

Hand and Wrist Injuries in Men's and Women's National Collegiate Athletic Association Basketball

David G. Deckey,* MD, Kelly L. Scott,* MD, Nathaniel B. Hinckley,* DO, Justin L. Makovicka,* MD, Jeffrey D. Hassebrock,* MD, Sailesh V. Tummala,[†] BS, Austin Pena,[‡] BS, Walker Asprey,[‡] BS, and Anikar Chhabra,*[§] MD

Investigation performed at Mayo Clinic, Phoenix, Arizona, USA

Background: Hand and wrist injuries (HWIs) are common in National Collegiate Athletic Association (NCAA) basketball players and can negatively affect performance. There is limited literature available on this topic.

Purpose: To open a discussion on prevention strategies and encourage future research on HWIs in basketball athletes.

Study Design: Descriptive epidemiology study.

Methods: HWIs sustained by male and female NCAA basketball players during the 2009-2010 through 2013-2014 academic years and reported to the NCAA Injury Surveillance Program (NCAA-ISP) database were utilized to characterize the epidemiology thereof. Rates and distributions of HWIs were identified within the context of mechanism of injury, injury recurrence, and time lost from sport.

Results: Over the 5-year period, 81 HWIs in women and 171 HWIs in men were identified through the NCAA-ISP database. These were used to estimate 3515 HWIs nationally in women's basketball athletes and 7574 HWIs nationally in men's basketball athletes. The rate of HWIs in women was 4.20 per 10,000 athlete-exposures (AEs) and in men was 7.76 per 10,000 AEs, making men 1.85 times more likely to sustain HWIs compared with women. In men, HWIs were 3.31 times more likely to occur in competition compared with practice, while in women, HWIs were 2.40 times more likely to occur in competition than in practice. Based on position, guards, both men and women, were the most likely to suffer HWIs.

Conclusion: HWIs were common in collegiate basketball players. Most injuries were new, and the majority of players were restricted from participation for less than 24 hours. Men were more likely to be injured compared with women, and injuries were most common in the setting of competition for both sexes. The majority of injuries was considered minor and did not extensively limit participation; however, prevention and detection remain important for optimal performance.

Keywords: hand; wrist; finger; basketball; NCAA; sports injuries; return to play; strength and conditioning

Hand and wrist injuries (HWIs) are common in basketball because of the sole involvement of the upper extremity in handling the ball. The upper extremity skill set includes dribbling, passing, shooting, and rebounding, all of which pose a risk of injuries based on mere repetition during the game of basketball.⁷ National Collegiate Athletic Association (NCAA) basketball players consist of a large group of athletes across all 3 divisions (Divisions I, II, and III), and participation rates have steadily increased each year. Combining men and women, there were 32,431 total athletes in the 2009-2010 season, 33,208 in the 2010-2011 season, 34,024 in the 2011-2012 season, 34,170 in the 2012-2013 season, and 34,639 in the 2013-2014 season.¹⁰ As the total number of athletes participating in collegiate basketball

rises, the inherent number of HWIs will increase correspondingly.

The purpose of this study was to analyze the NCAA Injury Surveillance Program (NCAA-ISP) database from the 2009-2010 to 2013-2014 academic years to describe and compare the epidemiology of HWIs in men's and women's NCAA basketball. With analysis of these data, we hope to better understand the impact of HWIs in collegiate basketball, open a discussion on prevention strategies, and encourage future research on HWIs in basketball athletes.

METHODS

Data Collection

The NCAA-ISP database was utilized to evaluate data from the 2009-2010 to 2013-2014 academic years. This database is a validated resource that has been previously used to report

The Orthopaedic Journal of Sports Medicine, 8(9), 2325967120953070
DOI: 10.1177/2325967120953070
© The Author(s) 2020

This open-access article is published and distributed under the Creative Commons Attribution - NonCommercial - No Derivatives License (<https://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits the noncommercial use, distribution, and reproduction of the article in any medium, provided the original author and source are credited. You may not alter, transform, or build upon this article without the permission of the Author(s). For article reuse guidelines, please visit SAGE's website at <http://www.sagepub.com/journals-permissions>.

injuries in collegiate athletes.¹¹ The NCAA-ISP is a prospectively gathered injury surveillance database managed by the Datalys Center for Sports Injury Research and Prevention, an independent nonprofit research organization. The study was exempt from institutional review board approval but was approved by the research review board of the NCAA.

