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The Distribution of Injuries in Men's Canada West University Football

A 5-Year Analysis

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ABSTRACT

We conducted a prospective cohort study from 1993 to 1997 to determine the frequency and severity of injury in men's Canada West university football. The Canadian Intercollegiate Sport Injury Registry was used to document baseline preseason data, daily athlete participation, and subsequent injury from five varsity football teams. An injury was defined as "any injury resulting in one or more complete or partial sessions of time loss" or "any concussion or transient neck neurologic injury." The annual proportion of injured athletes ranged from 53.5% to 60.4%, with a 5-year total of 1811 injuries. Regression analysis indicated that the rate of nonconcussion, nonneck neurologic injuries increased. Concussion ($N = 110$), hamstring strain ($N = 88$), and brachial plexus ($N = 84$) injuries were the most common, specific injury diagnoses. Knee injuries resulted in the highest rate of severe (greater than or equal to 7 sessions of time loss) injury and resulted in the most time loss (3350.5 sessions). Ligament sprains and muscle strains and spasms accounted for approximately half of all injury diagnoses. A total of 1173 injuries (65%) were related to contact between players or between players and other obstacles. Future studies should be conducted to identify risk factors for the ultimate purpose of implementing injury prevention strategies.

Although injuries associated with participation in American football have been studied extensively in high school,[1,3–6,13,14,19,25,31,32,35–38] college,[2,7–9,11,28,43] and professional athletes,[34] little research is available on injuries associated with participation in Canadian university football. Data from one previous study indicates that football injuries may represent the most frequent injuries reported to university health care providers and that the percentage of football players injured per team is second only to hockey at the intercollegiate level.[21] A number of American studies have identified football as a sport that results in injury to a substantial proportion of participants[12,32,37] with the very real potential for catastrophic injury.[3,10,18,24,26,27] There are differences between the Canadian and American games in terms of the number of downs and the size of the playing field, which may modify the rate or profile of injury.

The problem with many football injury studies to date concerns the way the athlete population at risk has been identified. Specifically, athlete participation in football has largely been based on observations of a group (that is, estimates of the total participation time for an entire team), rather than measurement at the individual-athlete level (Ref. 33; R. Pelletier, unpublished data, 1992; N. Powell and J. Powell, unpublished data, 1992). However, the difficulties that arise from drawing conclusions and applying them to individual players on the basis of the observations of a group have been elucidated.[20] Inaccuracies in the evaluation of injury rates can affect the quality of athlete care and confuse or change the relationship between potential risk factors and subsequent injury occurrence. For example, an overestimate of athlete-exposure can occur when all players are assumed to be fully participating in each game and practice, which is usually not the case. This would result in an underestimate of the true injury rate.

We have used a state-of-the-art injury reporting system that addresses the concerns associated with previous studies.[23] The Canadian Intercollegiate Sport Injury Reg-

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istry (CISIR) is based on a prospective cohort design that provides a detailed account of the temporal relationship between the risk factor of interest and the injury event. Further, because exposure, or athlete participation data, is measured rather than estimated, precise injury rates are available. Therefore, it is the purpose of this investigation to identify the distribution of injuries associated with participation in Canadian men's university football in a fashion that will allow detailed description by body region and time loss from participation. This report will set the stage for further analysis to determine modifiable risk factors for injury in football and to provide insight into possible injury prevention strategies.

