

10-Year Epidemiology of Ankle Injuries in Men's and Women's Collegiate Basketball

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Investigation performed at the Mayo Clinic, Phoenix, Arizona, USA

Background: Ankle injury is the most common injury in men's and women's basketball, regardless of the level of competition.

Purpose: To use the National Collegiate Athletic Association (NCAA) Injury Surveillance Program/System (ISP/ISS) to review the 10-year epidemiology of ankle injuries in men's and women's collegiate basketball players.

Study Design: Descriptive epidemiology study.

Methods: The NCAA ISP was queried for men's and women's collegiate basketball ankle injury data from the 2004 through 2014 academic years. Ankle injury rates were calculated based on injuries per athlete-exposure (AE). Injury proportion ratios (IPRs) were determined by comparing variables between sexes. Activity and position of injury were also studied.

Results: Over the 10-year study period, most ankle injuries in collegiate basketball occurred in the preseason (female, 1.45/1000 AEs; male, 2.00/1000 AEs), were contact related (female, 50.4%; male, 57.6%), were treated conservatively (female, 98.5%; male, 99.3%), and were new injuries (female, 78.0%; male, 78.9%), resulting in a time loss of less than 7 days (female, 62.7%; male, 65.2%). The most common injury types were lateral ligament complex tears (female, 83.5%; male, 80.0%), deltoid ligament tears (female, 5.6%; male, 7.2%), and high ankle sprains (female, 7.1%; male, 7.0%). Guards experienced the highest rate of ankle injuries in competition (female, 50.1%; male, 43.3%), and rebounding was found to be the most common activity during an injury (female, 30.3%; male, 34.4%). The rate of ankle injuries was significantly lower in women than in men (IPR, 0.81 [95% CI, 0.75-0.88]).

Conclusion: This study found that most ankle injuries in collegiate basketball occurred during the preseason, were contact related, were treated conservatively, and were new injuries that resulted in a time loss of less than 7 days.

Keywords: ankle; NCAA; basketball; sex comparison; prevention

An ankle ligament sprain is the most common injury in high school and collegiate athletics, accounting for 22.6% of all injuries.^{17,37} Further, it is the most common injury in

men's and women's basketball at any level of competition.[§] The high prevalence of ankle injuries in basketball can largely be attributed to the nature of the sport, which involves rapid changes in direction, player contact, repetitive jumping, and landing activities. Studies indicate that basketball players change motion every 2.0 to 2.82 seconds and jump up to 35 to 46 times per game.^{26,32} These activities have been linked with ankle injuries.^{7,8,33,37,39}

The majority of the previously published literature on ankle injuries focuses on circumstances surrounding the event, but there is little information regarding risk factors associated with them. Further, there is little published literature comparing the epidemiology of ankle injuries between male and female athletes.^{||} Comparing injuries based on sex is important, as male and female basketball players have different intrinsic risk factors and exposures.⁴⁷ The purpose of this study was to review the 10-year epidemiology of ankle injuries in both men's and

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women's collegiate basketball and compare the discovered rates and variables between the 2 sexes to inform players, athletic trainers (ATs), and coaches on a preventative strategy.

METHODS

Sampling

The National Collegiate Athletic Association (NCAA) Injury Surveillance Program/System (ISP/ISS) was queried for the 10-year period between the 2004-2005 and 2014-2015 academic years. The combined 10-year data set was composed of two 5-year sets (2004-2009 and 2009-2014) from the NCAA ISP. The 2 data sets differed slightly in the number of participating teams and classification of injuries because of the renaming of some injury variables between the 2 sets of years. For example, in the 2004-2009 data set, partial or complete lateral ligament complex (LLC) tears were separated variables, whereas they were combined in 2009-2014.

ISP data are dependent on a convenience sampling of institutions, with ATs voluntarily reporting injury and exposure data to an online database. A study by Kucera et al²² found that 88.3% of all time-loss injuries were recorded in the NCAA ISP for athletes, ensuring data capture by ATs and physicians. Because these data are obtained from volunteering institutions, participation from year to year has varied. An average of 81 men's and 84 women's teams participated in the NCAA ISP in 2004-2009, and an average of 28 men's and 29 women's teams participated in 2009-2014.²⁰ This database is a small sampling of the large number of NCAA basketball teams (>1000).

Data were only collected from organized practices and competitions from the preseason through postseason. For each injury, ATs and/or physicians examined and completed a detailed report on the injury itself as well as the circumstances surrounding it. They further recorded the number of student-athletes participating in each practice or competition to maintain exposure counts. Once submitted, data were deidentified in accordance with the Health Insurance Portability and Accountability Act (HIPAA) and passed through a review by data control staff to ensure quality in all variables. Data sets were then weighted after stratification to generate national estimates and account for potential underreporting of injuries.

Definitions

A "reportable injury" was defined as one that (1) occurred in an organized intercollegiate practice or competition, (2) required attention from an AT or physician, and (3) resulted in restriction of the student-athlete from basketball activities.²⁰

An "athlete-exposure" (AE) was defined as 1 student-athlete participating in 1 NCAA-sanctioned practice or competition, regardless of the length of participation. Competition exposures only included athletes with playing time

in the competition. AEs were recorded by a participating AT or physician.