Use of the NCAA-ISP has been previously well-described in the literature and will be briefly reviewed.^{1,3,5,7,9,14,17,22-24} The NCAA-ISP utilizes a voluntary convenience sample of NCAA programs over a 5-year period. Consequently, there is variability in the number of programs participating in the data set each year. As previously reported, this creates a deterministic sample of data, as opposed to a random sample, and has been used to monitor injury trends and patterns.

Athletic trainers (ATs) at each participating program record injury and exposure data electronically through each institution's electronic health record. Data are collected during organized practices and competitions during the preseason, in-season, and postseason. For each injury, ATs and/or physicians complete a detailed report on the injury itself as well as the circumstances surrounding the injury. Injury data collected include the anatomic site of injury, diagnosis, circumstances of the injury, and event type. The date on which players return to participation is also recorded. ATs also record the number of student-athletes participating in each practice and competition to determine exposures.

The database was queried for men's and women's basketball players in any division who sustained a "hand" or "wrist" injury. This study relied on the training and expertise of the ATs collecting data, as well as the other members of the medical staff assisting in documentation, to accurately diagnose and report all HWIs. The most recently updated diagnoses were used.

Computing National Estimates

To calculate national estimates of the number of HWIs, poststratification sample weights based on sport, division, and academic year were applied to each reported injury and athlete-exposure (AE). Poststratification sample weights were calculated with the following formula:

$$\text{sample weight}_{abc} = \left(\frac{\text{number of teams participating in ISP}_{abc}}{\text{number of teams in NCAA}_{abc}} \right)^{-1},$$

¹¹References 2, 4, 5, 7, 9, 13, 14, 17, 22-24.

where weight_{abc} is the weight for the a th sport of the b th division in the c th year. Weights for all data were further adjusted to correct for underreporting, accounting for the estimated 88.3% capture rate of all time-loss medical care injury events with the NCAA-ISP previously reported in the literature.¹⁶

Data Analysis

The data were analyzed to assess the rates and patterns of HWIs sustained in collegiate athletes. HWIs were analyzed for injury type, time loss, time of season, event type, recurrence, injury mechanism, and participation restriction. The injury rate was defined as the number of injuries divided by the number of AEs. An AE was defined as any student-athlete participating in 1 NCAA-sanctioned practice or competition. The rates were reported as the ratio of injuries per 10,000 AEs and calculated as an overall rate as well as individual rates for event type (practice vs competition) and time of season (preseason, in-season, or postseason).

Injury rate ratios (IRRs) were calculated to compare rates between event types and times of season, as they are useful for determining whether one participation type has an increased rate of injury compared with another. The following is an example of an IRR comparing injury rates between competition and practice:

$$IRR = \frac{\left(\frac{\sum \text{Number of competition injuries}}{\sum \text{Competition AEs}} \right)}{\left(\frac{\sum \text{Number of practice injuries}}{\sum \text{Practice AEs}} \right)}.$$

Injury proportion ratios (IPRs) were calculated to examine differences in injury rates between men's and women's basketball. The following is an example of an IPR comparing the proportion of HWIs that were caused by metacarpal fractures in men and women:

$$IPR = \frac{\frac{\sum \text{metacarpal fractures in men}}{\sum \text{total HWI in men}}}{\frac{\sum \text{metacarpal fractures in women}}{\sum \text{total HWI in women}}}.$$

All 95% CIs were calculated, assuming normally distributed data for HWIs by event type and time of season; CIs not containing 1.0 were considered statistically significant. Participation restriction time was reported as intervals (<24 hours, 1-6 days, 7-21 days, and >21 days), and descriptive data were presented as percentages of injuries. Data were analyzed using SPSS 2015 software (IBM) and Excel 2010 (Microsoft).

[§]Address correspondence to Anikar Chhabra, MD, Department of Orthopedic Surgery, Mayo Clinic, 5777 East Mayo Boulevard, Phoenix, AZ 85054, USA (email: chhabra.anikar@mayo.edu) (Twitter: @chhabraanikar).

^{*}Department of Orthopedic Surgery, Mayo Clinic, Phoenix, Arizona, USA.

[†]John A. Burns School of Medicine, University of Hawaii, Honolulu, Hawaii, USA.

[‡]Alix School of Medicine, Mayo Clinic, Scottsdale, Arizona, USA.

Final revision submitted April 2, 2020; accepted April 22, 2020.

One or more of the authors has declared the following potential conflict of interest or source of funding: K.L.S. has received educational support from Arthrex. A.C. has received educational support from Arthrex and Stryker and consulting fees from Arthrex, Cayenne Medical, Trice Medical, and Zimmer Biomet. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.

Ethical approval was not sought for the present study.