MATERIALS AND METHODS

The Canadian Intercollegiate Sport Injury Registry was designed to prospectively track athlete injury rates and risks at the university level. The CISIR system's development, implementation, and validation have been rigorously described.[23] Data were collected over 5 seasons of the Canada West division of Canadian Intercollegiate Athletic Union men's football (which includes the Universities of British Columbia, Alberta, Calgary, Saskatchewan, and Manitoba). Written informed consent was obtained from each participating athlete, and baseline preseason medical data were collected. During the course of the football season, from preseason to the end of the season, individual injury data and daily participation (exposure) were documented on standardized forms by the head and student athletic therapists at each institution. Therapist handbooks detailing the specifics of data collection were sent to each head athletic therapist before the start of the season. The therapists had the opportunity to ask questions regarding the data collection process before the start of and during the season to be sure they understood the tasks involved. Every 2 weeks, the completed data collection forms from each institution were sent to the central registry at the University of Calgary. The data were checked at the central registry for completeness, and any missing information was solicited from the therapists. The data sheets were subsequently entered into a dual-entry relational database program[22] in preparation for analysis.

Exposure Measurement

The CISIR system was designed to capture information on each athlete in every game or practice over the entire season. This was done using a weekly exposure sheet, a tabular instrument whereby an athlete's participation status was documented by an athletic therapist on a daily basis along with session duration (hours), session type (game or practice), field conditions (wet or dry), playing surface (artificial or natural), weather conditions (snow/rain/overcast/sunny), and temperature (°C).[23] The columns on the weekly exposure sheet represented one game or practice, while the rows represented one athlete. The participation experience of each athlete was documented using the following codes: F, full = participated >75%; P, partial = participated ≤75%; O, no participation = 0%. In addition, explanatory codes would be entered to identify the reason behind the use of a "P" or an "O" code. The explanatory codes were designated as injured (I), sick (S), or absent for reasons other than injury or sickness (A). In this way, a precise measure of an athlete's exposure could be captured on a session-by-session basis. This also provided a measure of the time loss from participation due to specific injuries. The athlete participation codes were used in place of an exact measure of the time an athlete participated (for example, minutes), as this approach was logistically more feasible, as determined by therapist consensus during pilot testing of the CISIR.[20]

Outcome Measurement

A single-page 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 of football.[20] Fixed response items and free text descriptions of the events surrounding an injury provided a comprehensive overview of injury circumstances along with the injury diagnosis. The injury definition employed for the data-collection phase of the investigation was "any event requiring assessment and treatment by a team therapist" or "any transient neurologic injury."

This reporting definition allowed an assessment of all injuries, regardless of whether the athlete missed participation in either games or practices (as determined by the weekly exposure data). It was decided, however, that because of differential reporting of "no-time-loss" injuries at each institution, as well as for the sake of consistency with the available literature,[16,19,30] that the analysis would use an injury definition of "any injury resulting in one or more complete or partial sessions of time loss" or "any concussion or transient neurologic neck injury."

To establish an estimate of the severity of injury, injuries were divided into those that resulted in less than seven, and those that resulted in seven or more sessions of time loss. Categorizing time loss has been suggested as a mechanism to reduce the bias associated with studies of football injuries.[40] Our rationale for using a 7-day threshold to establish the severity of injury follows from other investigations of football injuries that have attempted to distinguish levels of severity.[4,9,16,28]

When an injury occurred at the end of the season or caused the player to miss time to the end of the season (and therefore precluded our assessment of the time loss due to that injury) the therapist's estimate of time loss was used. This was done to avoid an underestimate of the time loss associated with injury.

Analysis

Linear least-squares regression was used to determine changes in yearly overall injury rates using S-Plus statistical software (AT&T Mathsoft, Inc., Seattle, Washington). The alpha level was set at 0.05. Body-region injuries were expressed as rates per 10,000 athlete-exposures for the time-loss categories. The proportion and absolute

number of injuries to specific body regions were calculated by time loss, injury diagnosis, and mechanism of injury. These analyses were completed using Microsoft Excel version 5.0 and Microsoft Visual FoxPro version 5.0. (Microsoft Corp., Redmond, Washington).

It should be noted that some athletes sustained an injury resulting in trauma to multiple body regions (for example, the knee and ankle). This injury would only be counted once in the numerator (of a rate calculation) because it represents only one specific situation, or injury event. In addition, in cases where an individual sustained a concussion or transient neck neurologic injury plus an additional injury (for example, concussion and facial laceration), the nonconcussion or nonneck neurologic injury would be included only if the injury event resulted in time loss from participation.

