# Epidemiology of Lumbar Spine Injuries in Men's and Women's National Collegiate Athletic Association Basketball Athletes

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**Background:** Lumbar spine injuries (LSIs) are common in both men's and women's National Collegiate Athletic Association (NCAA) basketball players and can frequently lead to reinjuries and persistent pain.

**Purpose:** To describe the epidemiology of an LSI in collegiate men's and women's basketball during the 2009-2010 through 2013-2014 academic years.

**Study Design:** Descriptive epidemiology study.

**Methods:** The incidence and characteristics of LSIs were identified utilizing the NCAA Injury Surveillance Program (ISP). Rates of injury were calculated as the number of injuries divided by the total number of athlete-exposures (AEs). AEs were defined as any student participation in 1 NCAA-sanctioned practice or competition. Incidence rate ratios (IRRs) were then calculated to compare the rates of injury between season, event type, mechanism, injury recurrence, and time lost from sport .

**Results:** The NCAA ISP reported 124 LSIs from an average of 28 and 29 men's and women's teams, respectively. These were used via validated weighting methodology to estimate a total of 5197 LSIs nationally. The rate of LSIs in women was 2.16 per 10,000 AEs, while men suffered LSIs at a rate of 3.47 per 10,000 AEs. Men were 1.61 times more likely to suffer an LSI compared with women. In men, an LSI was 3.48 times more likely to occur in competition when compared with practice, while in women, an LSI was 1.36 times more likely to occur in competition than in practice. Women suffered the highest LSI rate during the postseason, while the highest rate in men was during the regular season. The majority of both female (58.9%; n = 1004) and male (73.1%; n = 2353) athletes returned to play within 24 hours of injury.

**Conclusion:** To date, this is the largest study to characterize LSIs in NCAA basketball and provides needed information on the prevalence and timing of these injuries. The majority of injuries in both sexes were new, and most athletes returned to play in less than 24 hours. Injury rates were highest during competition in both sexes.

**Keywords:** NCAA; collegiate basketball; varsity athlete; lumbar spine; low back; injury; athletes; disk herniation; back strain; radiculopathy; epidemiology; return to play

Since 1981, men's and women's basketball have been the most highly sponsored sports in colleges across the nation.[11] During the 2016-2017 season, across all 3 collegiate divisions, there were 1103 women's and 1089 men's college basketball teams with a total of 16,532 and 18,712 athletes, respectively.[11] From 2009 to 2015, injuries occurred at rates of 6.54 per 1000 athlete-exposures (AEs) and 7.97 per 1000 AEs in men's and women's basketball, respectively.[24] While lower extremity injuries account for more than half of all injuries, lumbar spine injuries (LSIs) are also common, accounting for 11.4% and 13.5% of all injuries in competitions and practices, respectively, across all collegiate athletes.[3,24]

Although not as common as lower extremity injuries, LSIs are responsible for almost as much time missed from competition.[6] These injuries, if left untreated, can persist and lead to significant morbidity or missed participation in the future. Despite how common LSIs are in collegiate athletes, there is a paucity in the literature on these injuries in collegiate basketball athletes, and no study has analyzed sex-based differences in this population.[2,8,25] The purpose of this study was to analyze the National Collegiate Athletic Association (NCAA) Injury Surveillance Program (ISP) database from the 2009-2010 to 2013-2014 academic years

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to describe and compare the epidemiology of LSIs in women's and men's college basketball.

## 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 injuries in collegiate athletes.[4,5,7,9,15,21,22] It has been used previously to report on all LSIs in the NCAA over the same time period but has not been used to look at LSIs specifically in male and female basketball athletes.[17] The NCAA ISP is a prospectively gathered injury surveillance program managed by the Datalys Center for Sports Injury Research and Prevention, an independent nonprofit research organization. This study was found to be institutional review board exempt and approved by the research review board of the NCAA.

The use of the NCAA ISP has been previously described in the literature and consequently will only be briefly reviewed here.[13,21] 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 dataset each year.[7,13] 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.[4]

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 throughout the preseason, regular 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. The collected injury data 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 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 "low back" or LSI. This study relied upon 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 LSIs. The most recently updated diagnoses were used. Degenerative injuries were defined as a combination of lumbosacral degenerative disease and lumbar facet syndrome.

