

Injuries in Elite Men's Lacrosse

An Observational Study During the 2010 World Championships

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Background: There are limited data on injuries sustained during men's lacrosse. As the sport gains popularity, practitioners will be more likely to treat lacrosse players.

Purpose: To analyze data from the 2010 World Lacrosse Championships.

Study Design: Descriptive epidemiology study.

Methods: This was a prospective observational study of injuries reported during the 2010 World Lacrosse Championships. An injury surveillance questionnaire was completed, and data were categorized into body part injured, diagnosis, mechanism, and time of injury.

Results: Over 9 days, 667 players from 29 countries competed in 105 games. A total of 150 injuries were sustained by 129 individuals aged 16 to 46 years. Five times more injuries occurred during games than in training (69.3% [n = 104] vs 13.3% [n = 20]; rate ratio [95% CI] = 5.2 [4.9-5.5]), resulting in 39.5 injuries per 1000 hours played. The most frequent mechanism was contact (53.3%; n = 80), including direct impact with another player (30%; n = 45), with a stick (16.7%; n = 25), or with a ball (5.3%; n = 8). Change of direction and/or speed were the most common noncontact mechanisms (27.3%; n = 41). The most frequently reported injuries were contusions (32.0%; n = 48), sprains (22.7%; n = 34), and strains (22.7%; n = 34). The lower limb was the most injured body part (50.7%; n = 76) compared with the upper limb (23.3%; n = 35; rate ratio [95% CI] = 2.2 [2.1-2.3]). The ankle was the most injured joint (14.0%; n = 21), followed by the shoulder (10.0%; n = 15).

Conclusion: As participation expands, health professionals may become more responsible for treating lacrosse players. Players are susceptible to a range of injuries. Familiarity with the common injury patterns could help treatment and prevention. Despite differences in rules during international competition, this study corroborates reports from North America.

Clinical Relevance: The epidemiology of men's lacrosse injuries needs to be documented and understood to effectively prevent injuries. The 2014 World Championships are to be held in Denver, Colorado (July 10-19, 2014), and it is important that practitioners treating players are aware of the differences in the international game. Publication of these data will allow for those planning lacrosse tournaments to do so more effectively.

Keywords: lacrosse; epidemiology; prevention

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Originally played by North American Native American tribes,¹⁴ the fast-paced, contact, team sport of men's lacrosse is quickly gaining popularity. A total of 29 countries competed in the 2010 Men's World Championships, compared with only 5 in 1990 (Federation of International Lacrosse, personal communication, 2011). In teams of 10, players throw a hard rubber ball between netted sticks, at speeds of up to 100 mph. Contacting opposition players with the body or stick is permitted, and the game is played on a grass or artificial field measuring 110 × 55 yards.⁶ For those unfamiliar with the sport, the game has been described as full-contact basketball with sticks, or ice

TABLE 1
Key Rule Differences Between the NCAA and FIL^a

Rules	FIL ⁶	NCAA ¹³
Game time	4 × 20 min; running time	4 × 15 min; stop clock
Required equipment	Helmet and gloves	Helmet, mouth guard, gloves, arm and shoulder pads
Squad size	23	No limit
Stoppages for substitutions	No	Yes

^aFIL, Federation of International Lacrosse; NCAA, National Collegiate Athletic Association.

hockey at head height.¹⁴ As participation in men's lacrosse rapidly increases worldwide, the likelihood of practitioners treating lacrosse players also rises. Despite this increased popularity at both grassroots and professional levels, there are limited data available regarding injury type and sequelae.

Studies into injury types, time of injury, and injury mechanisms are limited in number and geographical area (North America only).^{5,7,12} Furthermore, differences between the sport exist depending on location. Lacrosse in North America generally adheres to the rules of the National Collegiate Athletic Association (NCAA), which differ from the rules outlined by the Federation of International Lacrosse (FIL, previously ILF) (Table 1).^{6,13} These differences include game time, squad size, and mandatory protective equipment worn. To our knowledge, there is a lack of preexisting data comparing equipment worn and injuries sustained in men's lacrosse. This is the first review of injuries sustained in men's lacrosse played under FIL rules.

The aim of the study was to gather and analyze injury surveillance data from the 2010 Men's Lacrosse World Championships to recognize potential injury patterns, establish risk of injury, and identify possible means for prevention.