RESULTS

There were a total of 1010 athletes eligible for participation in the study over the 5-year period with 29 (2.9%) athletes who did not consent. There were 344, 352, 373, 399, and 378 athletes participating in Canada West university men's football from 1993 to 1997, respectively. The proportion of athletes injured each year ranged from 53.5% ($N = 184$) in 1993 to 60.4% ($N = 241$) in 1996. There were 303, 328, 361, 420, and 399 injury events in 1993, 1994, 1995, 1996, and 1997, respectively, for a total of 1811 injury events. These 1811 injury events resulted in 1971 separate injuries, as some events produced more than one injury.

The information in Figure 1 represents injury event rates per 10,000 athlete-exposures with separate lines for time-loss injuries (excluding all concussions and transient neck neurologic injuries) and concussion and neck neurologic injuries. It should also be mentioned that a fibular fracture injury occurred on the last day of the season and

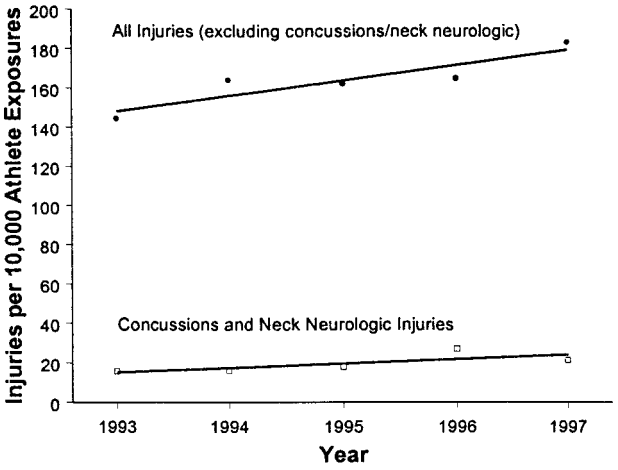

Figure 1. Separate regression lines indicating injury rate time trends for all injuries (excluding concussions and neck neurologic injuries) and concussions and neck neurologic injuries per 10,000 athlete-exposures.

no estimate of time loss was provided by the therapist. For this reason, the injury was not included in any of the analyses. In one case, an athlete sustained a concussion and a brachial plexus injury. This injury event was counted as two separate injuries (in the concussion and neck injury categories).

The slope of the line in Figure 1 for all injuries (excluding concussions and neck neurologic injuries) is positive and significant ($P = 0.036$; 95% confidence interval, 3.60 to 12.08). Using the lower limit of the confidence interval as the most conservative estimate, the equation estimates that the rate of injury will increase by at least 3.6 injuries for every 10,000 athlete-exposures (with 95% confidence) for every subsequent year of play. In absolute terms, considering that there were approximately 20,000 total exposures (4000 per team) each year in Canada West men's varsity football (mean, 19,956.1; range, 18,291.5 to 22,263.5), there will be at least an extra 7.2 or as many as an extra 24.2 injury events every subsequent year of play among the five teams (with 95% confidence).

Linear least-squares regression analysis indicated no evidence for a statistically significant increasing trend with respect to concussion and transient neck neurologic injuries over the past 5 years ($P = 0.15$). The rate for these types of injuries per 10,000 athlete-exposures increased approximately 52% in 1996 compared with the rate for 1995 (from 17.78 to 26.95 injuries per 10,000 athlete-exposures), but declined in 1997.

The information in Table 1 demonstrates those injuries resulting in less than seven sessions of time loss or seven or more sessions of time loss. The data in Table 1 represents individual injury events where only one body region was involved. Otherwise, if more than one body region was involved in a single event, that injury was placed in the "multiple regions" category. Brachial plexus injuries were treated as separate from neck injuries, and concussions were treated as separate from head injuries.

