4.41 (3.97, 4.86)	1.88 (1.21, 2.56)	1.69 (1.02, 2.37)
II	170	1030	232	1432	29	173
	33 810	268 723	73 719	559 820	9488	36 149
	5.03 (4.27, 5.78)	3.83 (3.08, 4.59)	3.15 (2.74, 3.55)	2.56 (2.15, 2.96)	3.06 (1.94, 4.17)	4.79 (3.67, 5.90)
III	281	8732	520	16 762	27	726
	37 504	1 098 057	79 494	2 256 257	6667	197 425
	7.49 (6.62, 8.37)	7.95 (7.08, 8.83)	6.54 (5.98, 7.10)	7.43 (6.87, 7.99)	4.05 (2.52, 5.58)	3.68 (2.15, 5.20)
Overall	632	12 337	1154	23 392	86	1282
	108 321	1 889 933	241 412	3 993 789	32 078	460 084
	5.83 (5.38, 6.29)	6.53 (6.07, 6.98)	4.78 (4.50, 5.06)	5.86 (5.58, 6.13)	2.68 (2.11, 3.25)	2.79 (2.22, 3.35)

[a] Data presented in the order of reported number, followed by athlete exposures (AEs), estimated injury rates, and associated 95% Confidence Intervals (CIs) for each cross-tabulation of division and season segments. Data pooled association-wide are presented overall, and separately for preseason, regular season, and post season. National estimates were produced using sampling weights estimated on the basis of sport, division, and year. All CIs were constructed using variance estimates calculated on the basis of reported data. 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 athletic trainer or physician (regardless of time loss). Only scheduled team practices and competitions were retained in this analysis.