METHODS

This prospective observational study collected data on all injuries sustained during the 2010 Men's World Lacrosse Championships. A total of 667 players competed in 105 games over 9 days. An injury surveillance questionnaire was developed and provided to tournament medical staff and individual teams. The documents were completed and submitted by medical personnel from 27 of 29 competing countries, as well as the medical team overseeing the tournament. Only injuries requiring some form of treatment were reported. Recorded data were categorized into body part injured, diagnosis, mechanism, and time of injury. A database was created and statistical analysis performed using Microsoft Excel (Microsoft Corp).

Individuals consented to anonymized injury data being recorded, and accepted that this information would be used in this study at the time of collection. Using the Medical Research Council algorithm, specific ethical approval to review these data was not required.¹¹

RESULTS

Mechanism of Injury

Injuries were divided into contact (56.0%; n = 84) and noncontact injuries (44.0%; n = 56). Eighty-eight percent of contact injuries were due to impact with a player (58.3%; n = 49) or stick (29.8%; n = 25). Impact with a ball (9.5% of contact injuries; n = 8) and impact with the ground (2.4% of contact injuries; n = 2) made up the remainder (Figure 1).

Of all reported injuries, contact with another player was the main mechanism reported (33.3%). Contact with stick constituted 16.7%, ball 5.3%, and ground 1.3%; 62.1% of noncontact injuries were due to change of direction (31.8%; n = 21) or twisting (30.3%; n = 20). The remainder were made up by overuse injuries (19.7% of noncontact injuries; n = 13), nonspecific (12.1% of noncontact injuries; n = 8), throwing/shooting (4.6% of noncontact injuries; n = 3), and slipping/falling (1.5% of noncontact injuries; n = 1).

Type and Mechanism of Injury

The most commonly reported injury type was contusion (32.0%; n = 48), with 47.9% (n = 23) of these caused by direct impact with another player (Figure 2). Nineteen were due to direct impact by a stick (39.6%), and 9 were due to direct impact with a ball (12.5%).

Sprains accounted for 22.7% of all injuries (n = 34), and 29.4% of the ligament sprains (n = 10) were a result of contact. Strains also accounted for 22.7% of all injuries (n = 34). Five muscle strains (14.7%) were a result of contact.

Body Part Injured

The lower limb was the most commonly injured body part, reported twice as often as upper limb injuries (50.7% [n = 76] vs 23.3% [n = 35]; rate ratio, 2.2; 95% CI, 2.1-2.3). The ankle was the most commonly injured joint (14.0%; n = 21), which was closely followed by the shoulder (10.0%; n = 15) (Table 2).

Time of Injury

Five times more injuries were reported to have occurred during games than during training or warm-up sessions (69.3% [n = 104] vs 13.3% [n = 20]; rate ratio, 5.2; 95% CI, 4.9-5.5). This is especially important as the international game is 20 minutes longer than that played under NCAA rules, from which all existing data are derived. The specific timing of the injuries, for example, in which quarter they occurred or how long the player had been on the field, was not available to analyze.

DISCUSSION

This study is the first to quantify and analyze the injuries sustained by men's lacrosse players outside of the United States. Over 9 days, 29 countries competed in 105 games,

