[Athletic Training]

Injury in the National Basketball Association: A 17-Year Overview

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Background: Injury patterns in elite athletes over long periods continue to evolve. The goal of this study was to review of the injuries and medical conditions afflicting athletes competing in the National Basketball Association (NBA) over a 17-year period.

Design: Descriptive epidemiological study.

Methods: Injuries and player demographic information were reported by each team's athletic trainer. Criteria for reportable injuries were those that resulted in (1) physician referral, (2) a practice or game being missed, or (3) emergency care. The demographics, frequency of injury, time lost, and game exposures were tabulated, and game-related injury rates and 95% confidence intervals were calculated.

Results: A total of 1094 players appeared in the database 3843 times (3.3 ± 2.6 seasons). Lateral ankle sprains were the most frequent orthopaedic injury (n, 1658; 13.2%), followed by patellofemoral inflammation (n, 1493; 11.9%), lumbar strains (n, 999; 7.9%), and hamstring strains (n, 413; 3.3%). The most games missed were related to patellofemoral inflammation (n, 10 370; 17.5%), lateral ankle sprains (n, 5223; 8.8%), knee sprains (n, 4369; 7.4%), and lumbar strains (n, 3933; 6.6%). No correlations were found between injury rate and player demographics, including age, height, weight, and NBA experience.

Conclusion: Professional athletes in the NBA experience a high rate of game-related injuries. Patellofemoral inflammation is the most significant problem in terms of days lost in competition, whereas ankle sprains are the most common injury. True ligamentous injuries of the knee were surprisingly rare. Importantly, player demographics were not correlated with injury rates. Further investigation is necessary regarding the consequences and sport-specific treatment of various injuries in NBA players.

Clinical Relevance: Knowledge of these injury patterns can help to guide treatments and provide more accurate guidelines for an athlete to return to play.

Keywords: National Basketball Association; basketball injuries; injury epidemiology

Over the history of the National Basketball Association (NBA), the nature of the game has undergone significant changes. Basketball was originally conceived as a noncontact sport, and the rules of the game were based on the idea that "if the offense did not have the opportunity to run with the ball, there would be no necessity for tackling and we would thus eliminate roughness."[7] Despite its origins as a noncontact sport, basketball has evolved into an increasingly physical game in which contact is accepted and expected. Contemporary coaches teach their players contact moves. Players routinely use their bodies to their advantage—to fight for position, to intentionally draw contact in the air while shooting the ball, for example—and they use their forearms and elbows to ward off defenders. This evolution has predictably led to a number of injuries to players in the NBA.

Few studies in the orthopaedic literature have reported on the epidemiology of various injuries in professional basketball.[2,4,5,9,10] Several recent studies have reported injury rates in high school and collegiate basketball.[3,6,8] When compared with their high school and collegiate counterparts, NBA athletes compete on a longer court, for a greater number of minutes per game and times per week, for a longer season, and at an older age. The aim of this study is to provide an overview of the injuries and illnesses reported by NBA athletic trainers and team physicians and to analyze the injury rates and games missed as a result of individual injuries.