### Computing National Estimates

We have previously used the following calculation to determine the national estimates of sporting injuries.[17,20,21] Poststratification sample weights were calculated with the following formula:

$$sample\ weight_{abc} = \left(\frac{number\ of\ teams\ participating\ in\ ISP_{abc}}{number\ of\ teams\ in\ NCAA_{abc}}\right)^{-1},$$

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.[17] The weighting varied based on sport, exposure type, division played, and calendar year. There was no uniform weight, and each case was weighted based on these contextual factors.

### Statistical Analysis

Data were analyzed to assess the rates and patterns of LSIs sustained in collegiate athletes.[17] LSIs 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, and an AE was defined as any student-athlete participation 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, regular season, and postseason).

Incidence rate ratios (IRRs) were calculated to compare the rates between event types and times of the season, as they are useful for determining whether one participation type has an increased rate of injuries compared with another. The following is an example of an IRR comparing injury rates between competition and practice[17]:

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

Injury proportion ratios (IPRs) were calculated to examine the differences in injury rates between men's and women's basketball players. The following is an example of an IPR comparing the proportion of lower back injuries that were caused by disk herniation in men and women[17]:

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Ethical approval for this study was waived by the Mayo Clinic Institutional Review Board (No. 17-008147).

TABLE 1
Types of Reported Lumbar Spine Injuries

| | |
|---|---|
| Coccydynia | Nonspecific low back pain |
| Lower back spasm | Lumbar facet syndrome |
| Lumbosacral degenerative disk disease | Lumbosacral disk injury |
| | Sacroiliac dysfunction |
| Paralumbar muscle strain | Lumbosacral spine contusion |
| Sciatica | |
| Other lumbar injury | |

$$IPR = \left( \frac{\frac{\sum disk\ herniation\ in\ men}{\sum total\ LSIs\ in\ men}}{\frac{\sum disk\ herniation\ in\ women}{\sum total\ LSIs\ in\ women}} \right).$$

All 95% 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 software (IBM) and Excel (Microsoft).

## RESULTS

In the setting of collegiate basketball, 45 LSIs in women and 79 LSIs in men were identified in the NCAA ISP database during the 2009-2010 to 2013-2014 academic years (Table 1). These numbers represent a national estimate of 5197 LSIs over this time period: 1806 in women and 3391 in men (Table 2). The overall LSI rate for all athletes was 2.87 per 10,000 AEs. The LSI rate was 2.16 per 10,000 AEs in women and 3.47 per 10,000 AEs in men. Men were 1.61 times (95% CI, 1.11-2.32) more likely to suffer an LSI compared with women. Unspecified low back pain accounted for 65.3% and 59.0% of women's and men's LSIs, respectively. When comparing individual injury rates between men and women, women were only more likely to sustain disk herniation (IPR, 0.41 [95% CI, 0.04-3.97]).

### Event Type and Time of Season

The LSI rate per 10,000 AEs for competition was 5.36 in both sexes combined and was nearly 3 times higher in men than in women (Figure 1). Women and men were both more likely to be injured during competition than during practice. Women were 1.36 times (95% CI, 0.62-3.01) more likely to sustain an LSI during competition when compared with practice, while men were 3.48 times (95% CI, 2.24-5.41) more likely. When compared with each other, men were 2.96 times (95% CI, 1.75-5.01) more likely to sustain an LSI during competition than women. Women experienced the highest injury rate during the postseason (5.42/10,000 AEs), while men sustained the highest rate of injuries during the regular season (3.59/10,000 AEs) (Table 3). Women were 3.25 times (95% CI, 1.25-8.43) as likely to be injured during the postseason compared with the regular season, while men experienced the reverse (IRR, 0.41 [95% CI, 0.60-2.95]). When comparing the sexes, women were 3.70 times more likely to be injured in the postseason compared with men (95% CI, 0.43-31.71), but men were more likely to be injured in the preseason (IPR, 0.88 [95% CI, 0.43-1.81]) and regular season (IPR, 0.47 [95% CI, 0.29-0.73]).