For those injuries that resulted in less than seven sessions of time loss from participation, thigh injuries demonstrated the highest rate, followed by knee, shoulder, and ankle injuries. When those injuries that resulted in seven or more sessions of time loss are considered, however, the knee represents the body region with the highest rate, followed by the ankle and shoulder. Considering all injuries together (less than seven sessions of time loss and seven or more sessions of time loss), the knee represents the body region with the highest overall rate of injury followed by the thigh, shoulder, and ankle.

Table 2 demonstrates the region of injury with the average amount of time loss over the 5 years of Canada West men's varsity football. Injuries resulting in trauma to more than one region of the body were placed in the "multiple regions" category, as in Table 1. There were 164 injuries over the 5-year period that occurred during the last game of the season ($N = 57$) or before the end of the season but for which the athlete never returned to full participation because of the injury ($N = 107$). Of the 57 injuries that occurred on the last day of the season, 20 had no therapist estimate of time loss and were not included in the analysis of time loss. Sixty-five of the 164 injuries had

TABLE 1
Injury Rate per 10,000 Athlete-Exposures by Body Region for Injuries Resulting in Less than Seven, or Seven or More Sessions of Time Loss

Body region	Injury rate		
	Less than seven sessions time loss	Seven or more sessions time loss	Any number of sessions time loss
Head	1.60 (N = 16)	0.10 (N = 1)	1.70 (N = 17)
Concussion[a]	9.02 (N = 90)	1.10 (N = 11)	10.12 (N = 101)
Neck[b]	8.82 (N = 88)	1.00 (N = 10)	9.82 (N = 98)
Brachial plexus[c]	6.92 (N = 69)	0.30 (N = 3)	7.22 (N = 72)
Shoulder	14.33 (N = 143)	4.41 (N = 44)	18.74 (N = 187)
Arm	0.70 (N = 7)	0.20 (N = 2)	0.90 (N = 9)
Elbow	2.61 (N = 26)	0.50 (N = 5)	3.11 (N = 31)
Forearm	0.50 (N = 5)	0.60 (N = 6)	1.10 (N = 11)
Wrist	1.40 (N = 14)	0.00 (N = 0)	1.40 (N = 14)
Hand	6.01 (N = 60)	1.10 (N = 11)	7.12 (N = 71)
Thoracic spine/chest	4.61 (N = 46)	0.70 (N = 7)	5.31 (N = 53)
Lumbar spine/pelvis	9.62 (N = 96)	2.21 (N = 22)	11.83 (N = 118)
Hip	6.31 (N = 63)	1.20 (N = 12)	7.52 (N = 75)
Thigh	21.15 (N = 211)	3.61 (N = 36)	24.76 (N = 247)
Knee	15.94 (N = 159)	8.92 (N = 89)	24.86 (N = 248)
Leg	9.02 (N = 90)	2.61 (N = 26)	11.63 (N = 116)
Ankle	13.53 (N = 135)	4.91 (N = 49)	18.34 (N = 184)
Foot	5.01 (N = 50)	1.10 (N = 11)	6.11 (N = 61)
Multiple regions	5.81 (N = 58)	1.40 (N = 14)	7.21 (N = 72)
Other	2.41 (N = 24)	0.20 (N = 2)	2.61 (N = 26)
All regions	(N = 1450)	(N = 361)	(N = 1811)

[a] Includes 26 no-time-loss injuries in the "less than seven sessions of time loss" category.
[b] Includes two no-time-loss, multiple-region injuries, where the individual player sustained a concussion or transient neck neurologic injury in the "less than seven sessions time loss" category.
[c] Includes 34 no-time-loss injuries in the "less than seven sessions time loss" category.