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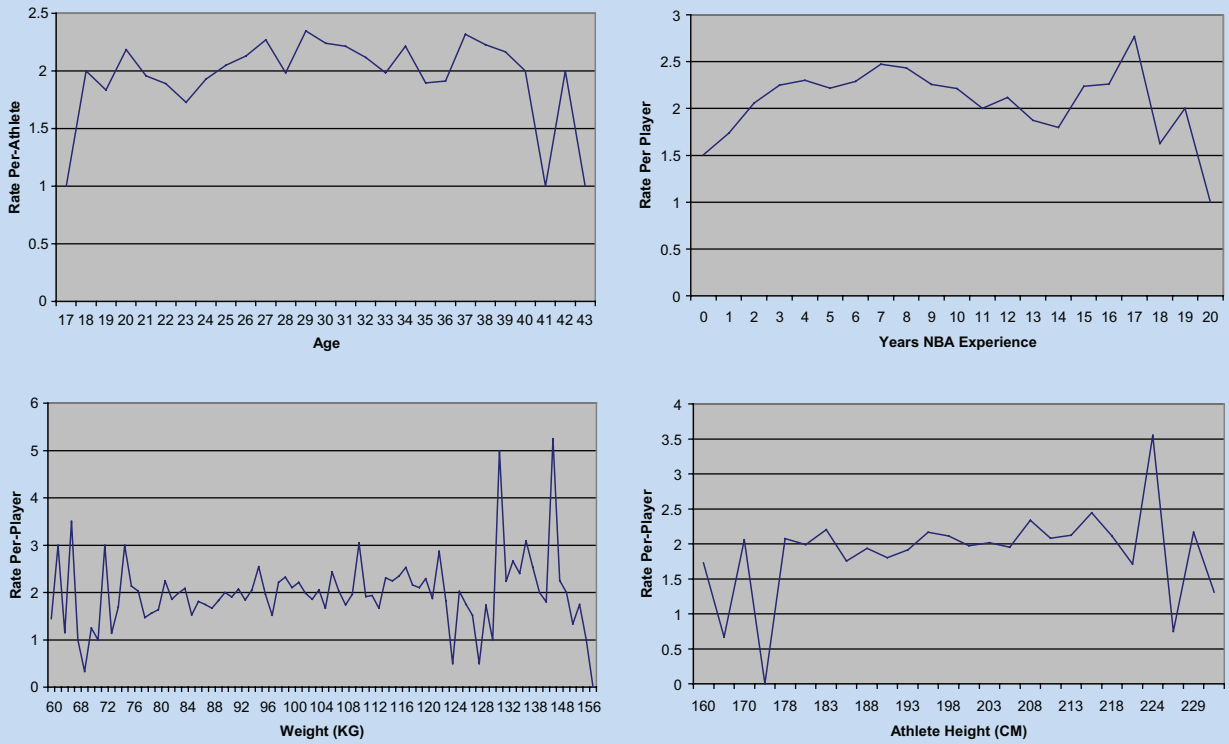

Figure 1. Injury rate by player demographics.

MATERIALS AND METHODS

NBA Database

Before the start of the NBA season, each team submits a detailed player profile for each member of the team with demographic and clinical information, including the permanent identification number, player position, height, weight, age, and years of NBA playing experience. Given the frequent turnover of an NBA team roster during the course of a season, this information is constantly being updated with player additions and subtractions. With the termination of the NBA season in June, statistical compilation is performed regarding exposures for games and playing minutes. The Player Profile database was linked to the injury database to provide athletic exposure and demographic information. Information from the 1988–1989 through the 1996–1997 seasons was acquired from the NBA's official statistical publication, *The NBA News* (New York, New York). From 1997 to the present, these data have been collected via the NBA's Web site: http://www.nba.com. This site is now the NBA's official source of statistical information.

The National Basketball Athletic Trainers Association maintains a database of all injuries and illnesses sustained by NBA players. The criteria for a reportable injury are based on three parameters: the injury required physician referral, prescription medication, or both; resulted in a game or practice being missed, or it necessitated emergent care. These records are leaguewide injury-reporting instruments that are completed by the team's athletic trainer and cosigned by the team physician. The data include pathology, time and place of onset, activity, and mechanism of the injury. Clinical follow-up data were also collected and analyzed regarding the number of practices and games missed, the support devices worn, injured reserve list status, hospitalization, surgery, and medication.

Data Analysis

An analysis was performed of the NBA database from the 1988–1989 through the 2004–2005 basketball seasons for league-sanctioned activities (approximately October 1 through June 15 of each year). The frequency, means, standard deviations, and incidence rates of injury were calculated using SPSS 13.0 (SPSS Inc, Chicago, Illinois).

For the purposes of this study, an athletic exposure was defined as 1 athlete appearing in 1 game. Game injury rates were calculated per 1000 athlete exposures. No distinction was made in the database between athletes who played all 48 minutes of a contest versus athletes who played 1 minute. During a single game, the maximum athlete exposures would be 24, when all 12 players from each team participate in the contest. This method describes the total number of athletes appearing in regular and postseason games. The incidence rate (per athletic exposure) for practices and preseason games was not calculated owing to unreliable reporting methods and lack of a standardized protocol.

Table 1. Injury rate by body area.