### Injury by Division and Athlete Position

Women's NCAA Division III basketball players suffered the highest rates of LSIs (Figure 2). Men's Division I and III players suffered similar rates of LSIs. Men, across all 3 divisions, were more likely to sustain injuries when compared with women. Both female and male guards suffered the highest amount of injuries (Figure 3). Female centers and guards were 2.38 and 1.22 times more likely than their male counterparts to be injured, respectively (centers: 95% CI, 0.86-6.57; guards: 95% CI, 0.72-2.08). Female forwards were 0.48 times as likely to be injured as male forwards (95% CI, 0.23-1.01).

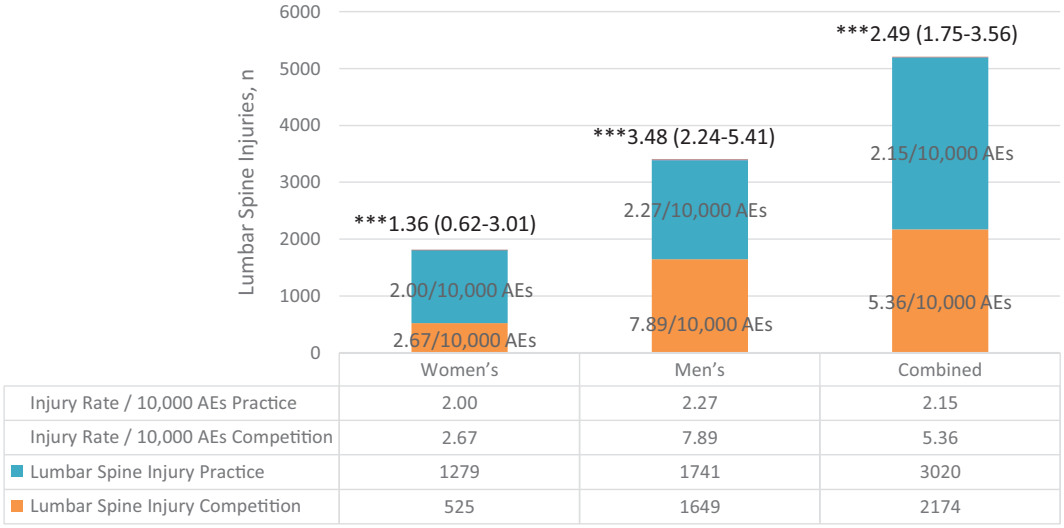
### Mechanism of Injury

Contact injuries were the most common injuries in both women (39.8%) and men (39.8%) (Figure 4). Men and

TABLE 2
Injury Types, Totals, and Rates[a]

| | Total No. (%)[b] | | | Injury Rate/10,000 AEs | | | |
|---|---|---|---|---|---|---|---|
| Injury Type | Women's | Men's | Combined | Women's | Men's | Combined | IPR Men/Women (95% CI) |
| Pain | 1180 (65.3) | 1999 (59.0) | 3179 (61.1) | 1.41 | 2.05 | 1.75 | 1.45 (0.91-2.32) |
| Degenerative | 131 (7.2) | 166 (4.9) | 297 (5.7) | 0.16 | 0.17 | 0.16 | 1.08 (0.24-4.84) |
| Disk herniation | 101 (5.6) | 49 (1.4) | 150 (2.9) | 0.12 | 0.05 | 0.08 | 0.41 (0.04-3.97) |
| Contusion | 255 (14.1) | 700 (20.6) | 955 (18.4) | 0.30 | 0.72 | 0.53 | 2.35 (0.98-5.67) |
| Sacroiliitis | 97 (5.4) | 307 (9.1) | 404 (7.8) | 0.12 | 0.31 | 0.22 | 2.72 (0.70-10.51) |
| Radiculopathy | 0 (0.0) | 52 (1.5) | 52 (1.0) | — | 0.05 | 0.03 | — |
| Other | 42 (2.4) | 118 (3.5) | 160 (3.1) | 0.05 | 0.12 | 0.09 | 2.38 (0.25-22.89) |
| Total | 1806 | 3391 | 5197 | 2.16 | 3.47 | 2.87 | 1.61 (1.11-2.32) |

[a]AE, athlete-exposure; IPR, injury proportion ratio.
[b]National estimates for sports may not sum to total because of rounding.