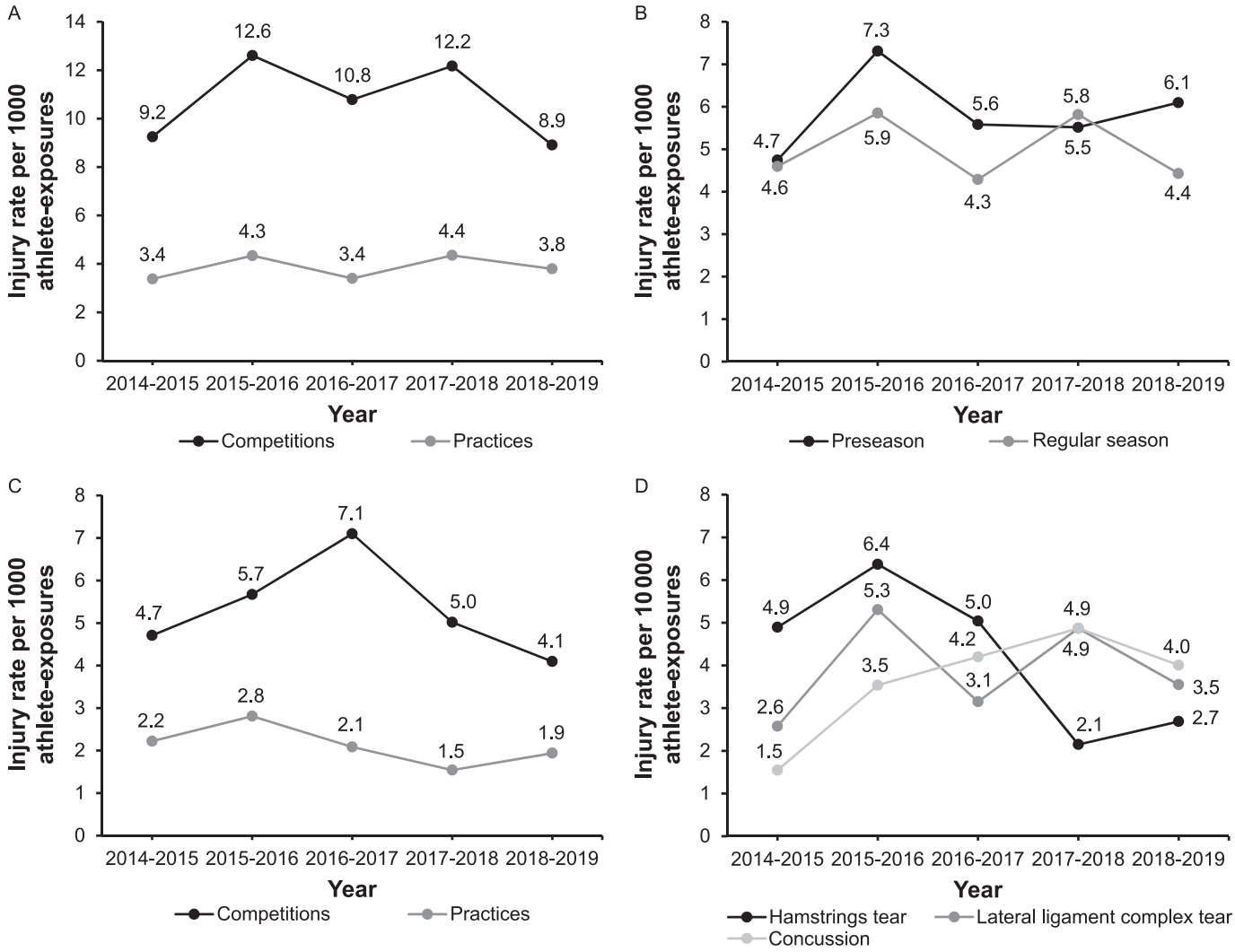

Figure. Temporal patterns in injury rates between 2014–2015 and 2018–2019. A, Overall injury rates (per 1000 AEs) stratified by event type (practices, competitions). B, Injury rates (per 1000 AEs) stratified by season segment (preseason, regular season). C, Rates (per 1000 AEs) of time loss injuries stratified by event type (practices, competitions). D, Rates (per 10000 AEs) of most commonly reported injuries. Rates presented in all figures are unweighted, and based on reported data.

comparable proportions of reported practice- and competition-related injuries (Table 3). In contrast, head or face injuries were more prevalent among reported competition injuries (14.1%) than practice injuries (8.6%). Noncontact (33.4%) followed by player contact (26.1%) were the primary mechanisms for all reported injuries (Table 3). In competition, the greatest proportion of reported injuries were attributed to player contact (38.8%), which accounted for a comparatively smaller proportion of practice injuries (19.2%). Noncontact mechanisms accounted for the greatest proportion of reported practice injuries (36.9%) and second greatest in competition (27.1%).

Overall, most men's lacrosse injuries reported between 2014–2015 and 2018–2019 were strains (23.3%), sprains (21.4%), and contusions (16.1%). Sprains and contusions accounted for larger proportions of competition injuries than practice injuries, while strains accounted for a larger proportion of practice injuries than competition injuries (Table 3). The most commonly reported injuries during the study period were concussions (8.0%), partial or complete lateral ligament complex tears (ankle sprains; 7.7%), and partial or complete hamstring tears (6.9%). Rates of hamstring tears decreased between 2015–2016 and 2017–2018 before increasing slightly during the final year of the study (Figure D). In contrast, rates of concussion increased steadily throughout the study period until 2017–2018, then decreased during the final year of the study (Figure D).

Injuries by Lacrosse-Specific Activities and Playing Positions

Most injuries in men's lacrosse between 2014–2015 and 2018–2019 occurred during general play (34.9%), followed by defending (11.8%) and running (11.3%). Similar proportions of competition (12.9%) and practice (11.1%) injuries occurred during defending. Ball handling accounted for a larger proportion of competition injuries (13.8%) than practice injuries (4.0%), whereas a larger proportion of practice injuries than competition injuries were attributed to general play (39.0% versus 27.4%) and running (13.7% versus 6.8%). Midfielders accounted for the largest proportion of injured men's lacrosse players reported during the study period (40.3%; Table 4).