Body Area	All Injuries (n, 12 594)				Game-Related Injuries (n, 6287)				95% CI[a]
	Total		Games Missed		Total		Game Related		
	n	%	n	%	n	%	%	Rate	
Lower extremity	7853	62.4	42 802	72.3	3636	57.8	46.3	11.1	10.7-11.4
Upper extremity	1945	15.4	7212	12.2	1213	19.3	62.4	3.7	3.5-3.9
Torso	1600	12.7	7647	12.9	652	10.4	40.8	2.0	1.8-2.1
Head	951	7.6	868	1.5	658	10.5	69.2	2.0	1.8-2.2
Cervical spine	198	1.6	590	1.0	116	1.8	58.6	0.4	0.3-0.4
Systemic	38	0.3	32	0.1	7	0.1	18.4	0.0	0.0-0.0
Genitals	9	0.1	28	0.0	5	0.1	55.6	0.0	0.0-0.0
Total	12 594	100.0	59 179	100.0	6287	100.0	49.9	19.1	18.7-19.6

[a]CI, confidence interval.

However, the frequency data for injuries and illnesses sustained during these activities were still included and analyzed.

Incidence rates for a particular injury were defined as number of injuries per 1000 athlete exposures, as calculated with the following formula:

$$\frac{\text{total number of injuries} \times 1000}{\text{total number of game exposures}}$$

A multivariate analysis was performed for several factors, including height, weight, and years of NBA experience. A P value of .05 was used to determine statistical significance between game-related injury groupings. Confidence intervals (95%) identified differences in game-related injury rates. For the rarer injuries (ie, injures with fewer than 10 game-related occurrences), we did not calculate the confidence intervals owing to the decreasing reliability with decreasing cell frequency.

RESULTS

Patients

From the 1988–1989 through the 2004–2005 seasons, 88.2% of the 30 NBA teams contributed consistent reports on an annual basis to the NBA injury and illness database. In 1988–1990 there were 25 NBA teams. Two expansion teams were added for both the 1989–1990 and 1995–1996 NBA seasons; one final expansion team was incorporated at the start of the 2004–2005 season. Compliant teams averaged 42.8 ± 23.4 reports per year. A total of 1643 individual players appeared on at least 1 preseason, regular season, or postseason roster; 1366 (83.1%) appeared in at least 1 regular season or postseason game. The average player was in the database for 3.7 ± 3.2 seasons, accounting for a total of 6145 player entries in the database across the duration of this study.

Demographics

During the period of study, there were 12 594 reported injuries. Of these, 6287 (49.9%) occurred during games. The incidence of injury was 19.1 per 1000 athlete exposures. These injuries accounted for 59 179 games missed. The players averaged 26.8 years of age. There were no correlations between injury rate and height, weight, or years of NBA experience (Figure 1).

Injury Prevalence

The lower extremity was the most frequently injured body area, accounting for 62.4% of all injuries and 57.8% of all game-related injuries (Table 1). These injuries also were responsible for 72.3% of the games that were missed because of injury. The rate of injury per 1000 athlete exposures was statistically higher than any other body area, at 11.1. The next-most-common areas of injury involved the upper extremity and torso, which accounted for 12.2% and 12.9% of all injuries, respectively.

The ankle was by far the most common joint injured, comprising 1850 injuries and 14.7% of all injuries (Table 2). There were 1123 game-related ankle injuries (17.9%) with an incidence of 3.4 injuries per 1000 athlete exposures. Lumbar spine injuries (n, 1279; 10.2%) were responsible for almost as many games missed (n, 6729) as the ankle injuries (n, 6838). Injuries to the patella (n, 1266; 10.1%) and the knee (n, 1135; 9.0%) resulted in more games missed (n, 8076 and 10 737, respectively) than either of the 2 most commonly injured areas (ankle and lumbar spine).

When the pathology was analyzed, lateral ankle sprains were found most common (13.2%), accounting for 8.8% of all games missed (Table 3). They also accounted for 17.0% of the injuries sustained during games. The incidence of ankle sprain (3.2 per

Table 2. Injury rate by structure.