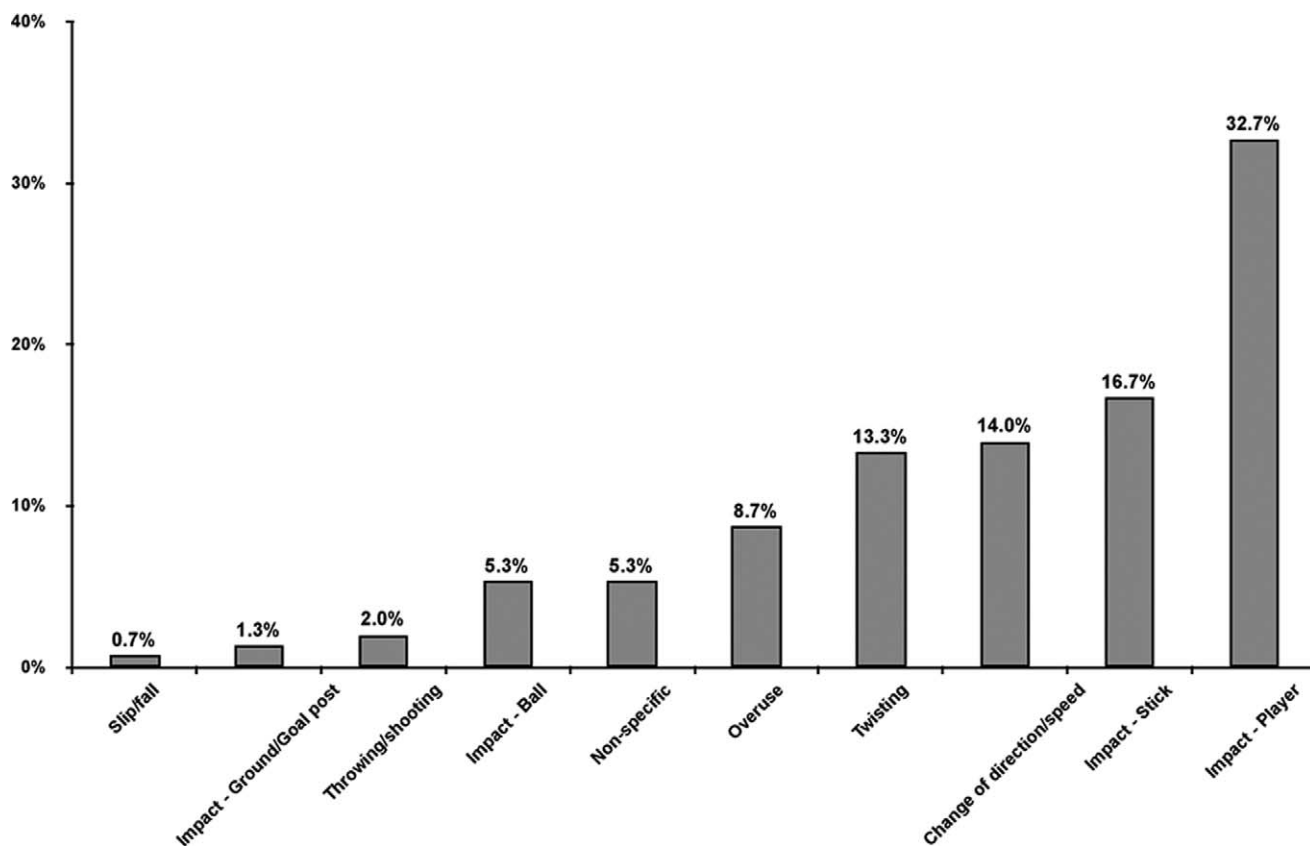


Figure 1. Percentage of injuries reported by mechanism.

with 667 players taking part. A total of 150 injuries were reported by 129 individuals ranging in age from 16 to 46 years (mean age, 26.4 years). Most injuries occurred during games (69.3%), with more than half of all injuries involving player contact (56.0%). Contusions were the most common injury type, constituting 32.0% of all injuries reported. The ankle was the most commonly injured joint, closely followed by the shoulder.

Injury Rate

Injury rate was calculated by dividing the total number of injuries reported to have occurred during a game (104) by the total number of player hours (2612.3 [the sum of the number of players participating on the field of play multiplied by 80 minutes then divided by 60 minutes]). Injuries occurring outside of games were excluded, as were the player hours from the 2 teams that did not provide data. Injury rate per 1000 hours was calculated as 39.5 injuries per 1000 hours of play (95% CI, 32.5-48.0). This compares similarly to soccer with an injury rate reported at 26, rugby union at 120, and ice hockey as 78 injuries per 1000 hours.¹

This rate may be lower than the true number of injuries that occurred as many reports did not have time of injury recorded and therefore were not included in this calculation.

