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Rates and Risks of Injury during Intercollegiate Basketball

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Background: Previous studies of basketball injury have not been able to assess injury incidence and risk.
Purpose: To determine rates and risks of injury in Canadian intercollegiate basketball.
Study Design: Prospective cohort study.
Methods: Standardized data were collected with a validated instrument from 98.1% of the 318 athletes on the eight men's basketball teams in the Canada West Division of the Canadian Intercollegiate Athletic Union.
Results: A total of 142 athletes sustained 215 injuries (44.7% of players injured) over the 2-year study period. The greatest number of injuries resulting in more than seven sessions of time loss involved the knee, whereas the most common injuries causing fewer than seven sessions of time loss involved the ankle. The most common mechanism of injury was contact with another player, especially in the "key." Injuries occurred 3.7 times more often in games than during practice. Centers had the highest rate of injury, followed by guards, and then forwards. The relative risk of reinjury was significantly increased by previous injuries to the elbow, shoulder, knee, hand, lower spine or pelvis, and by concussions.
Conclusions: Risk factors for injury were previous injury, games as opposed to practice, player position, player contact, and court location.

Although it is not considered a collision sport, basketball is a fast and aggressive game that has been shown to have a high frequency of injury. Men's and women's college-level basketball appears to have the highest frequency of injuries among noncontact sports.[12,25] Basketball has been identified as the sport having the second greatest number of facial injuries, including eye and oral trauma, in the United States.[10] The Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) found that basketball was associated with the greatest number of injuries occurring in players ages 5 to 19 years.[6] Previous research has focused primarily on frequency of injury and not on the actual risks involved in basketball participation.

One limitation of past studies has been the way in which the population at risk has been captured. The CHIRPP study included only injured children seen at emergency departments, and, thus, risk could not be determined.[6] Other studies have identified the population at risk, but participation was determined only at the team level by using person-years[15] or athlete-exposures.[2,9,26,27] Capture of participation or exposure information at the group level fails to account for differences in the amount of individual player participation. The difficulties that arise from drawing conclusions from group results and applying them to the individual athlete have been elucidated previously.[17] In addition, group-based methods of exposure assessment do not provide a strategy for measuring time loss after injury.

The Canadian Intercollegiate Sports Injury Registry (CISIR) is a state-of-the-art reporting system that addresses these concerns by providing a detailed account of the temporal relationship between risk factors, injury events, and time lost to play.[19] It was our purpose to study in detail the distribution of injuries by body region and associated time lost from participation in Canadian men's university basketball. Furthermore, we analyzed the risk factors associated with player position, practice versus game situations, and previous injury to the same body region.

MATERIALS AND METHODS

The data collected through the CISIR system spanned 2 years of participation in the Canada West Division of Canadian Intercollegiate Athletic Union men's basketball,

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which is composed of eight teams. The CISIR prospectively tracks injury and participation (exposure); its development, implementation, and validation have been extensively described previously.[19] Before each season, all participating athletes gave written consent and provided baseline medical information.

Exposure Measurement

During the season, team and student therapists recorded individual participation, exposure, and any injury data on a daily basis on standardized forms.[18] The design of the CISIR system is such that it captures information on every athlete for every exposure, whether in practice or during a game. A weekly exposure sheet, in tabular form, was completed by an athletic therapist to document the participation status and other information, including session type (game or practice), duration (hours), surface (such as wood or cement), and type of shoe worn.[19] The extent to which an athlete participated in each session was recorded by using the following codes: full (F), participation greater than 75%; partial (P), participation less than 75%; and zero (O), no participation. In addition, explanatory codes identified the reason for time loss with a "P" or "O" code and were designated as injured (I), sick (S), or absent (A) for reasons other than injury or illness. Thus, a precise measure of individual exposure could be captured for each session by weighting each exposure as full (1), partial (0.5), or none (0). By using this method, potential risk factors could also be weighted, and a measure of the time lost from participation after each injury was provided. The completed weekly data sheets were sent to a central registry, checked for completeness, and entered into a relational database program.

Outcome Measurement

The definition of injury used in the CISIR system for data collection was "any injury resulting in one or more complete or partial sessions of time loss" or "any concussion or transient neurologic neck injury." Information related to the injury was entered into a single-page report. This individual injury report form was developed for use in Canada West through a critical review of the literature to obtain information relevant to injury in the sport.[17] The report provided a comprehensive overview of the injury circumstances along with a detailed diagnosis.