"Time loss" was defined as time between the date of original injury and return to a level of play that would allow competition participation. A "nonsurgical injury" was defined as an injury in which surgery was not required or anticipated within 6 months of the injury. A "new injury" was defined as a new injury relative to the current or previous academic year. It did not consider injuries before this time period. "Recurrence" was defined as injuries that recurred from the same or previous academic years.

Combination of Data Sets

To provide a better estimate of trends, ankle injuries were evaluated over a 10-year period. To achieve this, the two 5-year NCAA ISP data sets were combined. Because of the subtle differences in the recording methods between the data sets, some variables were recorded for injuries in one of the data sets but not the other. Any variable that was not recorded in both data sets was omitted from the combined set and analyzed on its own.

Statistical Analysis

Percentages and rates of ankle sprains were then calculated using specific injury counts and AEs. The injury rate was calculated as a percentage using the number of specific injuries relative to the total injuries in the category studied. Injuries per AE were determined by dividing the number of a specific injury to the total number of AEs.

Injury proportion ratios (IPRs) were used to compare variable differences between sexes; 95% CIs were used for statistical significance. Activity and position of injury were also studied. A generic IPR equation for comparing a variable in women versus men is shown as follows²⁷:

$$IPR = \frac{\left(\frac{\sum X \text{ Sprain in Women}}{\sum \text{ Total Ankle Injuries in Women}} \right)}{\left(\frac{\sum X \text{ Sprain in Men}}{\sum \text{ Total Ankle injuries in Men}} \right)}$$

RESULTS

Men's Basketball

Injuries per Exposure. During the 10-year period, a total of 1298 recorded ankle injuries occurred in men during 868,625 AEs. This resulted in an injury rate of 1.49 injuries per 1000 AEs (Figure 1). The injury rate was increased in competition (2.51/1000 AEs) compared with practice (1.23/1000 AEs). The rate was also higher in the preseason (2.00/1000 AEs) compared with both the in-season (1.37/1000 AEs) and postseason (0.84/1000 AEs) (Figure 1).

Injury Characteristics. The most common ankle injuries in men were LLC tears (n = 1038; 79.97%), deltoid (medial) ligament (DL) tears (n = 94; 7.24%), anterior tibiofibular syndesmosis (high ankle) sprains (n = 91; 7.01%), and ankle contusions (n = 19; 1.46%) (Figure 2). Overall,

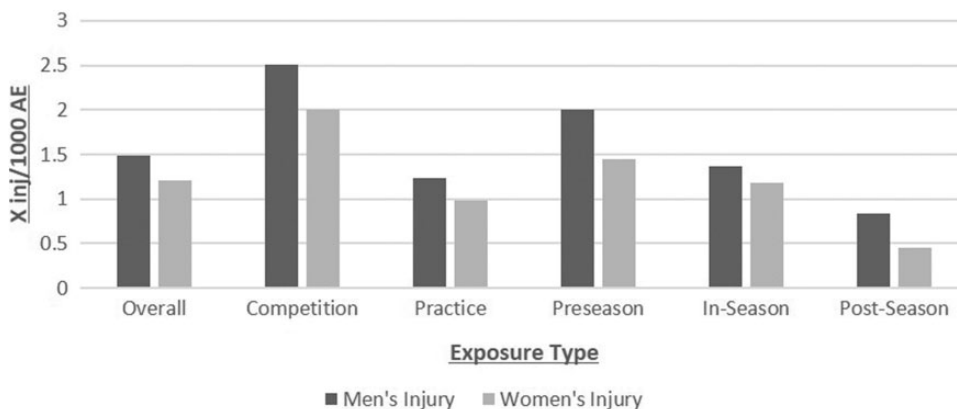


Figure 1. Comparison of ankle injuries per 1000 athlete-exposures (AEs) between sexes across various parts of the athletic season. All differences were statistically significant.