Table 3. Distribution of injuries by Body Part, Mechanism, and Injury Diagnosis stratified by Event Type[a]

	Overall		Competitions		Practices	
	Injuries Reported (%)	National Estimate (%)	Injuries Reported (%)	National Estimate (%)	Injuries Reported (%)	National Estimate (%)
Body part						
Head/face	197 (10.52)	3315 (8.96)	93 (14.13)	1795 (12.57)	104 (8.57)	1519 (6.68)
Neck	18 (0.96)	308 (0.83)	6 (0.91)	144 (1.01)	12 (0.99)	164 (0.72)
Shoulder	144 (7.69)	2618 (7.07)	78 (11.85)	1577 (11.05)	66 (5.44)	1042 (4.58)
Arm/elbow	50 (2.67)	1103 (2.98)	28 (4.26)	582 (4.08)	22 (1.81)	522 (2.30)
Hand/wrist	155 (8.28)	2697 (7.29)	60 (9.12)	1160 (8.13)	95 (7.83)	1537 (6.76)
Trunk	158 (8.44)	2941 (7.95)	48 (7.29)	970 (6.80)	110 (9.06)	1971 (8.67)
Hip/groin	155 (8.28)	3216 (8.69)	40 (6.08)	862 (6.04)	115 (9.47)	2353 (10.35)
Thigh	230 (12.29)	5589 (15.10)	68 (10.33)	1772 (12.41)	162 (13.34)	3817 (16.79)
Knee	282 (15.06)	5810 (15.70)	97 (14.74)	2381 (16.68)	185 (15.24)	3430 (15.09)
Lower leg	136 (7.26)	2794 (7.55)	32 (4.86)	872 (6.11)	104 (8.57)	1922 (8.45)
Ankle	217 (11.59)	4090 (11.05)	81 (12.31)	1702 (11.92)	136 (11.20)	2388 (10.50)
Foot	94 (5.02)	2050 (5.54)	24 (3.65)	421 (2.95)	70 (5.77)	1629 (7.16)
Other	36 (1.92)	479 (1.29)	3 (0.46)	38 (0.27)	33 (2.72)	442 (1.94)
Mechanism						
Player contact	488 (26.07)	9340 (25.24)	255 (38.75)	5527 (38.72)	233 (19.19)	3813 (16.77)
Surface contact	172 (9.19)	3364 (9.09)	67 (10.18)	1288 (9.02)	105 (8.65)	2076 (9.13)
Ball contact	101 (5.40)	1527 (4.13)	10 (1.52)	161 (1.13)	91 (7.50)	1366 (6.01)
Other apparatus contact	172 (9.19)	3283 (8.87)	97 (14.74)	1940 (13.59)	75 (6.18)	1343 (5.91)
Out of bounds contact	2 (0.11)	26 (0.07)	2 (0.30)	26 (0.18)	0 (0.00)	0 (0.00)
Noncontact	626 (33.44)	14 014 (37.86)	178 (27.05)	4458 (31.23)	448 (36.90)	9556 (42.03)
Overuse	203 (10.84)	4040 (10.92)	19 (2.89)	329 (2.30)	184 (15.16)	3711 (16.32)
Illness/infection	31 (1.66)	449 (1.21)	2 (0.30)	26 (0.18)	29 (2.39)	424 (1.86)
Other/unknown	77 (4.11)	969 (2.62)	28 (4.26)	521 (3.65)	49 (4.04)	448 (1.97)
Diagnosis						
Abrasion/laceration	31 (1.66)	727 (1.96)	15 (2.28)	317 (2.22)	16 (1.32)	410 (1.80)
Concussion	149 (7.96)	2584 (6.98)	68 (10.33)	1435 (10.05)	81 (6.67)	1149 (5.05)
Contusion	302 (16.13)	5694 (15.38)	155 (23.56)	3251 (22.77)	147 (12.11)	2443 (10.75)
Dislocation/subluxation	47 (2.51)	716 (1.93)	22 (3.34)	393 (2.75)	25 (2.06)	323 (1.42)
Fracture	76 (4.06)	1372 (3.71)	30 (4.56)	511 (3.58)	46 (3.79)	861 (3.79)
Illness/infection	4 (0.21)	137 (0.37)	0 (0.00)	0 (0.00)	4 (0.33)	137 (0.60)
Inflammatory condition	166 (8.87)	3597 (9.72)	25 (3.80)	591 (4.14)	141 (11.61)	3006 (13.22)
Spasm	68 (3.63)	1156 (3.12)	16 (2.43)	266 (1.86)	52 (4.28)	890 (3.91)
Sprain	401 (21.42)	8099 (21.88)	170 (25.84)	3874 (27.14)	231 (19.03)	4225 (18.58)
Strain	436 (23.29)	10 060 (27.18)	110 (16.72)	2808 (19.67)	326 (26.85)	7253 (31.90)
Other	192 (10.26)	2869 (7.75)	47 (7.14)	830 (5.81)	145 (11.94)	2039 (8.97)