TABLE 2
Total Number of Injuries, Sessions Lost, and Average Time Lost by Body Region

Body region	Total number of injuries	Total sessions lost	Average time loss (sessions)
Head	17	85.00	5.00
Concussions	101	307.00	3.04
Neck	98	305.50	3.12
Brachial plexus	72	93.50	1.30
Shoulder	187	1170.00	6.26
Arm	9	54.50	6.06
Elbow	31	143.00	4.61
Forearm	11	160.50	14.59
Wrist	14	34.50	2.46
Hand	71	303.00	4.27
Thoracic spine/ribs	53	203.50	3.84
Lumbar spine/pelvis	118	532.00	4.51
Hip	75	282.50	3.77
Thigh	247	906.50	3.67
Knee	248	3350.50	13.51
Leg	116	750.50	6.47
Ankle	184	1149.00	6.24
Foot	61	308.50	5.06
Multiple regions	72	350.00	4.86
Other	26	50.00	1.92
All regions	1811	10539.50	5.82

a therapist's estimate of time loss that was greater than the actual measured time loss. The time loss for these 65 injuries was subsequently changed to reflect the therapist's estimate (greater time loss due to the injury). In the case where the actual time loss was greater than or equal to the therapist's estimate, the actual measured time loss because of the injury was used in the analysis. Had we not used the therapist's estimate of time loss for these injuries, many significant injuries would have demonstrated no time loss from participation and an underestimate of injury time loss would have resulted from the following analysis.

Injuries to the forearm resulted in the most time loss per injury, followed by the injuries to the knee, leg, ankle, and shoulder. However, the overall burden of injury in terms of time loss from participation resulted from trauma to the knee (32.0% of the total time loss due to injury), followed by the shoulder and ankle.

Table 3 conveys information on the most common injuries over the past 5 years of Canada West football. The data in Table 3 represent specific injury types rather than

TABLE 3
The Most Common, Specific Injuries Overall

Specific injury	Total number
Concussion	110
Hamstring muscle strain	88
Brachial plexus injury	84
Quadriceps contusion	75
Knee medial collateral ligament first degree sprain	68
Adductor muscle strain	54
Iliopsoas muscle strain	51
Acromioclavicular first degree sprain	43
Ankle lateral ligament complex first degree sprain	42
Cervical facet syndrome	41
Anterior talofibular first degree sprain	39
Quadriceps strain	35

individual injury events (for example, one athlete injured his neck and sustained a concussion, representing two specific injuries). These 12 specific injury types account for approximately 37% of all injuries.

Concussions and brachial plexus injuries combined were the most prevalent specific problems over the past 5 years of Canada West University football. However, this is biased by the use of a different injury definition in that all concussions and brachial plexus injuries were reported irrespective of whether the athlete missed participation, whereas other types of injuries required missed participation to be included in the analysis. Thigh injuries (hamstring, adductor, and quadriceps muscle strains and quadriceps contusions) and knee and ankle ligament injuries also accounted for a large portion of the injuries.

Figure 2 demonstrates the breakdown of the specific diagnosis of injury over 5 years of Canada West varsity football. It should be noted that the information in Figure 2 represents every individual injury and not simply the number of injury events (for example, a player who sustained multiple injuries during one injury event would have each of these injury diagnoses counted separately). Concussions and brachial plexus injuries are not included in the calculations of percentages in Figure 2. Approximately two-thirds of injuries were sprains, muscle strains and spasms, and contusions. Fractures made up 4% of the injury diagnoses.

Table 4 demonstrates the severity of injury by the mechanism. The "other contact" category includes injuries caused by, for example, having other players fall on or step on the injured player. The "noncontact" category includes injuries resulting from overuse, gradual onset, or running and cutting injuries, for example, an offensive athlete rolling his ankle while cutting away from a defender. It should be noted that the data in Table 4 represent injury events and not individual injuries (for example, for a player who sustained multiple injuries during one specific injury event, only the event would be counted, not all of the associated injuries).