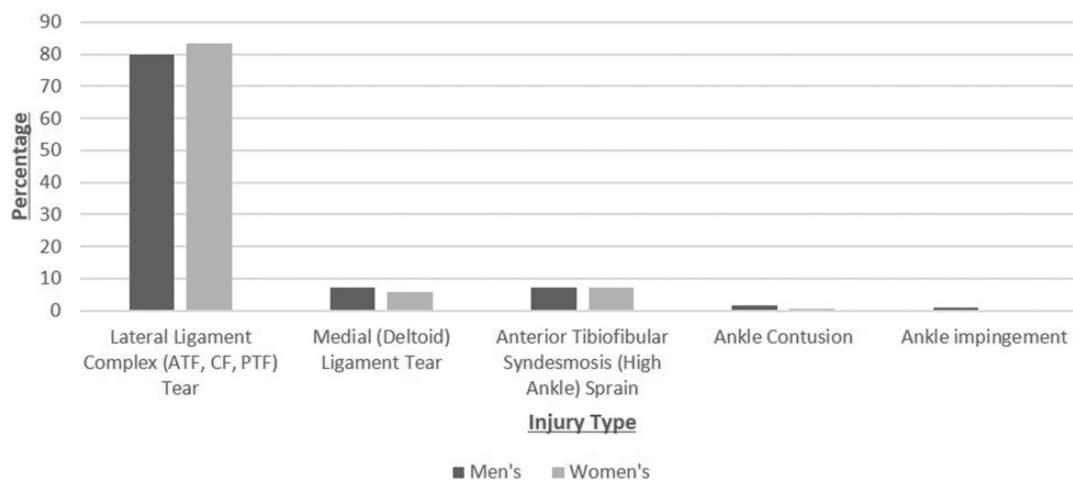


Figure 2. Comparison of ankle injury type between sexes. ATF, anterior talofibular ligament; CF, calcaneofibular ligament; PTF, posterior talofibular ligament.

78.89% (n = 1024) of ankle injuries were new, and 18.57% (n = 241) were recurrent (the characteristics for the remaining injuries were not reported). Almost all of these injuries were nonsurgical (n = 1289; 99.3%).

The most common activity at the time of injury was rebounding (n = 446; 34.36%), followed by general play (n = 306; 23.57%), defending (n = 170; 13.10%), and shooting (n = 151; 11.63%) (Figure 3). The most common mechanism of injury was contact with another player (n = 747; 57.55%), followed by an acute noncontact injury (sudden injury that does not involve contact with another player, playing surface, or apparatus; n = 390; 30.05%) and contact with a playing surface (n = 128; 9.86%). A total of 67.41% (n = 875) of injuries were contact related.

Guards experienced the highest rate of ankle injuries in competition (n = 194; 43.30%), followed by forwards (n = 155; 34.60%) and centers (n = 80; 17.86%) (Figure 4). Guards had a significantly higher injury rate than forwards (IPR, 1.25 [95% CI, 1.06-1.47]) and centers (IPR, 2.42 [95% CI, 1.94-3.04]). Forwards had a significantly higher injury

rate than centers (IPR, 1.94 [95% CI, 1.53-2.45]). Further, men had ankle injuries in the second half of the game 54.69% (n = 245) of the time and in the first half 37.50% (n = 168) of the time.

Overall, 43.8% (n = 569) of all men's ankle injuries resulted in a time loss of ≤3 days. This was followed by 21.3% (n = 277) between 4 and 6 days, 15.9% (n = 207) between 7 and 13 days, 10.7% between 14 and 29 days, and 3.3% (n = 43) ≥30 days (Figure 5). In total, 65.2% (n = 278) of ankle injuries resulted in a time loss of less than 7 days, and 29.7% (n = 386) of injuries lasted longer than 7 days.

Specific Injuries (LLC Tear, DL Tear, High Ankle Sprain). LLC tears in men were new injuries 78.8% (n = 818) of the time and recurrent injuries 18.7% (n = 194) of the time. They were more often caused by contact with a person (n = 55; 58.5%) versus noncontact (n = 30; 31.9%). Overall, 64.9% (n = 719) of LLC tears were contact related (contact with another player or with the playing surface). Further, 45.7% (n = 474) of LLC injuries resulted in a time loss of ≤3 days, followed by 21.6% (n = 224)

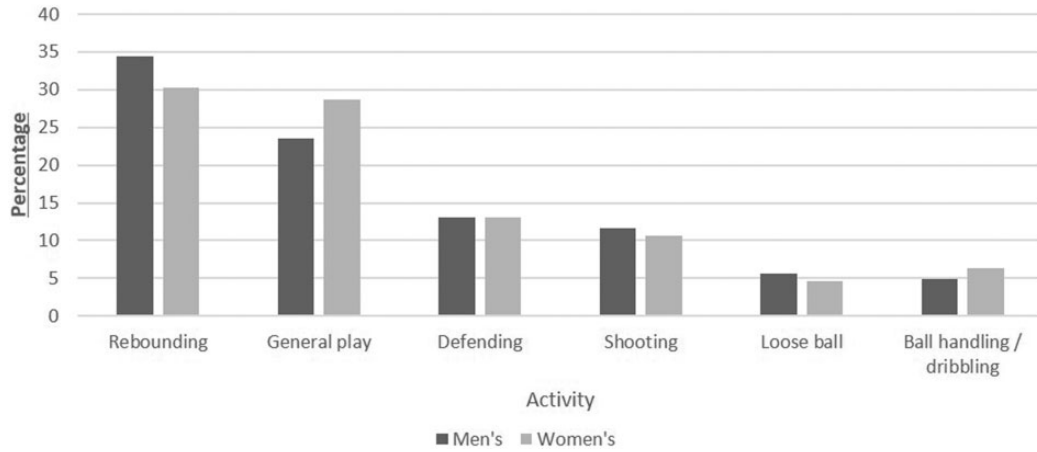


Figure 3. Comparison of activity during ankle injury between sexes.