TABLE 1
National Estimates for HWI Types, Totals, and Rates^a

Injury Type	Injuries, ^b n (%)		Injury Rate/10,000 AEs		IPR (95% CI)
	Women's	Men's	Women's	Men's	
All HWIs reported	81	171	N/A	N/A	N/A
Carpal fracture (except scaphoid)	0 (0.0)	100 (1.3)	N/A	0.10	N/A
Digital collateral ligament	686 (19.5)	875 (11.6)	0.82	0.90	0.92 (0.47-1.78)
Finger extensor tendon	36 (1.0)	166 (2.2)	0.04	0.17	0.25 (0.03-2.23)
Finger flexor tendon	154 (4.4)	210 (2.8)	0.18	0.22	0.86 (0.21-3.59)
Hand/finger infection	0 (0.0)	141 (1.9)	N/A	0.14	N/A
Hand/wrist contusion	453 (12.9)	951 (12.6)	0.54	0.97	0.56 (0.26-1.18)
Joint dislocation	242 (6.9)	521 (6.9)	0.29	0.53	0.54 (0.19-1.54)
Metacarpal fracture	182 (5.2)	423 (5.6)	0.22	0.43	0.50 (0.17-1.50)
Phalanx fracture	385 (11.0)	171 (2.3)	0.46	0.18	2.62 (0.81-8.52)
Scaphoid fracture	31 (0.9)	52 (0.7)	0.04	0.05	0.69 (0.04-10.99)
Thumb interphalangeal joint collateral ligament	172 (4.9)	226 (3.0)	0.21	0.23	0.89 (0.24-3.31)
Thumb radial collateral ligament	131 (3.7)	326 (4.3)	0.16	0.33	0.47 (0.14-1.61)
Thumb ulnar collateral ligament	540 (15.4)	876 (11.6)	0.65	0.90	0.72 (0.35-1.48)
Other HWIs	503 (14.3)	2536 (33.5)	0.60	2.60	0.23 (0.12-0.43)
Total	3515	7574	4.20	7.76	0.54 (0.42-0.71)

^aAE, athlete-exposure; HWI, hand and wrist injury; IPR, injury proportion ratio; N/A, not applicable.

^bNational estimates may not sum to total because of rounding.

Definitions

Injury. Reportable injuries included those that (1) occurred as a result of participation in an organized intercollegiate practice or competition, (2) required attention from an AT or physician, and (3) resulted in restriction of the student-athlete's participation for ≥ 1 days beyond the day of injury. ATs and the medical team collected the data.

Injury Mechanism. The injury mechanism was the manner in which the student-athlete sustained his or her injury. In the NCAA-ISP, ATs chose from a set list of options, including player contact, surface contact, equipment contact, contact with an out-of-bounds object, noncontact, overuse, illness, infection, and other/unknown. All contact events were condensed under the title "contact." Missing, unknown, or unreported data were demarcated as "missing."

Athlete-Exposure. AE was defined as 1 student-athlete participating in 1 NCAA-sanctioned practice or competition in which he or she was exposed to the possibility of an athletic injury, regardless of the time associated with that participation.

Time in Season. This was defined as the time of the season during which the injury took place. These were categorized as either preseason, in-season, or postseason. These categories were selected because athlete variables such as conditioning and intensity of play were hypothesized to vary during time in season (ie, lowest conditioning and intensity of play in preseason and highest in postseason).

Event Type. The event type was where the injury took place: that is, practice or competition. This distinction was made with the expectation that athletes vary in their intensity of play between practice and competition.

Recurrence. Recurrence was defined as repetition of the same injury that occurred previously in the student-athlete's career.

Position. This was reported by the NCAA-ISP.

Participation Restriction Time. This was the number of days that participation was restricted (the difference between the date of return and the date of injury). Injuries resulting in participation restriction < 24 hours were also included. Severe injuries were defined as injuries resulting in participation restriction over 3 weeks, the student-athlete choosing to prematurely end one's season (for medical or psychological reasons associated with the injury), or a medical professional having the student-athlete prematurely end his or her season.

Raw data contained the following categories of injury: digital collateral ligament, finger extensor tendon, finger flexor tendon, hand/wrist contusion, hand/finger infection, thumb interphalangeal joint collateral ligament, joint dislocation, metacarpal fracture, phalanx fracture, thumb radial collateral ligament, scaphoid fracture, thumb ulnar collateral ligament injury, and carpal fracture (except scaphoid).