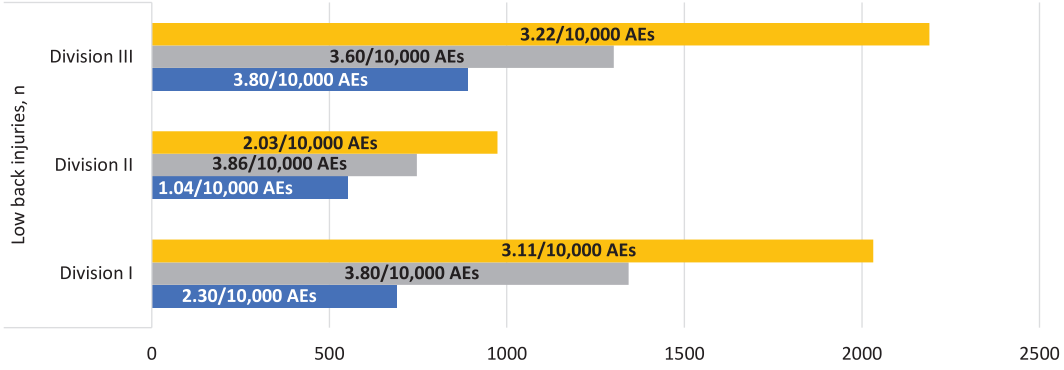

| | Women's | Men's | Combined |
|---|---|---|---|
| Injury Rate / 10,000 AEs Practice | 2.00 | 2.27 | 2.15 |
| Injury Rate / 10,000 AEs Competition | 2.67 | 7.89 | 5.36 |
| Lumbar Spine Injury Practice | 1279 | 1741 | 3020 |
| Lumbar Spine Injury Competition | 525 | 1649 | 2174 |

**Figure 1.** Injury occurrence in relation to practices and competitions. AE, athlete-exposure. ***Competition/practice incidence rate ratio (95% CI).

TABLE 3
Injuries in Relation to Time of Season[a]

| | Women's | | Men's | | Combined | | |
|---|---|---|---|---|---|---|---|
| | No. of LSIs | Injury Rate/ 10,000 AEs | No. of LSIs | Injury Rate/ 10,000 AEs | No. of LSIs | Injury Rate/ 10,000 AEs | IPR Women/Men (95% CI) |
| Preseason | 553 | 3.12 | 735 | 3.54 | 1288 | 3.34 | 0.88 (0.43-1.81) |
| Regular season | 1031 | 1.67 | 2584 | 3.59 | 3615 | 2.70 | 0.47 (0.29-0.73) |
| Postseason | 220 | 5.42 | 71 | 1.46 | 291 | 3.27 | 3.70 (0.43-31.71) |
| | Women's IRR (95% CI) | | Men's IRR (95% CI) | | Combined IRR (95% CI) | | |
| Postseason/preseason | 1.74 (0.62-4.88) | | 0.41 (0.06-3.11) | | 0.98 (0.41-2.35) | | |
| Postseason/regular season | 3.25 (1.25-8.43) | | 0.41 (0.60-2.95) | | 1.21 (0.53-2.76) | | |
| Preseason/regular season | 1.87 (0.96-3.62) | | 0.99 (0.58-1.69) | | 1.24 (0.82-1.87) | | |

[a]AE, athlete-exposure; IPR, injury proportion ratio; IRR, incidence rate ratio; LSI, lumbar spine injury.




| | Low back injuries, n | | |
|---|---|---|---|
| | Division I | Division II | Division III |
| Combined | 2032 | 973 | 2190 |
| Men's | 1343 | 747 | 1301 |
| Women's | 689 | 226 | 889 |