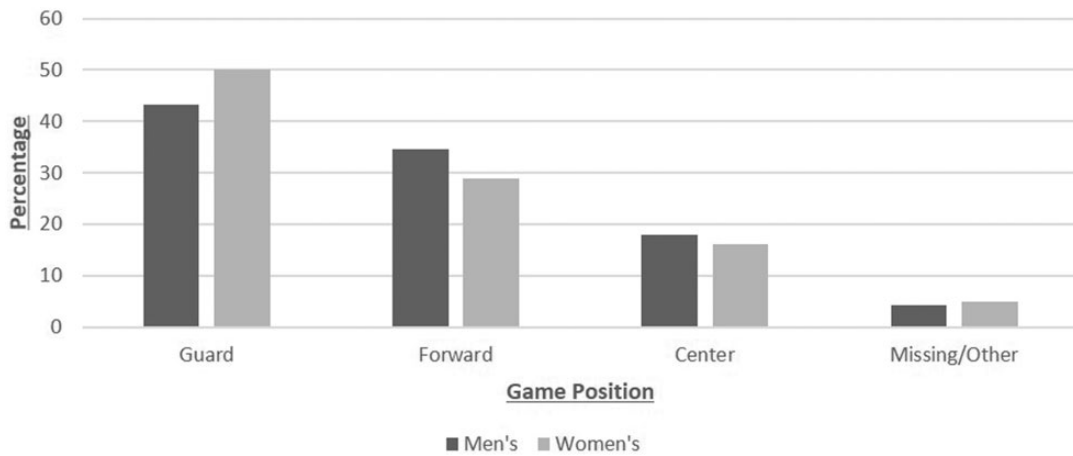


Figure 4. Comparison of game position during ankle injury between sexes.

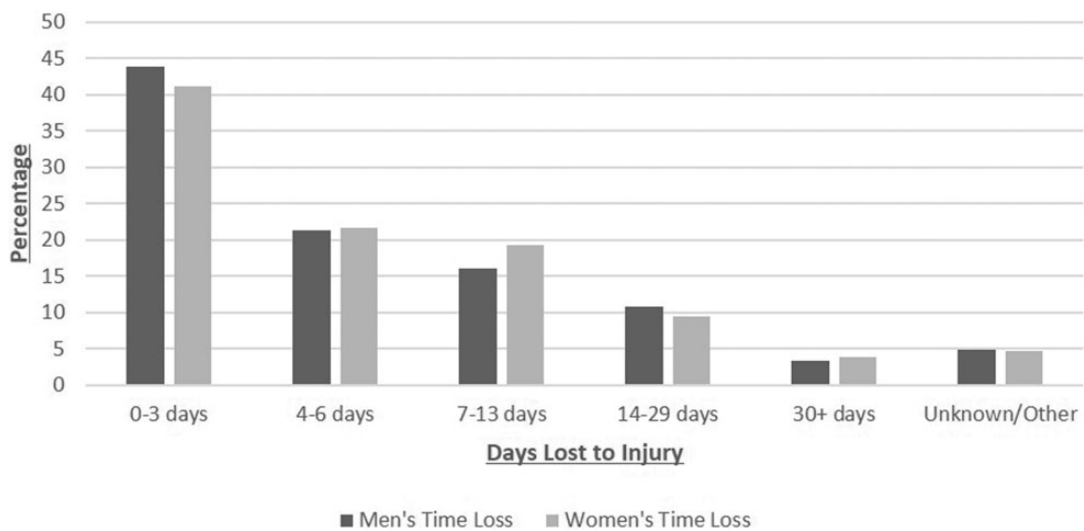


Figure 5. Comparison of time loss after ankle injury between sexes.

between 4 and 6 days and 16.3% (n = 169) between 7 and 13 days. Overall, 67.2% (n = 698) of injuries resulted in a time loss of less than 7 days, and 29.0% (n = 301) lasted longer than 7 days.

DL tears in men were new injuries 76.6% (n = 72) of the time and recurrent injuries 20.2% (n = 194) of the time. They were more often caused by contact with a person (n = 607; 58.5%) versus noncontact (n = 305; 29.4%). Overall, 69.3% (n = 61) of DL tears were contact related. Further, 46.8% (n = 44) of DL tears resulted in a time loss of ≤ 3 days, followed by 27.7% (n = 26) between 4 and 6 days and 10.6% (n = 169) between 7 and 13 days. Overall, 74.5% (n = 70) of injuries resulted in a time loss of less than 7 days, and 18.1% (n = 17) lasted longer than 7 days.

High ankle sprains in men were new injuries 85.7% (n = 78) of the time and recurrent injuries 11.0% (n = 10) of the time. They were more often caused by contact with a person (n = 55; 60.4%) versus noncontact (n = 29; 31.9%). Overall, 65.9% (n = 60) of high ankle sprains were contact related. Further, 31.9% (n = 29) of high ankle sprains resulted in a time loss of ≤ 3 days, followed by 17.6% (n = 16) between 4 and 6 days, 20.1% (n = 19) between 7 and 13 days, and 22.0% (n = 20) between 14 and 29 days (Figure 5). Overall, 49.5% (n = 45) of injuries resulted in a time loss of less than 7 days, and 47.3% (n = 43) lasted longer than 7 days.