RESULTS

Injury Rates and Frequencies

During the 2009-2010 to 2013-2014 academic years, 81 HWIs in women and 171 HWIs in men were sustained during the collegiate basketball season and identified through the NCAA-ISP database. These numbers yielded a national weighted estimate of 3515 total HWIs in women and 7574 total HWIs in men (Table 1). The HWI rate for women was 4.20 per 10,000 AEs and 7.76 per 10,000 AEs in men. Men were 1.85 times more likely to sustain an HWI

TABLE 2
HWIs in Relation to Practice and Competition^a

	No. of Injuries		Injury Rate/10,000 AEs		IRR ^b (95% CI)
	Competition	Practice	Competition	Practice	
Women's	1492	2021	7.58	3.16	2.40 (1.54-3.72)
Men's	3592	3979	17.18	5.19	3.31 (2.45-4.47)
IPR (95% CI)	0.44 (0.30-0.66)	0.61 (0.43-0.87)			

^aAE, athlete-exposure; HWI, hand and wrist injury; IPR, injury proportion ratio; IRR, injury rate ratio.

^bCompetition/practice.

TABLE 3
HWIs in Relation to Season of Play^a

	No. of Injuries			Injury Rate/10,000 AEs		
	Preseason	In-season	Postseason	Preseason	In-season	Postseason
Women's	649	2864	0	3.66	4.64	0.00
Men's	1616	5624	330	7.78	7.81	6.80
Combined	2265	8488	330	5.72	6.22	3.40
	IRR (95% CI)			IPR (95% CI)		
	Postseason/Preseason	Postseason/In-season	Preseason/In-season	Preseason	In-season	Postseason
Women's	N/A	N/A	0.79 (0.45-1.38)	0.47 (0.26-0.85)	0.59 (0.44-0.80)	N/A
Men's	0.87 (0.41-1.87)	0.87 (0.43-1.78)	1.00 (0.70-1.43)			

^aAE, athlete-exposure; HWI, hand and wrist injury; IPR, injury proportion ratio; IRR, injury rate ratio; N/A, not applicable.

compared with women. When comparing individual rates between men and women, men were more likely to sustain each category of injury type, with the exception of phalanx fractures.

Event Type and Time of Season

The HWI rate per 10,000 AEs for competition was 2.27 times higher in men than in women (Table 2). Women and men were both more likely to be injured during competition than during practice. Women were 2.40 times (95% CI, 1.54-3.72) more likely to sustain an HWI during competition compared to practice, while men were 3.31 times (95% CI, 2.45-4.47) more likely. Men experienced higher injury rates at any given time during the year (preseason, in-season, and postseason) (Table 3). Men were also least likely to be injured during the postseason compared with both the preseason and the in-season (IRR postseason to preseason, 0.87 [95% CI, 0.41-1.87]; IRR postseason to in-season, 0.87 [95% CI, 0.43-1.78]). Notably, no injuries were recorded during the postseason for women. When comparing the 2 sexes, women were less likely to be injured in the preseason and in-season compared with men (IPR women to men preseason, 0.47 [95% CI, 0.26-0.85]; IPR women to men in-season, 0.59 [95% CI, 0.44-0.80]).

Injury by Athlete Position

Both female and male guards sustained the highest number of injuries (Table 4). Female guards were 1.19 times

TABLE 4
HWIs by Position^a

	Injuries, n (%)		IPR (95% CI)
	Women's	Men's	
Center	436 (12.4)	1055 (13.9)	0.89 (0.41-1.92)
Forward	664 (18.9)	2338 (30.9)	0.61 (0.36-1.06)
Guard	1969 (56.1)	3555 (47.0)	1.19 (0.83-1.72)
Unknown	444 (12.6)	622 (8.2)	1.54 (0.68-3.46)
Total	3513	7570	N/A

^aHWI, hand and wrist injury; IPR, injury proportion ratio; N/A, not applicable.

more likely than their male counterparts to be injured (95% CI, 0.83-1.72). Female centers and forwards, respectively, were 0.89 and 0.61 times less likely to be injured than male centers and forwards (centers: 95% CI, 0.41-1.92; forwards: 95% CI, 0.36-1.06). There were no statistical differences between these positions.