Injury Timing

Injuries reported to have occurred during games were 5 times higher than those reported to have occurred outside of official play (69.3% [n = 104] vs 13.3% [n = 20]; rate ratio, 5.2; 95% CI, 4.9-5.5). The remainder did not have a specific time of injury. This is supported by the findings of previous studies based in the United States. Dick et al⁵ found that there were 3.9 times more injuries (95% CI = 3.7-4.1) in NCAA lacrosse games than practices. Hinton et al⁷ reported similar findings in high school lacrosse players. Looking at the greater scope, Hootman et al⁸ found a rate ratio of 3.5 between injuries sustained during games and practices across 16 different NCAA sports, including lacrosse. The higher number of injuries sustained during game play is expected due to an increased intensity and greater exposure to contact. In a practice setting, exposure is divided between noncontact drills, instruction, and conditioning in addition to drills and scrimmages that are similar to game conditions.¹² Furthermore, with regard to this study, the injuries were recorded during an intense 9-day tournament with games almost daily. Compared with a standard lacrosse season, from which previous studies have drawn data, players may be more inclined to play through an injury to compete in as many games as possible during a tournament. Conversely, due to the high frequency of games, injuries that would normally recover with rest are unlikely to do so. This factor may account for the high proportion of contusion injuries

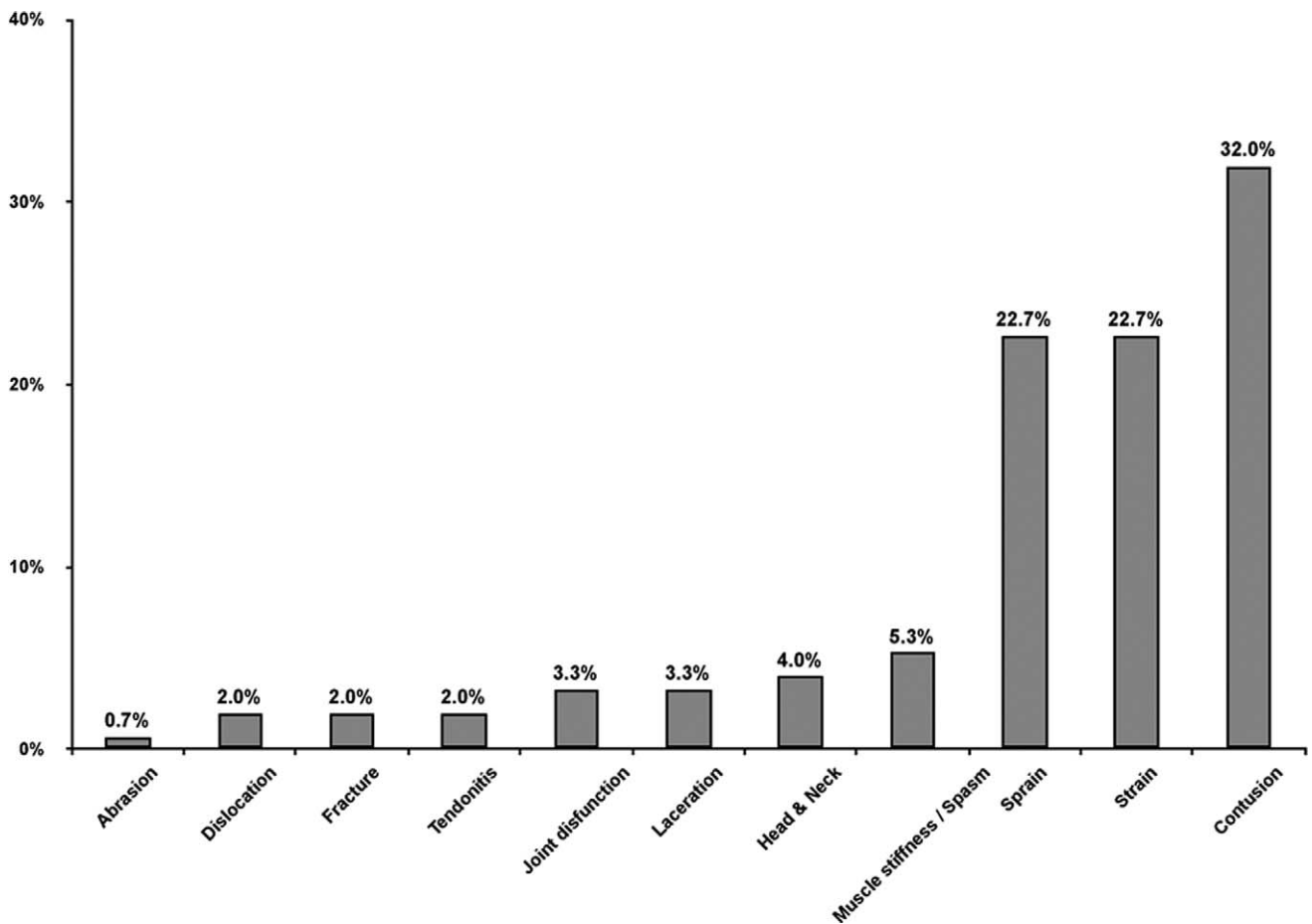


Figure 2. Percentage of injuries reported by type.

reported, whereby limited recovery time would affect the healing process of these injuries. One could argue, therefore, that this reflects a time bias of this study, as not all lacrosse games are played in this setting.