Women's Basketball

Injuries per Exposure. During the 10-year period in 2004-2014, there were a total of 783,630 AEs, with a total of 950 injuries, in female athletes. This led to an overall injury rate of 1.21 injuries per 1000 AEs. The rate of injuries per exposure was increased in competition (2.00/1000 AEs) compared with practice (0.98/1000 AEs). Further, the rate was higher in the preseason (1.45/1000 AEs) compared with both the in-season (1.18/1000 AEs) and the postseason (0.45/1000 AEs) (Figure 1).

Injury Characteristics. The most common ankle injuries noted were LLC tears (n = 793; 83.47%), anterior tibiofibular syndesmosis (high ankle) sprains (n = 67; 7.05%), and DL tears (n = 53; 5.57%) (Figure 2); 78.00% (n = 741) of ankle injuries were new, and 19.89% (n = 189) were recurrent. Further, 98.53% (n = 936) of injuries were nonsurgical.

The most common activity during injury was rebounding (n = 288; 30.32%), followed by general play (n = 272; 28.63%), defending (n = 124; 13.05%), and shooting (n = 101; 10.63%) (Figure 3). The most common mechanism of injury was contact with another player (n = 479; 50.42%), an acute noncontact injury (n = 342; 36.00%), and contact with a playing surface (n = 103; 10.84%). A total of 61.26% (n = 582) of injuries were contact related.

Guards experienced the highest rate of ankle injuries in competition (n = 177; 50.1%), followed by forwards (n = 102; 28.9%) and centers (n = 57; 16.1%) (Figure 4). Guards had a significantly higher injury rate than forwards (IPR, 1.73 [95% CI, 1.43-2.11]) and centers (IPR, 3.11 [95% CI, 2.40-4.03]). Forwards had a significantly higher injury rate than centers (IPR, 1.79 [95% CI, 1.34-2.39]). Further,

women had ankle injuries in the second half of the game 51.27% (n = 181) of the time and in the first half 38.81% (n = 137) of the time.

Overall, 41.2% (n = 391) of all women's ankle injuries resulted in a time loss of ≤ 3 days, followed by 21.6% (n = 205) between 4 and 6 days, 19.3% (n = 183) between 7 and 13 days, 9.4% (n = 89) between 14 and 29 days, and 3.9% (n = 37) ≥ 30 days (Figure 5). In total, 62.7% (n = 596) of ankle injuries resulted in a time loss of less than 7 days, and 32.5% (n = 309) of injuries lasted longer than 7 days.

Specific Injuries (LLC Tear, DL Tear, High Ankle Sprain). LLC tears in women were new injuries 77.3% (n = 613) of the time and recurrent injuries 20.4% (n = 162) of the time. They were most often caused by contact with a person (n = 393; 49.6%) versus noncontact (n = 292; 36.8%). Overall, 61.7% (n = 489) of LLC tears were contact related. Further, 42.7% (n = 339) of LLC injuries resulted in a time loss of ≤ 3 days, followed by 22.4% (n = 178) between 4 and 6 days and 19.4% (n = 154) between 7 and 13 days. Overall, 65.2% (n = 517) of injuries resulted in a time loss of less than 7 days, and 30.8% (n = 244) lasted longer than 7 days.

DL tears in women were new injuries 79.2% (n = 42) of the time and recurrent injuries 18.9% (n = 10) of the time. They were most often caused by contact with a person (n = 35; 66.0%) versus noncontact (n = 15; 28.3%). Overall, 71.7% (n = 38) of DL tears were contact related. Further, 52.8% (n = 28) of DL tears resulted in a time loss of ≤ 3 days, followed by 17.0% (n = 9) between 4 and 6 days and 15.1% (n = 8) between 7 and 13 days. Overall, 69.8% (n = 37) of injuries resulted in a time loss of less than 7 days, and 24.5% (n = 13) lasted longer than 7 days.

High ankle sprains in women were new injuries 83.6% (n = 56) of the time and recurrent injuries 14.9% (n = 10) of the time. They were most often caused by contact with a person (n = 31; 46.3%) versus noncontact (n = 27; 40.3%). Overall, 59.7% (n = 40) of high ankle sprains were contact related. Further, 17.9% (n = 12) of high ankle sprains resulted in a time loss of ≤ 3 days, followed by 19.4% (n = 13) between 4 and 6 days, 25.4% (n = 17) between 7 and 13 days, 16.4% (n = 11) between 14 and 29 days, and 14.9% (n = 10) ≥ 30 days. Overall, 37.3% (n = 25) of injuries resulted in a time loss of less than 7 days, and 56.7% (n = 38) lasted longer than 7 days.