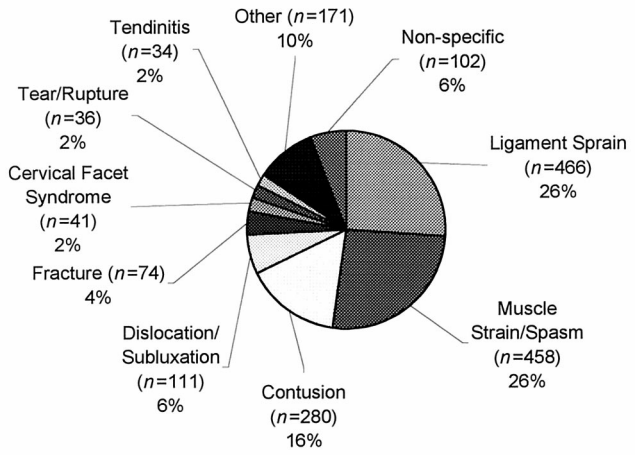

Figure 2. Injury diagnosis as a percentage of the total nonconcussion, nonneck neurologic diagnoses for men's Canada West football from 1993 to 1997 ("Tear/Rupture" category includes 28 knee meniscus tears, 2 shoulder glenoid labrum tears, 3 muscle tears, and 3 additional general knee injury tears).

TABLE 4
Time Loss from Participation by Mechanism of Injury

Mechanism of injury	Less than seven sessions of time loss	Seven or more sessions of time loss
Contact		
Blocking/being blocked	148	53
Being hit/tackled	373	96
Hitting/tackling	383	79
Other contact	34	7
Total contact	938	235
Noncontact	371	96
Other	17	8
No specific mechanism listed	124	22
All mechanisms	1450	361

Contact injuries accounted for 64.7% of injuries resulting in less than seven sessions of time loss and 65.1% of injuries resulting in seven or more sessions of time loss from participation. In terms of absolute numbers, being hit or tackled resulted in the most contact injuries, causing the athlete to miss seven or more sessions. Hitting and tackling, followed closely by being hit or tackled, resulted in the most contact injuries causing an athlete to miss less than seven sessions.

DISCUSSION

This study has examined the overall incidence, as well as specific body-region injury incidence in men's Canada West varsity football. The most common injuries as well as injury time loss were determined, along with the specific diagnosis and mechanism of injury.

Injury Rates and Proportions

Most studies use a time loss definition for reportable injuries usually involving missed participation for at least one session or more.[9,28,43] Other investigators have chosen to include head and concussion injuries or neck injuries in their definition regardless of time loss from participation, as long as the injury necessitated observation by a professional.[2,7] As has been identified in a comprehensive review of the literature concerning high school football injuries, an injury definition including time loss from participation reduces bias associated with the incidence estimate and "provides continuity with numerous past studies, allowing comparisons over time."[40] The rationale for the inclusion in this investigation of concussions and brachial plexus injuries regardless of time loss was to evaluate those injuries that represent serious health concerns.[40] The proportion of injured athletes in this investigation ranged from 53.5% in 1993 to 60.4% in 1996. These proportions compare favorably with those found in investigations using similar injury definitions for high school players, which range from 50.6% to 53.6% when measured as the number of injuries per total number of play-

ers.[4,13,38] Although the proportion of players injured is useful in terms of identifying the actual number of players who will be afflicted with an injury in a given year as a percentage of the total, a more precise and useful measure of risk can be conveyed as the incidence density or injuries per unit (session) of participation.

The actual rate of injury, or incidence density, in this investigation ranged from 158.0 (1993) to 201.4 (1997) injuries per 10,000 athlete-exposures for all injuries combined. These rates are comparable to those reported in the U.S. by the National Collegiate Athletic Association's (NCAA) Injury Surveillance System for games and practices combined.[30] There is evidence that this rate has been increasing over the past 5 years in Canada West university football. The opposite trend, however, exists with the NCAA Injury Surveillance System data for games.[29] To account for the difference in trends, it is possible that more athletes have been participating partially in games. This would function to gradually decrease the exposure in the CISIR system (which would increase the injury rate because of the fewer exposures) and increase, relative to the CISIR, the exposure for the NCAA Injury Surveillance System (which would decrease the injury rate because of the greater number of exposures).