Structure	All Injuries (n, 12 594)				Game-Related Injuries (n, 6287)				95% CI[a]
	Total		Games Missed		Total		Game Related		
	n	%	n	%	n	%	%	Rate	
Ankle	1850	14.7	6838	11.6	1123	17.9	60.7	3.4	3.2-3.6
Lumbar spine	1279	10.2	6729	11.4	481	7.7	37.6	1.5	1.3-1.6
Patella	1266	10.1	8076	13.6	309	4.9	24.4	0.9	0.8-1.0
Knee	1135	9.0	10 737	18.1	501	8.0	44.1	1.5	1.4-1.7
Foot	962	7.6	5992	10.1	374	5.9	38.9	1.1	1.0-1.3
Tibia	954	7.6	5597	9.5	431	6.9	45.2	1.3	1.2-1.4
Femur	905	7.2	3044	5.1	482	7.7	53.3	1.5	1.3-1.6
Hip	781	6.2	2518	4.3	416	6.6	53.3	1.3	1.1-1.4
Hand	571	4.5	2702	4.6	383	6.1	67.1	1.2	1.0-1.3
Face	493	3.9	255	0.4	342	5.4	69.4	1.0	0.9-1.2
Shoulder	466	3.7	1932	3.3	265	4.2	56.9	0.8	0.7-0.9
Eye	351	2.8	359	0.6	237	3.8	67.5	0.7	0.6-0.8
Fingers	298	2.4	696	1.2	195	3.1	65.4	0.6	0.5-0.7
Thumb	276	2.2	1212	2.0	172	2.7	62.3	0.5	0.4-0.6
Elbow	255	2.0	433	0.7	152	2.4	59.6	0.5	0.4-0.5
Thorax	241	1.9	419	0.7	131	2.1	54.4	0.4	0.3-0.5
Cervical spine	198	1.6	590	1.0	116	1.8	58.6	0.4	0.3-0.4
Skull	107	0.8	254	0.4	79	1.3	73.8	0.2	0.2-0.3
Abdomen	80	0.6	499	0.8	40	0.6	50.0	0.1	0.1-0.2
Humerus	79	0.6	237	0.4	46	0.7	58.2	0.1	0.1-0.2
Systemic	38	0.3	32	0.1	7	0.1	18.4	0.0	0.0-0.0
Genitals	9	0.1	28	0.0	5	0.1	55.6	0.0	0.0-0.0

[a]CI, confidence interval.

1000 athlete exposures) was more than twice as common as any other injury. Patellofemoral syndrome represented 11.9% of all reports but only 3.9% of injuries sustained during games. Patellofemoral injuries were the most common reason for games missed (n, 10 370; 17.5% of all causes).

Finally, analysis of injury type revealed that sprains were the most common (27.8%), followed by inflammatory conditions (21.8%) and strains or spasm (21.8%) (Table 4).

DISCUSSION

Professional basketball today has become a highly physical, high-contact sport. All reportable injuries were collected directly from NBA trainers and team physicians over a 17-year period, and injuries rates were determined by demographics, body area, structure, pathology, and injury type.

Player demographics revealed no correlation between injury rate and age, height, weight, or years of NBA experience. This is an essential finding, given that agents and organizations constantly attempt to stratify and predict the injury risk for each player. If there were a correlation between injury rate and player demographics, players at higher risk could be cut from their team.

The finding that lateral ankle sprains were the most common injury (13.2%) is not surprising in light of the frequency of jumping and landing in a crowd of players. Much attention has focused on prevention of ankle inversion injuries in basketball players. Players generally wear mid- or high-top sneakers designed to protect the ankle, and many players tape their ankles or wear braces. The high frequency of ankle injuries suggests that more clinical and biomechanical research is necessary to improve protective shoe and ankle equipment.

Table 3. Injury rate by specific pathology.[a]