Mechanism of Injury

Contact injuries were the most common injuries in both women (96.0%) and men (90.1%) (Table 5). Women were slightly more likely to sustain a contact injury but less likely

TABLE 5
HWIs by Mechanism of Injury^a

	Injuries, n (%)			IPR (95% CI)
	Women's	Men's	Combined	
Contact	3373 (96.0)	6822 (90.1)	10,195 (92.0)	1.07 (0.81-1.40)
Infection	0 (0.0)	33 (0.4)	33 (0.003)	N/A
No apparent contact	72 (2.1)	215 (2.8)	287 (2.6)	0.72 (0.14-3.72)
Overuse/gradual	0 (0.0)	192 (2.5)	192 (0.018)	N/A
Unknown	68 (1.9)	308 (4.1)	376 (3.4)	0.48 (0.10-2.24)
Total	3513	7570	11,083	N/A

^aHWI, hand and wrist injury; IPR, injury proportion ratio; N/A, not applicable.

TABLE 6
Recurrence of HWIs^a

	Injuries, n (%)			IPR (95% CI)
	Women's	Men's	Combined	
New injury	3330 (94.7)	6985 (92.2)	10,315 (93.0)	1.03 (0.78-1.35)
Recurrent injury	186 (5.3)	552 (7.3)	738 (6.7)	0.73 (0.21-2.57)
Unknown	0 (0.0)	36 (0.5)	36 (0.3)	N/A
Total	3515	7573	11,089	N/A

^aHWI, hand and wrist injury; IPR, injury proportion ratio; N/A, not applicable.

TABLE 7
Time Loss of HWIs^a

	Injuries, n (%)			IPR (95% CI)
	Women's	Men's	Combined	
<24 hours	2316 (73.4)	5304 (74.5)	7620 (74.2)	0.99 (0.71-1.36)
1-6 days	501 (15.9)	1112 (15.6)	1613 (15.7)	1.02 (0.51-2.01)
7-21 days	203 (6.4)	274 (3.9)	477 (4.7)	1.67 (0.53-5.27)
>21 days	134 (4.3)	425 (6.0)	559 (5.4)	0.71 (0.21-2.36)
Total	3154	7115	10,269	N/A

^aHWI, hand and wrist injury; IPR, injury proportion ratio; N/A, not applicable.

to sustain a noncontact injury (IPR women to men, 0.72 [95% CI, 0.14-3.72]); however, no statistical differences were found.

Injury Recurrence

Overall, 94.7% (n = 3330) of HWIs in women and 92.2% (n = 6985) of HWIs in men were new injuries (Table 6). Recurrent injuries accounted for 5.3% in women and 7.3% in men. Women were more likely to suffer from new injuries (IPR women to men, 1.03 [95% CI, 0.78-1.35]) and less likely to suffer from recurrent injuries (IPR women to men, 0.73 [95% CI, 0.21-2.57]). There were no statistically significant differences observed in these findings between men and women.

Time Lost From Injury

The majority of both female (73.4%; n = 2316) and male (74.5%; n = 5304) athletes returned to play within 24 hours of injury (Table 7). Women were more likely to return to play within 7 to 21 days (IPR, 1.67 [95% CI, 0.53-5.27]) and less likely to sustain injuries causing greater than 21 days of lost time (IPR, 0.71 [95% CI, 0.21-2.36]).

DISCUSSION

Currently, there are no studies that look specifically at HWIs in NCAA basketball players.^{7,11,18} The data presented in this investigation will help inform players, coaches, and ATs about incidence and return to play after these injuries.

Between the 2009-2010 and 2013-2014 seasons, the NCAA-ISP database revealed a total of 252 HWIs across both men's and women's basketball. These injuries revealed a few important findings: (1) players were most likely to sustain an injury during competition, (2) men were 1.85 times more likely to sustain an HWI than women, (3) guards were the most likely position to sustain an injury, (4) most injuries were attributed to contact, and (5) the majority of men and women injured were able to return to play within 24 hours. In this study, HWIs occurred in men at a rate of 7.76 per 10,000 AEs and 4.20 per 10,000 AEs in women.

The average NCAA basketball athlete will have approximately 500 AEs during his or her collegiate career, although this represents a highly variable total exposure,

as AE does not account for the length of competition or overall playing time.²⁵ Based on this, our data suggest that the average male athlete will experience 0.39 HWIs over his collegiate career, while the average female athlete will experience 0.21 HWIs in the same time period. There is a 25.8% chance for men and 26.6% for women that with each individual injury, athletes will be absent from participation for greater than 24 hours. Even small periods of time can be significant depending on timing in the season and the player's role. Despite the apparent low likelihood of suffering serious HWIs, the definition of an AE does not account for the different number of minutes that an athlete is active between a practice or a game, nor does it distinguish between starting and relief players. Although both types of athletes may experience the same number of AEs, the starter will have a significantly greater time on court and experience a greater exposure to injury-inciting events. This suggests that even though the average player may suffer fewer than 1 injury in his or her entire collegiate career, it is statistically likely that a star player will suffer multiple HWIs in that same time period. Despite our data revealing a lower rate of HWIs in the postseason for athletes, because of exposure length, these injuries are more likely to affect a key player who spends most AEs on the court.