[a] Data presented in the order of reported number, followed by the proportion of all injuries attributable to a given category. Data pooled across event types are presented overall, and separately for practices and competitions. National estimates were produced using sampling weights estimated on the basis of sport, division, and year. 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 Athletic Trainer or physician (regardless of time loss). Only scheduled team practices and competitions were retained in this analysis.

SUMMARY

This study describes the epidemiology of injuries among a convenience sample of NCAA men's lacrosse players during the 2014–2015 through 2018–2019 athletic seasons. The overall injury rate was similar to those previously reported in this population.[8,9] In addition, the competition-related injury rate was consistently higher than the practice-related injury rate across the study period, and the proportion of TL injuries resulting in 10 or more days was comparable with that observed between 1988–1989 and 2003–2004 (21%).[8] Interestingly, there was a marked decrease in the competition-related injury rate between the 2017–2018 and 2018–2019 athletic seasons. This may be attributable to the steadily increasing popularity of injury prevention techniques (eg, ankle bracing, neuromuscular training such as FIFA 11+) and athlete monitoring devices intended to manage athlete workload.[12–15] Further monitoring will be important to see if this trend continues. Future researchers should continue to examine temporal patterns in competition injury incidence and ways to examine the effect of workload monitoring more acutely on injury incidence. Rates of overall competition-related TL injuries also appeared to decrease during the final years of the study. Given the higher likelihood of player contact in the competition environment, this is surprising in comparison with the stable nature of overall practice-related TL injury rates. Notably, TL was not recorded for more than 20% of all reported injuries (and missingness varied from year to year), and so it is important to acknowledge that the prevalence of TL injuries may not be fully elucidated in this study. This may be considered an inherent limitation of the data collection methods employed by the NCAA ISP. With that said, to fully ascertain the burden of TL injuries, authors of future studies should aim to examine recovery after men's lacrosse injuries,[16] while also striving to capture more complete TL data in this population to better understand injury burden in this population.

Table 4. Distribution of injuries by Injury Activity and Playing Position stratified by Event Type[a]