Injury severity categories were divided into those resulting in loss of participation for fewer than seven sessions or for seven or more sessions, as noted on the weekly exposure sheet. This approach provided a more precise and more conservative measure of time loss than measurement of days missed because participation level over a given time period (such as a week) varied. However, data regarding days lost to participation were also recorded. Injuries occurring at the end of a season or when disability continued after the season were given an estimate of time loss by the team therapist to avoid a potential underestimation of time loss associated with end-of-season injuries.

Analysis

Numeric data were entered into Microsoft Visual FoxPro Version 5.0 (Microsoft Corporation, Redmond, Washington) and descriptive information was entered into Microsoft Excel Version 5.0. The rate of injury was assessed as the number of injuries per 1000 athlete-exposures. The numerator of the injury rate changed depending on the unit of analysis. Specifically, injury event referred directly to the injury circumstances (such as an athlete injured in a game in a particular court zone), body region injured referred to the anatomic location (for example, athlete sustained a head and a knee injury), and specific injury referred to the physician diagnosis or therapist assessment (for example, a head laceration and a knee ligament sprain). Risk ratios and 95% confidence limits were constructed by using two-by-two tables in Stata Release 5.0 (Stata Corporation, College Station, Texas)

RESULTS

Descriptive Results

A total of 318 athletes were eligible for enrollment in the study, and all but 6 provided consent, which resulted in a 98.1% participation rate. During the 2 years of the study, there were 215 injuries, resulting in 1508 sessions of time loss. The proportion of athletes injured was 44.7%, or 142 athletes, and the average time loss per injury was 7.02 sessions. There were 43,514 exposures, of which 71.1% were practices and 28.9% were games, a 2.46:1 ratio.

Table 1 shows the body region injury rate per 1000 athlete-exposures separately for injuries resulting in fewer than seven or seven or more sessions of time loss. Concussions resulting in time loss were treated as separate from head injuries. Multiple injuries were separated into individual injuries for analysis. There were 27 injury reports with 2 physician diagnoses (or therapist assessments), 2 injury reports with 3 diagnoses, and 1 injury

TABLE 1
Injury Rate and Severity by Body Region[a]

Body region	Time loss of fewer than 7 sessions		Time loss of 7 or more sessions	
	Injuries	Rate	Injuries	Rate
Ankle	44	1.01	9	0.21
Knee	27	0.62	11	0.25
Thigh	19	0.44	1	0.02
Foot	11	0.25	6	0.14
Head	12	0.28	1	0.02
Hand	8	0.18	3	0.07
Leg	9	0.21	1	0.02
Lumbar spine/pelvis	9	0.21	1	0.02
Shoulder	7	0.16	3	0.07
Concussion	8	0.18		
Hips	7	0.16		
Other[b]	17		1	0.02
Total	178	4.09	37	0.85

[a] Injury rate per 1000 athlete-exposures based on denominator of 43,514 exposures.

[b] Other includes all other body areas with fewer than five injuries, including the multiple injury category.

report with 4 diagnoses. Eighteen of these were for the same body region and, of the remaining, two were not due to participation in sport and another two were not associated with loss of participation. One multiple injury diagnosis included a concussion with a head injury, for 0.5 exposures of time loss. Body regions were ranked in decreasing order based on the total number of injuries. Ankle injuries were the most common injury with fewer than seven sessions of time loss. However, for injuries resulting in seven or more sessions of time loss, the knee had the highest injury rate.

Table 2 shows the average time loss by body region of injury over the 2 years of data collection. Fourteen end-of-season injuries occurred during the 2 years, including 2 injuries that occurred on the last day of play and 12 that occurred before the end of the season and resulted in the athlete not returning to full participation because of the injury. The therapist's estimate of time loss was greater than what was indicated on the weekly exposure sheet for nine athletes, and the time loss was changed to reflect this greater time loss. In two cases, the therapist's estimate was less than the measured time loss, and in three instances, the time loss section was left blank, in which case the team physician provided the estimate of time loss. In two cases, a greater time loss was estimated than that recorded and thus used for analysis. In one case, the estimate was less, and thus the actual time loss was used. The knee bore the greatest burden in terms of time loss (46.0% of the total time loss due to injury) and also the greatest average time loss per injury, at least 10 more days of time loss than for any other body region.