As reported by Gaston and Loeffler,⁸ basketball players are particularly prone to digital injuries, with most being proximal interphalangeal and metacarpophalangeal joint sprains. This is supported by our study. Excluding "other" HWIs, digital collateral ligament injuries were the most commonly reported HWIs in both men and women. These data do not distinguish by the degree of ligamentous injury. The high frequency of ligamentous injuries overall, in conjunction with a quick return to athletic participation, suggests that the majority are low grade. There was a disparity between men and women in "other" HWIs and hand/wrist contusions. Johnson and colleagues¹¹ found that in all US high school athletes, 45% of HWIs were attributed to fractures. We believe that fractures may be underrepresented in this group by possibly being labeled as contusions or "other" injuries, as they may be more challenging to determine during a physical examination. Morse et al¹⁸ looked at hand injuries in professional basketball players and found metacarpal fractures to be the most commonly reported injuries. Kerr et al¹⁵ found that in high school and NCAA soccer athletes, fractures were significantly less likely to be reported by ATs than they were in the emergency department setting. Data collection in this forum relies heavily on the judgment of ATs for both evaluation and proper coding of the diagnosis. Often in the case of HWIs, ATs rely on athletes to self-report their injuries and symptoms. This leads to an inherent bias beyond the tendency of athletes to undersell their injuries in that players may feel pressured to go without reporting their injuries when the stakes to win are the highest, such as the postseason. This effect also works in reverse, as players unmotivated to play may miss more games because of injuries. Morse et al found that among professional players, return to play was more likely after a hand injury if the players' team made the postseason.

The vast majority (94.7% in women and 92.2% in men) of HWIs were new injuries. It is apparent that most of these injuries heal quickly, do not significantly alter return to play, and are not likely to cause a second loss of participation in the future. Of note, only men experienced overuse- and infection-related HWIs in our study. This may suggest variability in reporting between men and women, as it would seem less likely for either type of injury to present acutely while the athlete is participating in an AE and more likely outside of competition or practice.

Both men and women experienced more HWIs during competition compared with practice. This is consistent with other studies on upper extremity injuries in NCAA athletes. Bartels et al¹ found that NCAA football players had a 9-fold increase in HWIs during competition compared with in-season practice. We feel that in NCAA basketball athletes, this may be because of the faster pace of play, increased contact, or simply competitive play in a less controlled environment. There was a notable decrease in the rate of injuries during the postseason for both men and women, which was an unexpected finding based on the theory that higher intensity play leads to a greater risk of HWIs. This is likely secondary to an underreporting bias in that players in vital roles to their team's success would be least likely to report injuries when the stakes for winning are the highest. This is exemplified by the lack of injuries reported during the postseason among women.

Guards were the most common position to experience HWIs, likely because of more frequent ball handling comparatively with other positions. In addition, their defensive assignments typically include attempting steals and deflecting passes, leading to more high velocity and close-range contact with the ball in an unpredictable fashion. Centers, on the other hand, experience contact with the ball less frequently during an AE than guards may. In contrast, Morse et al¹⁸ found the highest number of injuries in professional players among centers; however, there was no statistical difference in the number of injuries based on position.

Male NCAA basketball players were more than twice as likely to experience HWIs as their female counterparts. This discrepancy may in part be explained by differences in total contact between men's and women's NCAA basketball players. Analysis of statistics recorded on the NCAA website shows that the 25 teams in both men's and women's NCAA basketball with the lowest number of personal fouls per game average 15.33 and 13.68 fouls per game, respectively.^{19,20} These data provide the most conservative estimate. Depending on the team, time of season, and referee judgment, the total number of fouls can vary significantly. Over the course of an entire season, and across multiple teams, this difference accounts for more frequent contact in men's games. Morse et al¹⁸ found a higher rate of injuries among professional players than we found among NCAA athletes. We expect this is because of increased physicality, increased size and strength of professional players, and increased burden of games in a season.