	Overall		Competitions		Practices	
	Injuries Reported (%)	National Estimate (%)	Injuries Reported (%)	National Estimate (%)	Injuries Reported (%)	National Estimate (%)
Activity						
Ball handling	140 (7.48)	4072 (11.00)	91 (13.83)	2903 (20.34)	49 (4.04)	1169 (5.14)
Blocking shot	28 (1.50)	378 (1.02)	7 (1.06)	92 (0.64)	21 (1.73)	286 (1.26)
Checking	39 (2.08)	693 (1.87)	25 (3.80)	452 (3.17)	14 (1.15)	241 (1.06)
Conditioning	14 (0.75)	217 (0.59)	1 (0.15)	3 (0.02)	13 (1.07)	214 (0.94)
Defending	220 (11.75)	4701 (12.70)	85 (12.92)	2126 (14.89)	135 (11.12)	2575 (11.33)
Face off	69 (3.69)	1614 (4.36)	41 (6.23)	1013 (7.10)	28 (2.31)	601 (2.64)
General play	653 (34.88)	11 297 (30.52)	180 (27.36)	2935 (20.56)	473 (38.96)	8362 (36.78)
Goaltending/keeping	69 (3.69)	1492 (4.03)	8 (1.22)	266 (1.86)	61 (5.02)	1226 (5.39)
Loose ball	99 (5.29)	2390 (6.46)	57 (8.66)	1244 (8.71)	42 (3.46)	1146 (5.04)
Passing	11 (0.59)	131 (0.35)	3 (0.46)	36 (0.25)	8 (0.66)	94 (0.41)
Catching/receiving	33 (1.76)	642 (1.73)	20 (3.04)	419 (2.94)	13 (1.07)	223 (0.98)
Running	211 (11.27)	3834 (10.36)	45 (6.84)	869 (6.09)	166 (13.67)	2965 (13.04)
Shooting	120 (6.41)	3087 (8.34)	53 (8.05)	1427 (10.00)	67 (5.52)	1660 (7.30)
Weights	3 (0.16)	118 (0.32)	0 (0.00)	0 (0.00)	3 (0.25)	118 (0.52)
Other/unknown	163 (8.71)	2344 (6.33)	42 (6.38)	490 (3.43)	121 (9.97)	1855 (8.16)
Position						
Forward/attack	400 (21.37)	7887 (21.31)	156 (23.71)	3613 (25.31)	244 (20.10)	4274 (18.80)
Midfielder	755 (40.33)	15 880 (42.91)	282 (42.86)	6170 (43.22)	473 (38.96)	9710 (42.71)
Defensive back	384 (20.51)	8151 (22.02)	130 (19.76)	3133 (21.95)	254 (20.92)	5017 (22.07)
Goalkeeper	93 (4.97)	2004 (5.41)	20 (3.04)	415 (2.91)	73 (6.01)	1589 (6.99)
Other/unknown	240 (12.82)	3089 (8.35)	70 (10.64)	944 (6.61)	170 (14.00)	2145 (9.43)

[a] Data presented in the order of reported number, followed by the proportion of all injuries attributable to a given category. Data pooled across event types are presented overall, and separately for practices and competitions. National estimates were produced using sampling weights estimated on the basis of sport, division, and year. 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 Athletic Trainer or physician (regardless of time loss). Only scheduled team practices and competitions were retained in this analysis.

In the present study, overall injury rates for NCAA men's lacrosse were highest for Division III, followed by Division I and Division II, which is similar to previous studies of this population.[9] The higher injury rates observed among Division III programs may be a consequence of potentially smaller AT-to-student-athlete ratios, in part due to the relatively smaller nature of sports medicine programs than their Division I and II counterparts.[17,18] Smaller programs, though, may also be limited in their ability to provide preventative treatments and services. The NCAA ISP does not collect details regarding AT staffing models or the health care services employed by participating schools. However, future researchers could investigate this relationship by examining division-level injury incidence in the context of available sports medicine resources.

Consistent with previous studies of this population, the preseason injury rates across the study period were higher than the regular season injury rates, which in turn were higher than postseason injury rates (albeit authors of previous studies of NCAA men's lacrosse injuries have not always included NTL injuries).[7,9] The difference in injury rates between the preseason and regular season may be attributed to nuanced differences in the intensity and frequency of training that occurs during the preseason in contrast with offseason training characteristics.[19] Preseason practices are more likely to focus on skill development, drills, and competition-intensity scrimmages than regular season practices. Preseason may also be associated with a rapid return to contact drills. While the NCAA requires a 5-day progressive return to full contact for football (which is considered to have comparable levels of contact during gameplay as men's lacrosse),[20] no such restriction exists for lacrosse. Implementation of a progressive return to contact for other contact sports has been suggested as a policy that may benefit sports like lacrosse.[21] Investigation as to player activity in the offseason and exposure to contact during the preseason could offer valuable insights into injury rates during the preseason.[22,23] A more granular investigation as to when injuries occur during preseason may also offer unique insight into the potential benefits of a progressive approach to full contact training. The NCAA ISP does not capture specific information on training activities and is therefore not well positioned to describe the transition between offseason to preseason. Additional studies should investigate the nature and timing of preseason injuries and the role the offseason plays in preseason injury incidence. Moreover, baseline (preparticipation) performance and conditioning assessments measuring muscle strength, endurance, and flexibility are likely to aid coaching and athletic training staff in identifying injury risk factors to target for improvement and injury prevention.[24,25] The NCAA ISP in its current form also does not capture preinjury athlete characteristics and has limited capacity to provide further insight into this paradigm.