Injury Mechanism

The most frequent mechanism of injury was contact (53.3%; $n = 80$), which encompasses direct impact with another player (30.0%; $n = 45$), with a stick (16.7%; $n = 25$), or with a ball (5.3%; $n = 8$). This supports the findings of Lincoln et al,¹⁰ whereby player-to-player contact was found to be the primary mechanism of injury. McCulloch and Bach¹² also report a greater number of contact versus noncontact injuries. This is a clear indication of the physical nature of lacrosse, whereby body-on-body, stick-on-stick, and stick-on-hand contact is permitted.^{6,13} Change of direction, twisting, and sprinting were the most common noncontact mechanisms of injury (27.3%; $n = 41$), reflecting the athletic, fast-paced nature of lacrosse.

Injury Type

Only injuries requiring treatment were included in this study. The most frequently reported injuries were contusions

(32.0%; $n = 48$), closely followed by sprains (22.7%; $n = 34$) and strains (22.7%; $n = 34$). In contrast, despite listing the same 3 injuries as the most frequently occurring, studies on injuries sustained during NCAA lacrosse games show a greater level of sprains (26%) and strains (24%) than contusions (14%).¹² With regard to protective equipment, FIL rules only require players to wear a protective helmet with a face mask and padded gloves. All other protective equipment is voluntary, thereby leaving most of the body exposed to contact. In contrast, NCAA rules require participants to wear a helmet, gloves, gum shield/mouth guard, shoulder pads, and arm pads.¹³ This difference is evident in the data collected, whereby only 64.7% of injured players were reported to be wearing shoulder pads, 21.3% wearing mouth guards, and 92.0% wearing arm pads. It could be suggested based on these data that players partaking in lacrosse under the FIL rules tend to wear less protective equipment than those playing in the NCAA. Furthermore, when reporting figures collected regarding NCAA lacrosse, only injuries that caused players to miss a training session or game were included.^{7,12} In comparison, injury data collected in this study included any that required assessment and treatment by medical staff. Rule differences with regard to protective equipment and inclusion criteria, in addition to the aforementioned differences in game

TABLE 2
Reported Injuries by Body Region and Part

	n	% Total	% Region
Lower limb	80	53.3	
Hip/groin/pelvis	4	2.7	5.0
Upper leg	18	12.0	22.5
Knee	14	9.3	17.5
Lower leg	22	14.7	27.5
Ankle	21	14.0	26.3
Foot	1	0.7	1.3
Toes	0	0.0	0.0
Upper limb	35	23.3	
Shoulder	15	10.0	42.9
Upper arm	1	0.7	2.9
Elbow	8	5.3	22.9
Forearm	2	1.3	5.7
Wrist	2	1.3	5.7
Hand	1	0.7	2.9
Thumb/fingers	6	4.0	17.4
Head and neck	21	14.0	
Head	4	2.7	19.0
Face	3	2.0	14.3
Eye	1	0.7	4.8
Mouth/teeth	0	0.0	0.0
Neck	13	8.7	61.9
Trunk and back	14	9.3	
Back/spine	7	4.7	50.0
Chest/ribs	7	4.7	50.0
Abdominal	0	0.0	0.0

frequency, may therefore explain the higher incidence of contusions reported in this study.