Although the majority of HWIs did not lead to a long-standing loss of participation, it is imperative that these injuries are recognized and appropriately treated. Athletes may minimize the amount of pain that they experience or the severity of their injury to prevent loss of participation and playing time; however, many HWIs can have a negative impact on players' functionality if not appropriately treated. In the case of a tendinous injury or injury to a joint, delay in treatment may lead to significant stiffness, particularly if contracture has begun to develop. These injuries must be managed with adequate stabilization, appropriate early motion, pain control, and edema control applicable to the level of injury.¹² Our study highlights the need for appropriate education and vigilance among ATs and those seeing athletes in an acute setting, particularly in the high school setting when injury management relies heavily on AT coverage for athlete safety. It is clear based on existing literature that adequately treating HWIs necessitates a short time to diagnosis and management.

Because of the high frequency of exposure and potential for missed participation, it appears prudent to discuss prevention strategies for higher risk athletes, particularly guards. Drury et al⁶ discussed methods for preventing HWIs in athletes participating in boxing and mixed martial arts. They highlighted the importance of taping and supportive measures such as gloves. Although bulkier supports would likely hinder the ability of a basketball player to perform, it is not inconceivable to imagine players with a history of multiple injuries using supportive taping or compression wraps around fingers, as is occasionally seen in the professional game. Kinesio taping (Kinesio Group LLC) may provide a lightweight and flexible option to prevent reinjuries and discomfort in players with frequent contact with the ball. In a study by Serbest et al²¹ comparing Kinesio taping and splint treatment among child athletes with proximal interphalangeal joint sprains, taping was found to have higher patient compliance and better outcomes in terms of edema, joint range of motion, and night pain. In addition, maintenance of strength and flexibility in the fingers may help improve athletes' ability to absorb impact through their hands. This may contribute to a lessening of both overuse and ligamentous injuries.

Limitations

While the NCAA-ISP is a validated database that has been used to characterize injuries in many collegiate sports, it has its limitations. Data entry is performed by ATs, and errors can occur during entry. This also creates limitations in the specificity of injury reporting, as trainers are tasked with placing an injury within a predetermined category. Additionally, given that not all colleges contribute to this database, there is a possibility of underreporting injuries. Also, given the sample size, it is possible that more obscure injuries are underestimated. For this reason, we reported on consecutive seasons, not just one individual academic year. Database participation is voluntary, allowing for selection bias among participating programs. These shortcomings can limit the generalizability across all schools. Despite these limitations, we consider these findings to be

descriptive of HWIs in NCAA basketball players. Future efforts are needed to assess which injuries are commonly responsible for longer absences as a result of AEs in these athletes.

CONCLUSION

HWIs were common in collegiate basketball players. Most injuries were new, and a majority of players were restricted from participation less than 24 hours. Men were more likely to be injured compared with women, and injuries were most common in the setting of competition for both sexes.

ACKNOWLEDGMENT

This publication contains materials created, compiled, or produced by the Datalys Center for Sports Injury Research and Prevention on behalf of the National Collegiate Athletic Association (NCAA). © 2019 National Collegiate Athletic Association. All rights reserved. The NCAA Injury Surveillance Program (ISP) data were provided by the Datalys Center. The ISP was funded by the NCAA. The content of this article is solely the responsibility of the authors and does not necessarily represent the official views of the Datalys Center or the NCAA. The authors thank the many athletic trainers who have volunteered their time and efforts to submit data to the NCAA-ISP. Their efforts are greatly appreciated and have had a tremendously positive effect on the safety of collegiate athletes.

REFERENCES

1. Bartels DW, Hevesi M, Wyles C, Macalena J, Kakar S, Krych AJ. Epidemiology of hand and wrist injuries in NCAA men's football: 2009–2010 to 2013–2014. *Orthop J Sports Med.* 2019;7(4):2325967119835375.
2. Chung AS, Makovicka JL, Hasebrock JD, et al. Epidemiology of cervical injuries in NCAA football players. *Spine (Phila Pa 1976).* 2019;44(12):848-854.
3. Deckey DG, Makovicka JL, Chung AS, et al. Neck and cervical spine injuries in National College Athletic Association athletes: a 5-year epidemiologic study. *Spine (Phila Pa 1976).* 2020;45(1):55-64.
4. Dick R, Hootman JM, Agel J, Vela L, Marshall SW, Messina R. Descriptive epidemiology of collegiate women's field hockey injuries: National Collegiate Athletic Association Injury Surveillance System, 1988–1989 through 2002–2003. *J Athl Train.* 2007;42(2):211-220.
5. Dragoo JL, Braun HJ, Bartlinski SE, Harris AHS. Acromioclavicular joint injuries in National Collegiate Athletic Association football: data from the 2004–2005 through 2008–2009 National Collegiate Athletic Association Injury Surveillance System. *Am J Sports Med.* 2012;40(9):2066-2071.
6. Drury BT, Lehman TP, Rayan G. Hand and wrist injuries in boxing and the martial arts. *Hand Clin.* 2017;33(1):97-106.
7. Fraser MA, Grooms DR, Guskiewicz KM, Kerr ZY. Ball-contact injuries in 11 National Collegiate Athletic Association sports: the Injury Surveillance Program, 2009–2010 through 2014–2015. *J Athl Train.* 2017;52(7):698-707.
8. Gaston RG, Loeffler BJ. Sports-specific injuries of the hand and wrist. *Clin Sports Med.* 2015;34(1):1-10.