Table 3 shows information regarding the most common injuries. The table refers to specific injury diagnoses or assessments and not to individual events. These seven injury diagnoses or assessments represented a total of 75 injuries or 34.9% of all injuries.

Table 4 shows the mechanism of injury as contact (with another player, the floor, the basketball, the rim, or nonspecific), noncontact, or other. The nonspecific contact category included one injury due to an athlete colliding with a scorer's table and four injuries in which the mechanism of contact was not specified. The "other" category included injuries for which the mechanism was either entered as blank or not available (N/A). More injuries were contact than noncontact (a 4:3 ratio). The primary mechanism of contact injury was with another player; player contact accounted for 79.8% of contact injuries and 34.9% of all injuries. There was effect modification of the rate ratio by time loss. Specifically, for those injuries resulting in fewer than seven sessions of time loss, the rate of a contact injury was 12.6 times that of a noncontact injury, whereas the ratio was only 1.5 to 1 for those injuries resulting in seven or more sessions of time loss.

TABLE 2
Total Injuries, Sessions Lost, and Average Time Loss for Specific Body Regions

Body region	Total number of injuries	Total sessions lost	Average time loss (days/injury)
Ankle	53	290.0	5.47
Knee	38	693.5	18.25
Thigh	20	84.5	4.23
Foot	17	133.0	7.82
Head	13	23.0	1.77
Hand	11	62.0	5.64
Shoulder	10	55.5	5.55
Lumbar spine/pelvis	10	50.5	5.05
Leg	10	54.5	5.45
Concussion	9	14.5	1.61
Hips	7	13.0	1.86
Multiple injuries	5	11.0	2.20
Wrist	4	6.5	1.63
Thoracic spine/ribs	4	7.0	1.75
Elbow	3	1.5	0.50
Arm	1	8.0	8.00
Total	215	1508.0	6.98

TABLE 3
The Most Common Specific Injury Diagnoses/Assessments

Specific injury	Total	Percentage of total
Ankle sprain	34	15.8
Thigh strain	12	5.6
Concussion	8	3.7
Quadriceps contusion	7	3.3
Iliopsoas strain	5	2.3
Knee contusion	5	2.3
ACL complete tear, acute	4	1.9
Other	140	65.1
Total	215	100.0

TABLE 4
Injury Rate by Mechanism and Severity[a]

Mechanism	Time loss of fewer than 7 sessions		Time loss of 7 or more sessions	
	Injuries	Rate	Injuries	Rate
Contact	77	1.77	18	0.41
Another player	63	1.45	12	0.28
Floor	5	0.12	1	0.02
Basketball	2	0.05	1	0.02
Rim	2	0.05	0	
Nonspecific	5	0.12	4	0.09
Noncontact	6	0.14	12	0.28
Other	92	2.11	10	0.23
Total	175	4.02	40	0.92

[a] Injury rate per 1000 athlete-exposures based on denominator of 43,514 exposures.

TABLE 5
Injury Rate by Court Zone and Severity

Zone	Time loss of fewer than 7 sessions		Time loss of 7 or more sessions	
	Injuries	Rate	Injuries	Rate[a]
The key	81	1.86	15	0.34
Midcourt	12	0.28	2	0.05
3-point line	7	0.16	5	0.11
Center	8	0.18	3	0.07
Out of bounds	5	0.12	2	0.05
Blank or N/A	65	1.49	10	0.23
Total	178	4.09	37	0.85

[a] Injury rate per 1000 athlete-exposures based on a denominator of 43,514 exposures.

Table 5 provides an analysis of the frequency and rate of injury by different court zones. The greatest number of injury events occurred in the key, which accounted for 44.7% of all injuries at a rate of 2.21 injuries per 1000 athlete-exposures.

Risk

Table 6 shows a breakdown of injury event frequency and injury rate for game and practice sessions. The absolute number of injuries in practices was higher than that during games. The rate of injury events resulting in fewer than seven sessions of time loss was similar in games and practices. However, for injuries resulting in seven or more sessions of time loss, the rate of injury was statistically significant, 3.7 times greater during games compared with practices.