Sex-Based Comparison

The overall distribution of variables was similar between women and men. Significant differences were found, with women more likely to be injured during the season (IPR, 1.08 [95% CI, 1.02-1.14]) and less likely to be injured during the preseason (IPR, 0.87 [95% CI, 0.77-0.99]) compared with men. Further, women were found to be injured more often through acute noncontact mechanisms (IPR, 1.20 [95% CI, 1.06-1.35]) and less often because of contact (IPR, 0.88 [95% CI, 0.81-0.95]). Finally, women were more likely than men to have a recurrent injury (IPR, 1.77 [95% CI, 1.22-2.57]).

Women were found to have a significantly lower rate of ankle injuries overall (IPR, 0.81 [95% CI, 0.75-0.88]).

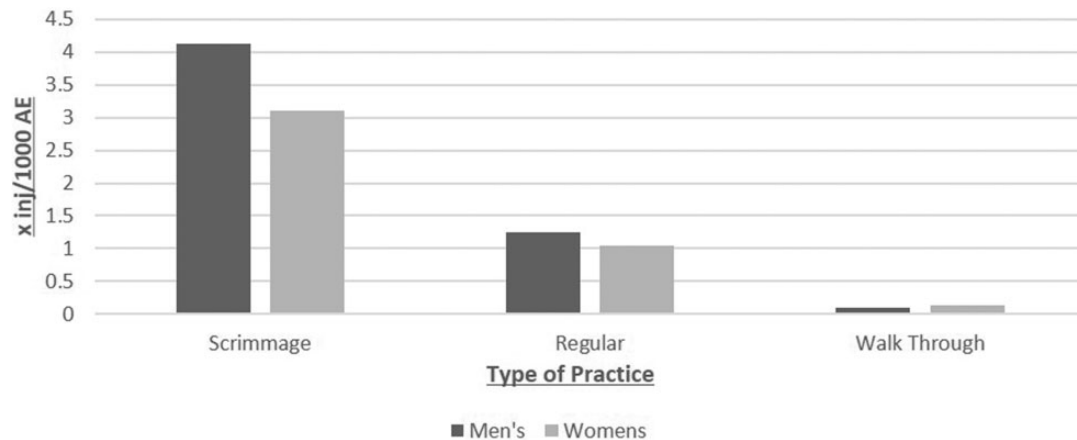


Figure 6. Comparison of practice type during ankle injury between sexes, 2004-2009. AE, athlete-exposure.

Further, they had a decreased ankle injury rate in competition (IPR, 0.80 [95% CI, 0.69-0.92]), practice (IPR, 0.80 [95% CI, 0.69-0.92]), preseason (IPR, 0.72 [95% CI, 0.62-0.84]), in-season (IPR, 0.87 [95% CI, 0.78-0.96]), and postseason (IPR, 0.53 [95% CI, 0.30-0.96]) compared with men. The largest differences were seen in competition and preseason exposures.

Although these variables were not included in the overall 10-year study, in the 2004-2009 data set, we found that the type of practice affected the rate of injuries for both men and women (Figure 6). Data from this period indicated that the highest rates of injuries were in scrimmages (female, 3.10/1000 AEs; male, 4.13/1000 AEs), followed by regular practices (female, 1.06/1000 AEs; male, 1.24/1000 AEs) and walk-throughs (female, 0.14/1000 AEs; male, 0.09/1000 AEs). These findings indicated that scrimmages in practice have the highest risk of ankle injuries, including the risk during competition (female, 2.00/1000 AEs; male, 2.51/1000 AEs).

DISCUSSION

This study explored and compared the rates of ankle injuries between men's and women's NCAA basketball players to identify risk factors. These results provide insight into the profile of collegiate basketball ankle injuries and can be used to develop preventative strategies.

We found that most ankle injuries in collegiate basketball resulted in a time loss of less than 7 days (62.7%-65.2%), were nonsurgical (98.5%-99.3%), and were new injuries (78.0%-78.9%). Similar time loss has been noted in the previous literature on high school and professional players (51.3%-51.7% <7 days).^{7,16,37} Further, although other studies have found high rates of first-time ankle injuries in athletes, it should also be noted that up to 83% of players with a positive history of ankle sprains had multiple injuries.^{7,24,37,43} The time between injuries could have affected data collection in this study, and it is likely that more ankle injuries are recurrent than have been reported. Cumps et al⁸

found that 50% of ankle reinjuries occurred more than a year after the initial injury.

By far the most common injuries reported among the male and female basketball players in this study were LLC tears (female, 83.5%; male, 80.0%), followed by DL tears (female, 5.6%; male, 7.2%) and high ankle sprains (female, 7.1%; male, 7.0%). LLC tears have been reported in the literature as not only the most common injury in collegiate athletics, with up to 7.3% of all reported injuries, but also the predominant injury in both men's and women's collegiate basketball.⁴¹ This result has also been seen in studies looking at play in the National Basketball Association (NBA) and Women's National Basketball Association.^{10,44}

The most common mechanism of ankle and all injuries in basketball, regardless of the level of competition, has been contact with another player.^{7,11,21,34,35} This study supported this result in finding that 50.4% of ankle injuries in women and 57.6% in men were caused by contact with another player. Further, this study found that 30.3% of injuries in women and 34.4% of injuries in men occurred during rebounding. Contact with another player in this scenario is likely related to the mechanism of landing on an opponent after securing a rebound.^{7,33,37,39}