Injury Area

Lower limbs were the most commonly injured area (53.3%), followed by upper limbs (23.3%), head and neck (14.0%), and the back and trunk (9.3%). Similar findings were reported by Dick et al⁵ in a study that found lower limb injuries made up 48.1% of all injuries sustained during games and 58.7% sustained during practices. Lower limb injuries were reported twice as often as upper limb injuries (50.7% [n = 76] vs 23.3% [n = 35]; rate ratio, 2.2; 95% CI, 2.1-2.3), which may be due to a lack of protection.^{7,12} No padding is worn on the lower limbs, apart from padded shorts and shin pads occasionally worn by goaltenders. This can account for the high number of lower limb contusion injuries (15.3%; n = 23), predominantly caused by contact with another player, stick, or ball. This is in keeping with existing evidence collected regarding lacrosse injuries.⁷ It could therefore be suggested that players should be encouraged to wear lower limb protection; however, one is then faced with the issue of balancing protection with the necessity of mobility and agility. The ankle was the most commonly injured joint (14.0%; n = 21).^{5,12} This equates to the nature of the sport involving physical play, frequent changes of direction, and speed.¹⁴ One could therefore suggest that players are encouraged by coaches and trainers to undergo preventative strength and conditioning programs

to promote ankle stability and proprioception to reduce the risk of noncontact ankle sprains.⁴ Appropriate and effective injury prevention programs and techniques, however, are another area of debate and research.⁴

The second most commonly injured joint was the shoulder (10.0%; n = 15), with 7 contusions, 3 acromioclavicular joint sprains, and 2 fractured collar bones reported. Of interest, under FIL rules, shoulder pads are not mandatory, and more than one-third of the sample (35.3%) did not report to be wearing shoulder pads at the time of injury (Figure 3). However, shoulder injuries are also reported in the existing literature despite the NCAA requiring the use of shoulder pads.^{5,7,12} For example, in this study, 3 acromioclavicular joint sprains (2% of total) and 2 fractured collar bones (1.3% of total) were sustained while wearing shoulder pads. Despite the mandatory use of shoulder pads in the NCAA, Dick et al⁵ reported acromioclavicular joint injuries made up 5% of all injuries sustained in game play and 2% in practice. This shows that shoulder injuries occur despite the use of shoulder pads. This could be because lacrosse players tend to use equipment that allows maximum mobility, and thus, lacrosse pads are smaller, less bulky, and more flexible compared with similar contact sports such as ice hockey and American football.^{7,12} It is reasonable to suggest, therefore, that shoulder pads designed for lacrosse may not provide adequate or appropriate protection.

Protective equipment used in lacrosse has not greatly evolved, apart from the helmet, over the past 20 years.^{2,7,12} From our literature search, the only lacrosse-specific protective equipment that has undergone stringent testing is the helmet.² Lacrosse padding is much lighter and less bulky than similar equipment used in ice hockey, American football, and other contact sports.^{7,12} For example, shoulder pads are smaller, thinner, and lighter compared with ice hockey and are of a noncantilevered design, meaning the pads rest directly on the shoulder.¹² Lacrosse has been described as an overhead collision sport, where the arm is extended and externally rotated in the normal throwing, catching, and ball-carrying positions.⁷ The force from a blow by another player, a ball, or the ground can therefore be directly transferred to the bony structures, joints, and soft tissues in the area. Dick et al⁵ suggested that shoulder pads be redesigned to protect the acromioclavicular joint while allowing good range of movement based on the nature of the sport. The findings of this study corroborate this suggestion and support the concept of further research into more appropriate and effective shoulder padding to help limit the frequency and severity of shoulder injuries.

Limitations

Only 27 of 29 countries compiled the requested data, therefore limiting the study size. Broad classifications were used to group data (body part injured, diagnosis, mechanism, and time of injury), which risks confounding variables. No indication of injury severity within these broad classifications was collected. Therefore, differentiating significance of injury was not possible. There was no follow-up of players after injury with regard to short-term impact, such as the