Table 7 combines information regarding injuries to the ankle, knee, and foot by player position. Players in the forward position had the lowest injury rate and thus were used as the baseline for comparison. Centers had a considerably higher rate of injury compared with forwards and guards. The rate of knee, ankle, and foot injury was 13, 4.5, and 10 times greater, respectively, for centers compared with forwards. There were no statistically significant differences between the rate of knee, ankle, or foot injuries in guards compared with forwards.

Table 8 examines the mechanism of injury by player position. Injuries were analyzed as either contact or noncontact for each position. Guards and forwards sustained a greater absolute number of injuries, but centers had significantly higher rates of both contact and noncontact injury.

Table 9 demonstrates the relative risk of injury for those athletes with a history of injury to a particular body region. Information regarding previous injury was obtained from medical history forms completed before the season and also from injury data collected throughout the season. Any previous injury or injury incurred during the season was recorded as a positive history of injury to that particular body region. Any athletes who had not completed a preseason medical form or whose injury report form did not designate a side of the body injured had a "blank" entry for history of injury. Body regions were ranked by rate of risk of injury. Concussions and injuries of the elbow, shoulder, knee, hand, and the lower spine and pelvis generated a relative risk value of greater than 1. The confidence interval did not include the null value, thus indicating that a previous injury to these body regions may predispose an athlete to a repeated injury in the same region.

TABLE 6
Injury Frequency and Severity by Exposure Type (Game or Practice)

Time loss	Injuries	Athlete-exposures	Rate[a]	Rate ratio (95% CI[b])
Fewer than 7 sessions				
Game	51	12,573	4.06	1.01 (0.73–1.40)
Practice	124	30,941	4.01	Reference[c]
Total	175	43,514	4.02	
7 or more sessions				
Game	24	12,573	1.91	3.69 (1.69–6.95)
Practice	16	30,941	0.52	Reference
Total	40	43,514	0.92	

[a] Risk based on 12,573 games, 30,941 practice sessions, and 43,514 total exposures.
[b] CI, confidence interval.
[c] Baseline for comparison.

TABLE 7
Frequency and Rate of Common Injuries by Player Position

Position	Injuries	Exposures	Rate	Rate ratio (95% CI[a])
Knee				
Forward	10	6687.0	1.50	Reference[b]
Guard	14	7911.0	1.77	1.18 (0.53–2.66)
Center	11	553.0	19.89	13.06 (5.57–30.62)
Multiple	0	1397.5		
Other	3	26,965.5	0.11	
Total	38	43,514.0	0.87	
Ankle				
Forward	16	6687.0	2.39	Reference
Guard	23	7911.0	2.90	1.21 (0.64–2.30)
Center	6	553.0	10.85	4.50 (1.77–11.45)
Multiple	1	1397.5	0.72	
Other	7	26,965.5	0.26	
Total	53	43,514.0	1.21	
Foot				
Forward	6	6687.0	0.90	Reference
Guard	3	7911.0	0.38	0.42 (0.11–1.69)
Center	5	553.0	9.04	10.00 (3.06–32.65)
Multiple	1	1397.5	0.72	
Other	2	26,965.5	0.07	
Total	17	43,514.0	0.39	

[a] CI, confidence interval.
[b] Baseline for comparison.

TABLE 8
Frequency and Rate of Injury by Player Position and Injury Mechanism

Position	Injuries	Exposures	Rate	Rate ratio (95% CI[a])
Contact				
Forward	29	6687.0	4.33	Reference[b]
Guard	38	7911.0	4.80	1.11 (0.68–1.79)
Center	15	553.0	27.12	6.12 (3.30–11.34)
Noncontact				
Forward	18	6687.0	2.69	Reference
Guard	25	7911.0	3.16	1.17 (0.64–2.15)
Center	20	553.0	36.16	9.37 (5.24–16.77)

[a] CI, confidence interval.
[b] Baseline for comparison.

DISCUSSION

In this 2-year study of men's collegiate varsity basketball we examined the incidence of injury by body region, severity, diagnosis, and injury type as well as the relative risk of injury based on a history of injury to a specific body region.