A number of potential explanations may account for the increasing injury rate over the past 5 years in Canada West football. It may be that athletes are not as physically prepared coming from high school football, which could put them at greater risk of injury. There may be a trend toward a more aggressive style of play or larger athletes (in both height and weight) being recruited from high school, enabling them to exert larger forces when hitting or tackling one another. Another explanation may concern injury reporting. That is, if the therapists involved in the data collection for the CISIR were reporting more injuries because, for example, they have become more comfortable with the data collection method, this would have also led to an increase in the injury rate.

Exposure measurement, as opposed to exposure estimation, is relatively new to the body of literature surrounding injury risk in football. Simply multiplying the number of players by the number of games and practices to obtain the denominator for the injury rate calculation could lead to dramatically reduced rates of injury, as all players do not participate in every session or they participate only partially for reasons such as injury, sickness, or absence. As future investigations attempt to measure, rather than estimate, the number of athlete-exposures for the denominator of a football injury incidence rate or density calculation, more precise estimates will be available to determine the risk of injury in football at all levels of play.

Body Region of Injury and Most Common Specific Injuries

Although the thigh was the most frequently injured region of the body for injuries that resulted in less than seven sessions of time loss, knee injuries were the most frequent overall injuries and resulted in over twice as much time loss. Further, the rate of knee injuries per 10,000 athlete-exposures was highest for those injuries resulting in seven or more sessions of time loss, followed by the ankle and shoulder. Thus, knee, ankle, and shoulder injuries represent the most common and severe injuries sustained by Canadian intercollegiate football players. This is a recurrent finding, particularly with respect to the knee, of investigations at various levels of football play.[4,9,11–14,16,28,30,31,35,37,43] With the consistency of this evidence, it is reasonable to state that knee injuries represent the greatest problem for football players and every effort should be made to reduce their frequency and severity.

Concussions, followed by hamstring muscle strains, and brachial plexus injuries were the most prevalent specific injury types over the past 5 years of Canada West intercollegiate football. Most of these injuries resulted in fewer than seven sessions of time loss, which is consistent with the definition of injury chosen for the analyses. However, it is recognized that no-time-loss neurologic injuries can be dangerous and justify their inclusion in this report. Specifically, athletes who have sustained a concussion, "characterized by immediate impairment of neural function,"[7] may be subject to the second-impact syndrome,[39] which can lead to death or disability.[17] Other researchers indicate that there may be a cumulative effect of concussion[15] and that the risk of sustaining a concussion is greater for an athlete who has already sustained a concussion within the past 5 years.[44]

Brachial plexus injuries result from a blow to the head, neck, or shoulder resulting in a lateral flexion and shoulder depression (traction) or a quadrant extension with axial loading, causing "a temporary dysfunction of the neural structures in the brachial plexus."[42] These injuries represent a problem, in part due to the neurologic injury and also because of their differential diagnosis (including cervical spine fractures and dislocations, transient quadriplegia, cervical sprains and strains, and acute brachial neuropathy).[42] The frequency with which concussion and brachial plexus injuries have occurred in Canada West varsity football is a concern warranting further investigation. Specifically, investigators need to identify ways of more objectively assessing and managing these problems. Further, it would be helpful to determine the groups of players at highest risk for concussions and neck neurologic injury so that interventions designed to reduce their frequency may be identified and implemented.