**Figure 2.** Injuries by division. AE, athlete-exposure.

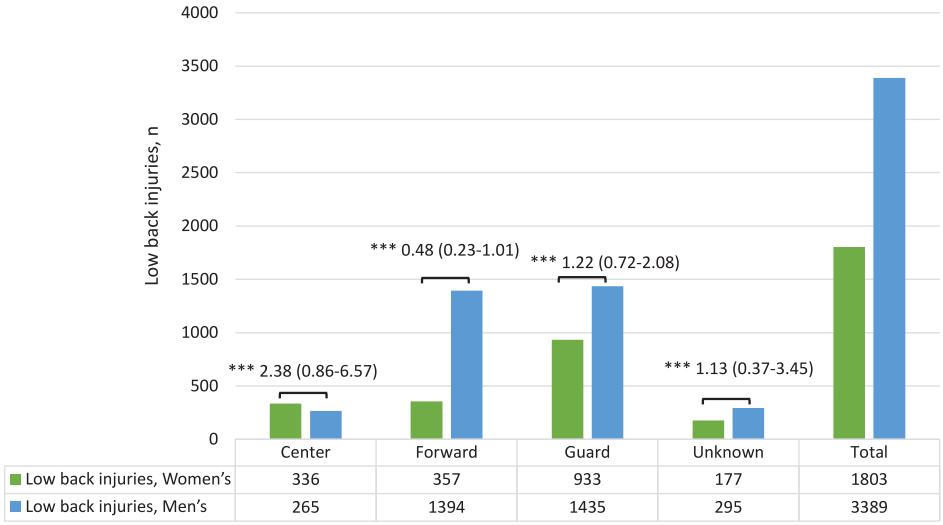



**Figure 3.** Injuries by position. ***Women's/Men's injury proportion ratio (95% CI).

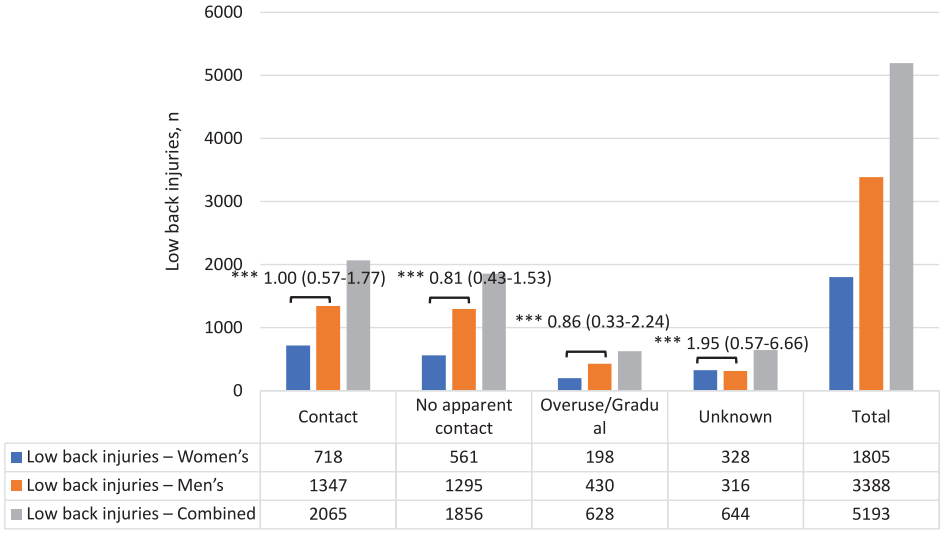



**Figure 4.** Comparison of mechanism of injury between men and women. ***Women's/Men's injury proportion ratio (95% CI).

TABLE 4
Injury Recurrence[a]

| | Lumbar Spine Injuries, n (%) | | | |
|---|---|---|---|---|
| | Women's | Men's | Combined | IPR Women/Men (95% CI) |
| New injury | 1465 (81.2) | 2877 (84.9) | 4342 (83.6) | 0.96 (0.64-1.43) |
| Recurrent injury | 310 (17.2) | 512 (15.1) | 822 (15.8) | 1.14 (0.45-2.85) |
| Unknown | 29 (1.6) | 0 (0.0) | 29 (0.6) | — |
| Total | 1804 | 3389 | 5193 | — |

[a]IPR, injury proportion ratio.