9. Hassebrock JD, Patel KA, Makovicka JL, et al. Lumbar spine injuries in National Collegiate Athletic Association athletes: a 6-season epidemiological study. *Orthop J Sports Med.* 2019;7(1):232596711882004.
10. Irick E. 1981/82-2017/18 NCAA Sports Sponsorship and Participation Rates Report. National Collegiate Athletic Association; 2018.
11. Johnson BK, Brou L, Fields SK, Erkenbeck AN, Comstock RD. Hand and wrist injuries among US high school athletes: 2005/06–2015/16. *Pediatrics.* 2017;140(6):e20171255.
12. Kammerdnakta S, Huetteman HE, Chung KC. Complications of proximal interphalangeal joint injuries: prevention and treatment. *Hand Clin.* 2018;34(2):267-288.
13. Kerr ZY, Dompier TP, Snook EM, et al. National Collegiate Athletic Association Injury Surveillance System: review of methods for 2004-2005 through 2013-2014 data collection. *J Athl Train.* 2014;49(4):552-560.
14. Kerr ZY, Marshall SW, Dompier TP, Corlette J, Klossner DA, Gilchrist J. College sports-related injuries: United States, 2009–10 through 2013–14 academic years. *MMWR Morb Mortal Wkly Rep.* 2015;64(48):1330-1336.
15. Kerr ZY, Pierpoint LA, Currie DW, Wasserman EB, Comstock RD. Epidemiologic comparisons of soccer-related injuries presenting to emergency departments and reported within high school and collegiate settings. *Inj Epidemiol.* 2017;4(1).
16. Kucera KL, Marshall SW, Bell DR, DiStefano MJ, Goerger CP, Oyama SK. Validity of soccer injury data from the National Collegiate Athletic Association's Injury Surveillance System. *J Athl Train.* 2011;46(5):489-499.
17. Makovicka JL, Patel KA, Deckey DG, et al. Lower back injuries in National Collegiate Athletic Association football players. *Orthop J Sports Med.* 2019;7(6):2325967119852625.
18. Morse KW, Hearn KA, Carlson MG. Return to play after forearm and hand injuries in the National Basketball Association. *Orthop J Sports Med.* 2017;5(2):2325967117690002.
19. National Collegiate Athletic Association. *Men's basketball personal fouls per game.* Published 2019. Accessed August 12, 2019. <https://www.ncaa.com/stats/basketball-men/d1/current/team/286>.
20. National Collegiate Athletic Association. *Women's basketball personal fouls per game.* Published 2019. Accessed August 12, 2019. <https://www.ncaa.com/stats/basketball-women/d1/current/team/288>.
21. Serbest S, Tiftkci U, Durgut E, Vergili Ö, Yalın Kilinc C. The effect of Kinesio taping versus splint techniques on pain and functional scores in children with hand PIP joint sprain. *J Investig Surg.* 2020;33(4):375-380.
22. Tummala S, Chhabra A, Makovicka JL, Patel KA, Hartigan DE. Hip and groin injuries among collegiate male soccer players: the 10-year epidemiology, incidence, and prevention. *Orthopedics.* 2018;41(6):e831-e836.
23. Tummala S, Hartigan DE, Makovicka JL, Patel KA, Chhabra A. 10-year epidemiology of ankle injuries in men's and women's collegiate basketball. *Orthop J Sports Med.* 2018;6(11):232596711880540.
24. Tummala S, Hartigan DE, Patel KA, Makovicka JL, Chhabra A. Shoulder injuries in National Collegiate Athletic Association quarterbacks: 10-year epidemiology of incidence, risk factors, and trends. *Orthop J Sports Med.* 2018;6(2):2325967118756826.
25. Zuckerman SL, Wegner AM, Roos KG, Djoko A, Dompier TP, Kerr ZY. Injuries sustained in National Collegiate Athletic Association men's and women's basketball, 2009/2010-2014/2015. *Br J Sports Med.* 2018;52(4):261-268.