Lower extremity injuries both combined and individually (hip or groin, thigh, knee, lower leg, ankle, foot) accounted for the greatest proportion of reported injuries. Most reported injuries were classified as sprains and strains, though sprains were more prevalent among competition-related injuries, whereas strains were more prevalent among practice-related injuries. As practices are focused on improving performance by means of high-intensity drills and new skill acquisition, athletes may subject their muscles to excessive tensile strain and subsequently

increase the risk of muscular injury.[26] This may be further evidenced in the prevalence of hamstring strains observed both overall and specifically in practice-related injuries in the current study. Hamstring strains, which are characterized by eccentric overload, represent a significant injury with a high rate of recurrence,[27–29] thereby warranting further attention in this context. In contrast, sprains, which often occur when joint congruency is compromised through a contact mechanism or a failure of sensorimotor control, were more common during competition.[30,31] Competitions may expose the athlete to greater contact as well as more sensory input,[32] challenging both integrity of ligaments and sensorimotor control. The differences in the nature of practice and competition exposures may provide some explanation as to the prevalence of strains in practice and sprains in competition. Future researchers should consider examining more granular aspects of men's lacrosse workload and exposure, such as distance covered, rapid accelerations and decelerations, and impacts sustained in practice and competition. Together, these findings reflect the large amount of running, cutting, physicality, and fast-paced nature of the men's lacrosse game.[7,9,10] Such movement and environmental characteristics are not captured within the NCAA ISP, and targeted, small-sample studies may be needed to better understand their relationship with injury risk.

A large proportion of reported injuries, particularly among competitions, were attributed to player contact. Moreover, head or face injuries (most often resulting from player contact) were prevalent among competition-related injuries, consistent with previous findings.[7,9,10] Despite the equipment worn by players to dissipate biomechanical forces sustained during contact and lower the risk of serious injury,[33,34] the concussion injury rate followed an increasing trajectory for most of the study period. Awareness and education surrounding concussions has escalated considerably in the past 2 decades. Given existing evidence indicating the effectiveness of concussion awareness programs in other sports,[35,36] it may be prudent to create analogous programs targeting men's lacrosse athletes. Such programs may be used to promote safe playing behaviors among lacrosse athletes, as well as to improve concussion awareness among other stakeholders, athletes, and coaches. Importantly, further investigation into the nature of contact-related injuries during competition and the role of protective equipment and injury prevention strategies in men's lacrosse is needed to inform such injury prevention programs.

Recruitment strategies for the NCAA ISP have evolved over time, and improvements in participation reflect successful strategies employed to increase participation and improve the engagement of participating programs, including support and communication from the NCAA Sport Science Institute. It is important to note the limitations to external validity of the results observed here, as these data do not represent the overall membership of the NCAA, since not all membership programs participate in the ISP.

This study established the nature and incidence of injuries in a sample of men's lacrosse players in the NCAA from 2014–2015 through 2018–2019. Study findings were comparable with existing epidemiological evidence, though notable differences across years were observed. Due to the increasing popularity of men's lacrosse, ongoing monitoring of this population is critical. Further epidemiological research is needed to determine true differences in injury incidence over time and to inspire nuanced, mixed-methods research aimed at developing targeted interventions.

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