	All Injuries				Game-Related Injuries				
	Total		Games Missed		Total		Game Related		
Pathology	n	%	n	%	n	%	%	Rate	95% CI[b]
Lateral ankle sprain	1658	13.2	5223	8.8	1066	17.0	64.3	3.2	3.0-3.4
Patellofemoral inflammation	1493	11.9	10 370	17.5	245	3.9	16.4	0.7	0.7-0.8
Lumbar sprain/strain	999	7.9	3933	6.6	361	5.7	36.1	1.1	1.0-1.2
Hamstring strain	413	3.3	1826	3.1	189	3.0	45.8	0.6	0.5-0.7
Adductor strain	394	3.1	1416	2.4	185	2.9	47.0	0.6	0.5-0.6
Knee sprain	392	3.1	4369	7.4	268	4.3	68.4	0.8	0.7-0.9
Foot inflammation	362	2.9	2043	3.5	94	1.5	26.0	0.3	0.2-0.3
Quadriceps contusion	338	2.7	478	0.8	232	3.7	68.6	0.7	0.6-0.8
Knee/patella contusion	321	2.5	690	1.2	213	3.4	66.4	0.6	0.6-0.7
Finger sprain	308	2.4	336	0.6	205	3.3	66.6	0.6	0.5-0.7
Triceps surae strain	259	2.1	2078	3.5	138	2.2	53.3	0.4	0.3-0.5
Leg contusion	227	1.8	316	0.5	157	2.5	69.2	0.5	0.4-0.6
Hip contusion	218	1.7	249	0.4	159	2.5	72.9	0.5	0.4-0.6
Foot sprain	207	1.6	866	1.5	120	1.9	58.0	0.4	0.3-0.4
Achilles tendinopathy	204	1.6	1038	1.8	45	0.7	22.1	0.1	0.1-0.2
Thumb sprain	196	1.6	811	1.4	127	2.0	64.8	0.4	0.3-0.5
Wrist sprain	181	1.4	851	1.4	125	2.0	69.1	0.4	0.3-0.4
Periorbital laceration	172	1.4	52	0.1	114	1.8	66.3	0.3	0.3-0.4
Ankle inflammation	150	1.2	1026	1.7	37	0.6	24.7	0.1	0.1-0.1
Cervical sprain/strain	124	1.0	150	0.3	71	1.1	57.3	0.2	0.2-0.3
Lumbar disc degeneration	110	0.9	2151	3.6	23	0.4	20.9	0.1	0.0-0.1
Lumbosacral contusion	109	0.9	169	0.3	90	1.4	82.6	0.3	0.2-0.3
Foot contusion	107	0.8	255	0.4	54	0.9	50.5	0.2	0.1-0.2
Foot fracture	106	0.8	2169	3.7	37	0.6	34.9	0.1	0.1-0.1
Mouth laceration	103	0.8	2	0.0	69	1.1	67.0	0.2	0.2-0.3
Foot strain	102	0.8	302	0.5	51	0.8	50.0	0.2	0.1-0.2
Meniscal tear	102	0.8	2421	4.1	40	0.6	39.2	0.1	0.1-0.2
Quadriceps strain	101	0.8	312	0.5	44	0.7	43.6	0.1	0.1-0.2
Hand/wrist fracture	100	0.8	1470	2.5	76	1.2	76.0	0.2	0.2-0.3
Rotator cuff tendinopathy	89	0.7	303	0.5	23	0.4	25.8	0.1	0.0-0.1
Hip flexor strain	87	0.7	296	0.5	39	0.6	44.8	0.1	0.1-0.2
Elbow inflammation	84	0.7	203	0.3	31	0.5	36.9	0.1	0.1-0.1

(continued)

Table 3. (continued)