Injury Rates and Proportions

In the past, a number of studies have used a time loss definition for reportable sports injuries that included at

TABLE 9
Relative Risk of Injury in Players with a History of Injury by Body Region

Region	Injured				Uninjured		Relative risk	Confidence interval (95%)
	History positive		History negative		History positive	History negative		
	N	(ID[a])	*N*	(ID[a])				
Elbow	1	(0.02)	2	(0.05)	8	447	24.94[b]	(2.48–250.79)
Shoulder	4	(0.09)	6	(0.14)	45	387	5.35[b]	(1.56–18.29)
Knee	16	(0.37)	12	(0.28)	94	337	4.23[b]	(2.07–8.67)
Concussion	5	(0.12)	4	(0.09)	51	175	4.00[b]	(1.11–14.37)
Hand	6	(0.14)	9	(0.21)	64	379	3.70[b]	(1.36–10.06)
Lumbar spine/pelvis	6	(0.14)	4	(0.09)	61	159	3.65[b]	(1.06–12.52)
Thoracic spine/ribs	1	(0.02)	3	(0.07)	19	207	3.50	(0.38–32.10)
Hip	2	(0.05)	7	(0.16)	36	408	3.12	(0.67–14.50)
Wrist	1	(0.02)	3	(0.07)	60	386	2.12	(0.22–20.11)
Thigh	3	(0.07)	20	(0.46)	33	401	1.75	(0.55–5.62)
Ankle	27	(0.62)	33	(0.76)	140	248	1.38	(0.86–2.21)
Head	8	(0.18)	18	(0.41)	53	155	1.26	(0.58–2.75)
Leg	1	(0.02)	14	(0.32)	27	412	1.09	(0.15–7.97)
Foot	2	(0.05)	18	(0.41)	49	390	0.89	(0.21–3.72)
Brachial plexus	0		0		5	224		
Neck	0		1	(0.02)	13	215		
Arm	0		1	(0.02)	10	441		
Forearm	0		0		13	445		
Other	0		1	(0.02)	11	220		

[a] Incidence density, injuries per 1000 athlete-exposures; based on 43,514 injuries.
[b] Significant values.

least one missed participation.[1,2,4,8,9,11,21,22,26] Other researchers used an injury definition not requiring any time loss from participation,[3,13,16,24,27] four investigations used emergency department records,[5–7,14] and another analyzed acute injuries from an insurance registry.[15] Five studies measured exposure on a daily basis for each player,[1,2,11,16,22] whereas eight estimated exposure based on team size and number of participations.[4,5,9,13,15,21,26,27] Only three studies investigating time loss and exposure focused solely on basketball.[9,11,21] Clearly, there is no established convention in the literature for reporting injury rates.

In the present study, an injury definition that included time loss from participation was used to reduce the bias associated with the incidence estimate[23]; it provided a "reference standard."[20] Time loss was calculated on the basis of missed sessions rather than calendar days (or weeks). This approach was used to control for variations in the number of games and practices in any time period over the season.

Previous investigations have estimated exposure rather than measuring it directly. Because not every player participates in every game or practice session, the method of simply multiplying the number of players by the number of sessions could overestimate the denominator and thus underestimate the actual injury rate.

The incidence density, or injury rate, in this study was 4.94 injuries per 1000 athlete-exposures for all injuries combined. Our data are not comparable with those of McKay et al.,[16] who found 18.2 injuries per 1000 athlete-exposures. They used an injury definition that included any injury regardless of time loss (which would increase the rate). Clarke and Buckley[4] found a lower injury rate of 2.1 injuries per 1000 athlete-exposures; they determined exposure by a team index, and thus the injury rate was likely underestimated. Beachy et al.[3] found 0.93 injuries per athlete, but only 0.34 time loss injuries per athlete. Garrick and Requa[8] noted 0.31 time loss injuries per athlete; however, the high school population they studied may not have been as competitive or aggressive or may not have participated as much as a university population and thus may have been less prone to injury.

Body Region of Injury and Most Common Injuries and Diagnoses

The knee had the highest injury rate when injuries resulting in seven or more sessions of time loss were examined, but the ankle had the highest overall rate. Our findings are consistent with those of a study based on data from the National Collegiate Athletic Association's Injury Surveillance System[2] that found the knee injury rate to be 0.7 per 1000 athlete-exposures. Furthermore, a number of other investigations found ankle and knee injuries to be the most frequent.[4,9,13,15,21,27] Two investigations found the fingers and hand to be the most common region of injury,[6,26] whereas another found the head and neck to be the area most frequently injured.[16] In all three of these reports, the ankle was the next most commonly injured region. With such consistency in the literature, it seems reasonable to suggest that the ankle represents the most commonly injured region and the knee one of the next most common. It should be noted that although injuries to the foot are not as prevalent as ankle or knee injuries,

these injuries resulted in greater average time loss than those to the ankle.