TABLE 5
Time Loss[a]

| | Lumbar Spine Injuries, n (%) | | | IPR Women/Men (95% CI) |
|---|---|---|---|---|
| | Women's | Men's | Combined | |
| <24 h | 1004 (58.9) | 2353 (73.1) | 3357 (68.1) | 0.81 (0.50-1.29) |
| 1-6 d | 422 (24.7) | 679 (21.1) | 1101 (22.4) | 1.17 (0.51-2.72) |
| 7-21 d | 280 (16.4) | 141 (4.4) | 421 (8.5) | 3.75 (31.10-12.80) |
| >21 d | 0 (0.0) | 47 (1.5) | 47 (1.0) | — |
| Total | 1706 | 3220 | 4926 | — |

[a]IPR, injury proportion ratio.

women were equally likely to sustain a contact LSI, but men were 1.23 and 1.16 times as likely to sustain either a noncontact injury or an overuse injury, respectively (noncontact: IPR, 1.23 [95% CI, 0.65-2.31]; overuse: IPR, 1.16 [95% CI, 0.45-3.00]).

### Injury Recurrence

Overall, 82.5% (n = 1465) of LSIs in women and 84.9% (n = 2877) of LSIs in men were new injuries (Table 4). Although the majority of injuries were new, 17.5% (n = 310) of LSIs in women and 15.1% (n = 512) of LSIs in men were recurrent. Women were more likely to suffer from recurrent injuries (IPR, 1.14 [95% CI, 0.45-2.85]), while men were more likely to suffer from new injuries (IPR, 0.96 [95% CI, 0.64-1.43]).

### Time Lost From Injury

The majority of both female (58.9%; n = 1004) and male (73.1%; n = 2353) athletes returned to play within 24 hours of injury (Table 5). After suffering from unspecified low back pain, 55.3% of female athletes and 67.3% of male athletes returned to play within 24 hours. All female athletes returned to play within 3 weeks, regardless of the injury; however, 18.2% (n = 47) of male athletes with sacroiliitis took longer than 21 days to return to play (Table 6). Women were 0.81 times as likely to return to play within 24 hours when compared with men across all injuries (95% CI, 0.50-1.29).

## DISCUSSION

The current literature fails to characterize the epidemiology of LSIs in the collegiate athlete.[1,3,6,8,10,12,18,19,24] This study adds unique knowledge, as well as an in-depth analysis not available previously, and it can help guide athletes, coaching staff, training staff, and physicians in understanding how these injuries affect basketball players in particular. Characterizing lower back injuries in NCAA women's and men's basketball players will help to guide the prevention, treatment, and management of these injuries. This in-depth review revealed a number of important discoveries: (1) an LSI is common in the collegiate basketball athlete; (2) both women and men were more likely to sustain an LSI during competitions than in practices; (3) the majority of LSIs were new injuries that occurred via contact in both women and men; (4) the majority of players with LSIs returned to play within 24 hours of injury; (5) women and men experienced relatively high recurrence rates at 17.5% and 15.1%, respectively; and (6) men were more likely to sustain an LSI than women.

Spinal column injuries have been known to be a problem in professional basketball, but little is known on how these injuries affect collegiate athletes.[6] Previous studies have shown LSIs to be the most common in NCAA ice hockey.[25] Understanding the frequency, rates, types, chronicity, mechanism of injury, and time loss in both men's and women's college basketball and comparing the results according to sex can help address these injuries with the goal of making basketball safer for these athletes. Epidemiological studies of National Basketball Association (NBA) injuries from 1988 to 2015 showed that LSIs occurred at a rate of 34 per 10,000 AEs (n = 1279; 10.2% of all injuries reported).[6] Fortunately, we found rates of injury to be lower in the collegiate athlete: 2.16 and 3.47 per 10,000 AEs in female and male players, respectively.

The highest rates of injury for both female and male NCAA basketball players were during competitions.