Injury Diagnosis

Ligament sprains, muscle strains and spasms, and contusions were the most common injury diagnoses over the 5-year period of data collection, accounting for 26.4%, 25.8%, and 15.8% of all nonconcussion, nonneck neurologic injuries, respectively. Other investigations have also found sprains to be the most prevalent injuries in football, making up 20.4% to 45% of all injuries.[4,11,13,14,37] Although muscle strains accounted for the second-highest proportion of injuries in this investigation, other researchers have reported lower proportions.[4,11,14,43] Possible explanations for this disparity could relate to a slight variation of the injury definition,[43] the low number of injuries

studied on primarily starting players,[11] or that the other investigations collected data on a younger group of athletes.[4,14] The findings regarding fractures are consistent with a longitudinal study on college-level football players.[43] Investigations concerned with injuries in younger football players have reported higher proportions of fractures, possibly due to growth plate trauma,[4,13,14] and more severe (greater time loss) injuries.[31,37]

Mechanism of Injury

Of all injury events in this investigation, 65% were the result of direct contact. Most of these injuries involved hitting and tackling or being hit or tackled. Other investigators have also found that contact situations result in the greatest burden of injury in terms of rates and proportions[5,8,11,35] as well as severity.[10,38,41] Further, tackling has been identified as the mechanism of injury most often associated with catastrophic head and neck injury.[10,41] There were no catastrophic head or neck injuries sustained during this investigation.

Limitations of this Study

The injury definition chosen included time-loss injuries as well as any concussion or neck neurologic injury. Thus, the finding that neurologic injuries were among the most prevalent may be attributed to the inclusion of no-time-loss concussions and brachial plexus injuries. However, it was deemed important to include these types of injuries because of the seriousness of the problems that can arise from seemingly minor occurrences.

An estimate of time loss for those injuries that occurred at the end of the season or for which a player did not return to full participation due to an injury was made based on the athletic therapist's impression (that is, the time loss was estimated and not measured). The direction (under- or overestimate of the time loss) and magnitude of a bias associated with using the therapist's estimate of time loss is unknown.

Different field positions may require drastically different rehabilitation times for a similar injury before returning to play. For example, a quarterback who injures his hand may be out for several sessions, whereas a lineman may not miss any participation for the same injury. Depending on the position, this type of bias could lead to an underestimate or an overestimate of the time loss from injury. Future studies should identify the type of injury and time loss in relation to player position so that interventions may be specifically directed at high-risk groups.

Athletes may be more likely to participate after an injury in a specific session. For example, if an athlete is injured in a game, he may be more likely to take the next practice off than if he sustains the same injury in a practice immediately before a game. The former case is probably more prevalent, as most pregame practices are not as intense as regular practices. This bias would result in an overestimation of the observed time loss from injury and an overestimation of the observed injury rates (that is, reduced exposure in the denominator of the incidence-rate calculation). Using categories of time loss (that is, less than seven sessions of time loss or seven or more sessions of time loss) has been proposed as a way of reducing this bias when evaluating the severity of injury.[40]

Although the data for this investigation came from the five Canada West university teams, it is believed that the results will apply to all Canadian university football players. The rules are the same across Canada and the best teams from each division eventually play each other for the Vanier Cup at the end of the season. In addition, the Canada West, as well as all other divisions, provide a pool for selection by professional Canadian Football League teams.

CONCLUSIONS AND RECOMMENDATIONS

This study was unique in its ability to assess the effect of specific injury definitions on the observed injury profile. Within these tightly controlled parameters, the injury trends noted in this investigation are comparable with those of other investigations using similar injury definitions in American high school and college football players. Examining the overall picture of injury in men's Canada West University football has provided valuable information on the incidence and types of injuries players sustain. In addition, this work has set the stage for the development of injury-prevention strategies through the identification of risk factors.

Further work is needed to evaluate risk factors for injury in the sport of Canada West men's varsity football including the differences between the risk of injury in games and in practices, between artificial turf and grass, between wet and dry conditions, and the risk resulting from player position, history of injury, and year of varsity sport.

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