Ankle sprains were the most common injury diagnosis over the 2 years of investigation, followed by concussions. The injury definition included concussions and brachial plexus injuries without time loss, based on the rationale that these injuries constituted serious health concerns that are not necessarily reflected in missed participation. However, only one concussion did not result in time loss. Powell and Barber-Foss[22] found a concussion injury rate among high school basketball players of 0.11 per 1000 athlete-exposures, similar to our result of 0.16 per 1000 athlete-exposures. In our investigation, all concussions resulted in fewer than seven sessions of time loss.

Mechanism of Injury

The majority of time loss injuries were due to contact with another player; noncontact injuries caused the next greatest amount of time loss. Yde and Nielsen[26] found that, for contact injuries, the ball itself was responsible for the greatest number of injuries, and contact with an opponent the next greatest. Players in the guard position sustained the most injuries during the 2 years of study, followed by forwards and centers. The greatest number of injuries occurred within the 3-point line. This result is likely due to the amount of playing time spent in the key (thus, greater exposure) and the increased player-to-player contact due to higher player concentration. Future studies should examine the effect of protective interventions employed to reduce the injury rate to guards and to other players in the key.

Risk

In terms of absolute numbers, more injuries occurred in practices, although the rate of injuries resulting in fewer than seven sessions of time loss was similar for games and practices. Games were responsible for the majority of injuries causing more than seven sessions of time loss, resulting in a rate of severe injury 3.69 times greater than that during practices. Thus, therapists and physicians should be prepared for injuries of greater severity during games.

When player position was considered, forwards had the lowest injury rate, followed closely by guards. Centers had the highest injury rate for all injuries combined and for injuries to the knee, ankle, and foot when compared with forwards. The contact, noncontact, and overall injury rates were significantly higher for centers when compared with the rate of injury to forwards, indicating no confounding of position-specific rates of injury by mechanism of injury. Centers may have had a greater rate of injury in the jump-off or because they tend to move in the areas of highest player concentration (and thus have greater potential for contact). Guards generally incurred more injuries than forwards; however, the rate of injury between the two positions was not significantly different. Future investigators should consider analyzing the reason why centers are so predisposed to injury. Players, coaches, and referees should be aware of the playing style and situations that result in injury to centers.

This investigation is the only one of its kind to have studied the relative risk of a history of injury among basketball players. When the frequency, associated time loss, and the relative risk of reinjury were considered, the knee was the most problematic body region. Other regions of concern for a risk of reinjury included the elbow, shoulder, hand, and lower spine or pelvis as well as repeat concussions. Caregivers should focus on protective measures for these types of injuries.

Limitations

The calculation of exposure and time loss from injury can vary from study to study based on the method used to calculate the amount of time played (or missed). This study measured the exact number of sessions of participation. With this method, a bias may be introduced when comparing the findings with those of studies that calculate exposure based on the number of days (rather than sessions). Specifically, the use of sessions rather than days missed because of injury would tend to result in overestimation of the severity of injury during times of the year when there are more than seven sessions per week and underestimate severity when there are fewer than seven sessions per week.

The estimate of time loss for end-of-season injuries was based on the impressions of the athletic therapists and physicians, and thus the direction and magnitude of bias is unknown. Injured athletes are more likely to participate in certain exposures than in others. For example, an injured athlete may be more likely to participate in a game than in a practice session; however, this is not likely to occur for the severe injuries resulting in seven or more sessions of time loss. For minor injuries sustained in games, the athlete would be more likely to miss the following practice, but for minor practice injuries, the athlete would be less likely to miss the next game. This tendency would result in an overestimate of time loss injuries resulting from game participation and an underestimate of those resulting from practices. Selection bias was not an issue in this investigation because of our high participation rate (98.1%). Furthermore, no players were lost to follow-up over the course of the study.

CONCLUSIONS

In this 2-year investigation, we were able to accurately measure injury and athlete-specific participation. The trends in this study were comparable to those of many other investigations that used a similar injury definition. We identified a number of specific risk factors, including previous injury, game situations, player position, player contact, and court location. These results can be used to plan prevention strategies to reduce injuries, particularly to the commonly injured areas of the knees and ankles.

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