TABLE 6
Time Loss by Injury Type[a]

| | Women's, n (%) | | | | | Men's, n (%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Injury Type | <24 h | 1-6 d | 7-21 d | >21 d | Total | <24 h | 1-6 d | 7-21 d | >21 d | Total |
| Pain | 652 (55.3) | 321 (27.2) | 207 (17.5) | 0 (0.0) | 1180 | 1290 (67.3) | 552 (28.8) | 75 (3.9) | 0 (0.0) | 1917 |
| Degenerative | 88 (67.7) | 0 (0.0) | 42 (32.3) | 0 (0.0) | 130 | 87 (69.0) | 39 (31.0) | 0 (0.0) | 0 (0.0) | 126 |
| Disk herniation | 0 (0.0) | 41 (56.9) | 31 (43.1) | 0 (0.0) | 72 | 49 (100.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 49 |
| Contusion | 191 (86.8) | 29 (13.2) | 0 (0.0) | 0 (0.0) | 220 | 631 (90.1) | 36 (5.1) | 33 (4.7) | 0 (0.0) | 700 |
| Sacroiliitis | 31 (50.0) | 31 (50.0) | 0 (0.0) | 0 (0.0) | 62 | 178 (69.0) | 0 (0.0) | 33 (12.8) | 47 (18.2) | 258 |
| Radiculopathy | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 | 0 (0.0) | 52 (100.0) | 0 (0.0) | 0 (0.0) | 52 |
| Other | 42 (100.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 42 | 118 (100.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 118 |
| Total | 1004 (58.9) | 422 (24.7) | 280 (16.4) | 0 (0.0) | 1706 | 2353 (73.1) | 679 (21.1) | 141 (4.4) | 47 (1.5) | 3220 |

[a]Percentage of athletes who had returned to play with the listed injury.

Moreover, both sexes were more likely to suffer an LSI during competition compared with practice. This supports previous findings and is likely caused by the increased athletic effort found during competitions.[3] As previously proposed by Dick and colleagues,[3] this high level of intensity can lead to increased exertion and fatigue during a more unpredictable environment, resulting in a higher potential for injuries.

Interestingly, it was found that women had the highest rate of injuries during the postseason, but men suffered the highest rate of injuries during the regular season. Potential fatigue and overuse injuries could have contributed to high injury rates in the postseason for women. This is consistent with previous findings in female collegiate athletes in which women suffered overuse injuries at 24.6 per 10,000 AEs, compared with 13.2 per 10,000 AEs in men.[23] It is still not clear why female athletes suffer overuse injuries at higher rates than male athletes. Conversely, a high regular season injury rate in men may have been consequent to poor conditioning, core strength, and flexibility imbalances.[9] Women were over 3 times as likely to be injured in the postseason when compared with the regular season, whereas men were less likely to be injured in the postseason compared with the regular season.

LSIs were common for both women and men across all 3 divisions. It is notable, however, that over 80% of LSIs in both female and male athletes were new injuries, with the majority of players returning to play in less than 24 hours. All women returned to play within 21 days; however, when men were diagnosed with sacroiliitis, almost 20% of players missed more than 21 days of play.

### Limitations

The NCAA ISP is a validated and frequently used injury reporting system, but as with all retrospective databases, it has its limitations.[14,21,24] First, data entry relies upon the AT entering the data accurately, and errors in data entry can occur. Moreover, there is a potential for overreporting or underreporting of LSIs, as the system may miss or fail to report a specific injury. Previous studies suggest an injury capture rate of roughly 88%.[16] Program participation in the database is voluntary, and therefore, selection bias may exist. As with any national database, regional biases may exist, as could differences in varying levels of competition. Moreover, the sample size was small, as was the number of reported injuries. All of these things could limit the generalizability of these study findings across all NCAA programs. Additionally, the data lack more specific temporal details, such as when during games/practices injuries specifically occurred. Finally, the database does not provide any meaningful information on any preinjury or postinjury rehabilitative efforts that may have been employed. Despite these limitations, we believe that the data presented in this study represent the most current understanding of LSIs in NCAA women's and men's basketball players.

### Future Directions

Characterizing the injury incidence in collegiate athletes is important. Currently, more research needs to be conducted. Ideally, more programs will participate in this national injury database or a similar one in the future. It is our hope that this research, along with results from other studies, teams, and ATs, can begin to implement injury prevention strategies. Future studies should then evaluate how these prevention strategies affect injury rates.

## CONCLUSION

To date, this is the largest study to characterize LSIs in NCAA basketball and provides needed information on the prevalence and timing of these injuries. The majority of injuries in both sexes were new, and most returned to play in less than 24 hours. Injury rates were highest during competition in both men and women.

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