The rates of ankle injuries were highest in the preseason (female, 1.45/1000 AEs; male, 2.00/1000 AEs). This is supported in other studies and is likely because of a variety of reasons, including the high-intensity nature of preseason workouts combined with potentially poorly conditioned athletes coming off a break from training.^{17,48} Further, during the season, there is an increased risk of ankle injuries in competition compared with practice across all levels of basketball competition.^{21,35,37,50} The results in this study validated these previous findings (rate of injuries: female, 0.98/1000 practice AEs; male, 1.23/1000 practice AEs vs female, 2.00/1000 competition AEs; male, 2.51/1000 competition AEs).

The results also indicated that the type of practice affected the rate of injuries for both men and women. The 5-year data in 2004-2009 indicated that the highest rates of

injuries were in scrimmages (female, 3.10/1000 AEs; male, 4.13/1000 AEs), followed by regular practices (female, 1.06/1000 AEs; male, 1.24/1000 AEs). Although these data are not supported by the 10-year data, they should still be considered, as Hootman et al,¹⁷ using the NCAA ISS from the 16-year period before this study (1988-2004 academic years), found no significant change in game or practice injury rates.

In competition, guards (female, 50.1%; male, 43.3%) were the most likely to sustain an ankle injury. The literature is mixed regarding which position is most likely to be injured, and factors such as height and weight have not been found to be independent risk factors.^{6,7,21,33,35,42} However, studies have indicated that guards have the highest physiological stress during competition when comparing game intensity by position.¹ This fact, combined with evidence that repetitive changes in motion can lead to neuromuscular fatigue,³⁶ could explain the increased rate of injuries for this position.

The rates of ankle injuries during competition (female, 2.00/1000 AEs; male, 2.51/1000 AEs) were less than the rate found in NBA athletes (3.4/1000 AEs⁴⁴). It should be noted that NBA seasons are longer and more rigorous than their collegiate counterparts. A study by Hosea et al¹⁸ indicated that male and female basketball players doubled their risk of an ankle sprain as the level of competition increased from high school to college. This assumption is supported by studies showing that high school basketball injuries occur at a rate of 1.94 per 1000 exposures,⁷ collegiate injuries occur at rates between 6.0 and 9.9 per 1000 exposures,^{11,35} and professional injuries occur at rates up to 21.4 per 1000 exposures.^{7,11,35,44}

Sex-Based Comparison

In this study, the rate of ankle injuries was found to be lower in women than men (IPR, 0.81 [95% CI, 0.75-0.88]). The literature is mixed regarding injury rates by sex, with a study by Zuckerman et al⁵⁰ finding that men's basketball had a higher rate of injuries overall than women's basketball (IPR, 1.22 [95% CI, 1.15-1.30]) but other studies indicating that female basketball players suffered higher rates of injuries.^{7,10,18} Despite these findings, it has been consistently noted that severe sports-related injuries are more common in women than in men.^{2,11,39,50}

Women were also found to be injured more often than men through acute noncontact mechanisms (IPR, 1.20 [95% CI, 1.06-1.35]) and less often through contact (IPR, 0.88 [95% CI, 0.81-0.95]). We hypothesize that this could be because of differences in the style of play between men's and women's basketball, along with other inherent sex-based differences including laxity of ligaments, hormonal differences, height, weight, and strength.⁴⁷

Overall, the distribution and rates of ankle injuries were relatively similar between men's and women's basketball players. This has been echoed in other studies comparing the sexes in professional and recreational sports.^{10,34} Further research comparing the incidence of ankle sprains across sex is needed.

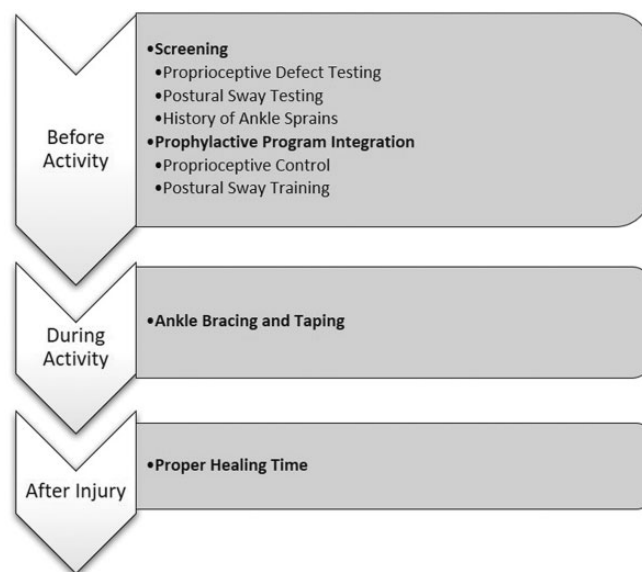


Figure 7. Visual model for ankle prevention strategy.