Pathology	All Injuries				Game-Related Injuries				95% CI[b]
	Total		Games Missed		Total		Game Related		
	n	%	n	%	n	%	%	Rate	
Glenohumeral sprain	82	0.7	853	1.4	55	0.9	67.1	0.2	0.1-0.2
Ac sprain	76	0.6	309	0.5	53	0.8	69.7	0.2	0.1-0.2
Shoulder contusion	75	0.6	62	0.1	56	0.9	74.7	0.2	0.1-0.2
Concussion	73	0.6	220	0.4	53	0.8	72.6	0.2	0.1-0.2
Nose fracture	73	0.6	92	0.2	55	0.9	75.3	0.2	0.1-0.2
Elbow contusion	72	0.6	64	0.1	50	0.8	69.4	0.2	0.1-0.2
Rotator cuff strain	70	0.6	271	0.5	40	0.6	57.1	0.1	0.1-0.2
Hand contusion	69	0.5	31	0.1	47	0.7	68.1	0.1	0.1-0.2
Elbow sprain	64	0.5	123	0.2	43	0.7	67.2	0.1	0.1-0.2
Face laceration	61	0.5	11	0.0	45	0.7	73.8	0.1	0.1-0.2
Periorbital contusion	60	0.5	19	0.0	48	0.8	80.0	0.1	0.1-0.2
Abdominal strain	59	0.5	342	0.6	29	0.5	49.2	0.1	0.1-0.1
Shoulder strain	57	0.5	67	0.1	31	0.5	54.4	0.1	0.1-0.1
Tooth fracture	54	0.4	14	0.0	32	0.5	59.3	0.1	0.1-0.1
Finger fracture	52	0.4	457	0.8	35	0.6	67.3	0.1	0.1-0.1
Patellar tendon strain	48	0.4	454	0.8	25	0.4	52.1	0.1	0.0-0.1
Peroneal strain	45	0.4	331	0.6	25	0.4	55.6	0.1	0.0-0.1
Thumb fracture	40	0.3	331	0.6	24	0.4	60.0	0.1	0.0-0.1
Tooth fracture	36	0.3	7	0.0	21	0.3	58.3	0.1	0.0-0.1
Ankle fracture	24	0.2	528	0.9	10	0.2	41.7	0.0	0.0-0.0
Total	11 006	87.4							

[a]Sprains include dislocations and subluxations.
[b]CI, confidence interval.

In 1982, Henry et al reported on 576 injuries that occurred in 71 professional basketball players over 7 years.[4] In the current study, 12 594 injuries in 1366 players occurred over 17 years. During this period, the game became increasingly physical and played by larger individuals. Henry et al noted that 94% of games missed were due to injuries of the knee, ankle, and foot, compared to 53% of games missed in this study. Both studies found that ankle injuries were the most common but that knee injuries accounted for the greatest number of games missed.

Starkey reported on NBA injuries over a 10-year period and similarly reported no correlation between injury rate and player demographics.[9] A 12.4% increase in game-related injuries was noted during the 10-year period, which may be due to an increase in contact in professional basketball. The increase in size and speed of the players, as well as the improvement in diagnostic tools, may also be a factor in the injury increase.

Meeuwisse et al reported on rates and risks of injury in Canadian intercollegiate competition.[6] Ankle injuries were the most common, but knee injuries resulted in more games missed. Studies of elite basketball in Sweden and high school basketball in Texas also found that the ankle was the most commonly injured area, followed by the knee.[1,8]

Several limitations may affect the accuracy of this study. The injuries in the database include only those reported by the

Table 4. Injury rate by type.

Classification	All Injuries (n, 12594)				Game-Related Injuries (n, 6287)				95% CI[a]
	Total		Games Missed		Total		Game Related		
	n	%	n	%	n	%	%	Rate	
Sprain	3503	27.8	15 047	25.4	2231	35.5	63.7	6.8	6.5-7.0
Inflammatory	2742	21.8	16 843	28.5	552	8.8	20.1	1.7	1.5-1.8
Strain/spasm	2740	21.8	11 467	19.4	1225	19.5	44.7	3.7	3.5-3.9
Contusion	1923	15.3	2734	4.6	1341	21.3	69.7	4.1	3.8-4.3
Skin wounds	535	4.2	242	0.4	360	5.7	67.3	1.1	1.0-1.2
Fractures	517	4.1	6816	11.5	295	4.7	57.1	0.9	0.8-1.0
Neurological	250	2.0	3324	5.6	105	1.7	42.0	0.3	0.3-0.4
Systemic	164	1.3	117	0.2	72	1.1	43.9	0.2	0.2-0.3
Eye injuries	102	0.8	155	0.3	64	1.0	62.7	0.2	0.1-0.2
Meniscal tear	102	0.8	2421	4.1	40	0.6	39.2	0.1	0.1-0.2
Heat injuries	23	0.2	13	0.0	6	0.1	26.1	0.0	0.0-0.0

[a]CI, confidence interval.

team trainers according to the criteria outlined above. Minor injuries that did not meet the criteria are not included. Injuries may at times be falsely reported to keep players on injured reserve, allowing teams to carry more players on their roster. Finally, the reporting method used does not differentiate between playing the entire game or only a few minutes.

In conclusion, NBA basketball has evolved to become a highly physical sport with a predictably high rate of injury.

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