Prevention

Many studies have found that there are effective interventions that can reduce both the incidence of ankle injuries and chronic symptoms that may impair performance.⁴ Most studies emphasize screening, use of lace-up ankle braces, and/or appropriate treatment with proper healing time (Figure 7). It should be noted that the ISP does not capture information on the preventative measures being undertaken in athletes who sustain an ankle sprain.

Screening. Screening techniques are critical to identifying at-risk athletes. Factors described in the literature that identify athletes at risk for ankle injuries include proprioceptive defects, weak postural sway scores, and a history of ankle sprains. Proprioceptive control can be defined as the stabilizing reflex in vertical stability, especially related to the single-leg stance, and it plays a critical role in joint stability.⁴⁰ Deficits have been shown to be predictors for an ankle injury.^{38,40} Similarly, players screened with decreased single-leg balance (postural sway) had a significantly increased risk (nearly 7 times as many ankle injuries in some studies) as those with good balance.^{25,30,46} Both proprioception and postural sway can be used as screening tools to recommend pre-emptive training to at-risk players.

A systematic review and meta-analysis by Taylor et al⁴⁵ found that prophylactic injury prevention programs have significantly reduced the incidence of lower extremity injuries. A training program that improves neuromuscular performance in proprioceptive control and postural sway integrated into athletic training activities (even once a week) is effective in reducing not only ankle sprains but also knee sprains and lower back pain.^{13,40} Finally, a history of ankle sprains has consistently been found to be the most common factor for recurrence, with up to 5 times the

⁴References 5, 8, 10, 13-15, 21, 25, 29, 31, 33, 38, 42.

increased risk.^{5,21,33} The literature suggests that basketball has the highest prevalence of ankle injuries, with some studies indicating that up to 92% of elite players have sustained some form of an ankle injury.^{7,24,37,43} As such, screening for a history of recent ankle injuries is the strongest identifying risk factor for players.

Ankle Bracing and Taping. Ankle bracing and taping have long been used as a form of external support in preventing ankle injuries. Multiple studies have shown the use of ankle stabilizers (lace-up or semirigid) to reduce the incidence, but not the severity, of acute ankle injuries in basketball players, regardless of their history of injuries.^{14,15,21,29,33,42} Further, ankle bracing has not been associated with any increase in the incidence or severity of knee injuries or injuries to the leg overall. It should be noted that the use of “high-top” basketball shoes has shown no correlation in reducing the rate of ankle sprains in basketball players and cannot serve as a replacement for bracing.^{4,9,15} Despite this convincing evidence, a study by McGuine et al³¹ found that less than half of high school basketball coaches required or encouraged players to use ankle supports, despite their belief that using these would decrease the risk of acute ankle injuries.

Proper Healing Time. As described in this study, 65.2% of men and 62.7% of women sustaining ankle injuries returned within 1 week of the injury. This hasty return to sport may increase the risk for recurrence or chronic injuries. A study by Hubbard and Hicks-Little¹⁹ indicated that proper ligamentous healing takes 6 weeks to 3 months, and despite rehabilitation, up to 30% of patients may have mechanical laxity up to a year after the injury. An early return to basketball after ankle injury may result in failure of adequate healing and serve as an explanation for the high frequency of residual symptoms.⁴¹ Smith and Reischl⁴³ found that up to 50% of athletes with ankle sprains had residual symptoms and that 15% felt that those symptoms compromised their playing performance. Early return to sport and interruption of rehabilitation programs after an ankle injury have been reported as problems in both basketball and other sports.^{3,21,34}

Limitations

There are limitations to this study. All injuries may not have been reported because this was a convenience sampling, certain schools may have entered more data than others, and the injury classification was based on the clinical judgment of ATs and physicians. In the data analysis, the slight difference in data collection from the 2004-2009 and 2009-2014 data sets, including the collection of non-time-loss injuries in the 2009-2014 data set and not the 2004-2009 data set, may have affected results. The rates of ankle injuries by position could be skewed by the composition of the team, with most teams employing 2 guards, 2 forwards, and 1 center during play.

CONCLUSION

The nature of play in basketball places players at an elevated risk for ankle injuries. During the 10-year study

period, most ankle injuries in collegiate basketball occurred in the preseason (female, 1.45/1000 AEs; male, 2.00/1000 AEs), involved contact with another player (female, 50.4%; male, 57.6%), were nonsurgical (female, 99.1%; male, 99.6%), and were new injuries (female, 78.0%; male, 78.9%), resulting in a time loss of less than 7 days (female, 62.7%; male, 65.2%). The most common injury types were LLC tears (female, 83.5%; male, 80.0%), DL tears (female, 5.6%; male, 7.2%), and high ankle sprains (female, 7.1%; male, 7.0%). Guards experienced the highest rate of ankle injuries in competition (female, 50.1%; male, 43.3%), and rebounding was found to be the most common activity during injuries (female, 30.3%; male, 34.4%). The rate of ankle injuries was significantly lower in women than in men (IPR, 0.81 [95% CI, 0.75-0.88]).

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