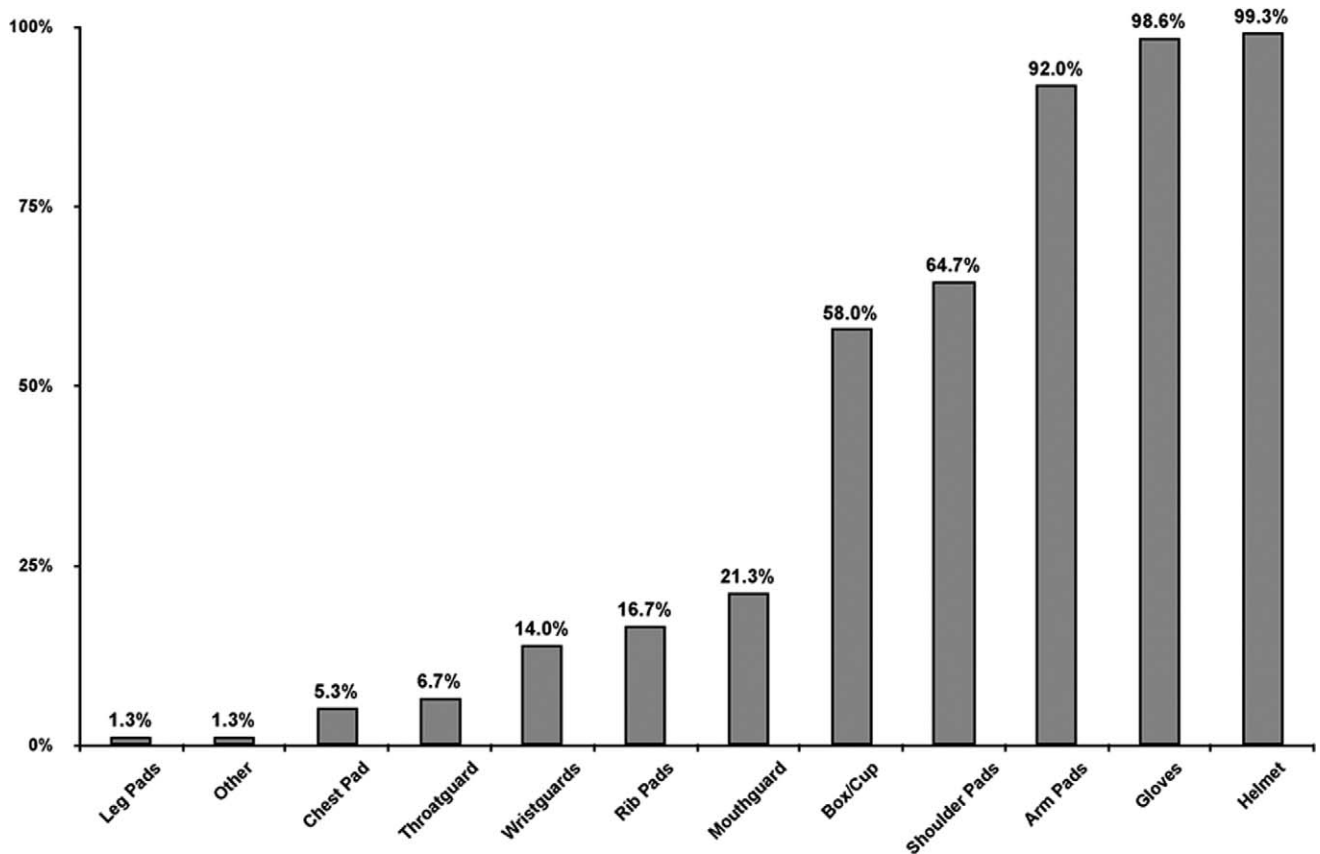


Figure 3. Percentage of players wearing equipment at the time of specific injuries.

remainder of the tournament, or longer term with regard to future sporting performance or daily activities. The NCAA has an established injury surveillance system that allows for robust analysis, which was not possible in this study due to financial and resource limitations. Furthermore, this study included a more diverse age range of between 16 and 46 years (mean, 26.4 years) compared with previous studies based on NCAA data limited to college-age athletes. This may affect the type of injuries sustained and their impact, meaning differing injury sequelae and thus biased injury reporting. Additionally, the participants involved in the World Championships ranged from amateurs to professional athletes, which could have an impact on fitness levels, recovery time, and access to specialist medical and athletic staff during and prior to the tournament. From the data collected, it is not possible to differentiate between the 2 groups, which could limit the generalizability of the results. However, despite these limitations, the findings of this study have been shown to corroborate with the results and conclusions of previous research.

Implications and Suggestions

As participation in men's lacrosse expands globally, health professionals unfamiliar with the sport could be responsible for lacrosse players. The combination of physical play,

athleticism, and equipment used means players are susceptible to a range of injuries. Familiarity with the sport's common injury patterns could help in treatment, prevention, and recovery, an argument also put forth by previous studies.⁷ Despite differences in rules, the findings of this study agree with reports from North America.^{5,7,12} We would like to encourage the FIL to develop a system to allow prospective injury data collection during all FIL events, which would be designed to address the limitations identified with regard to this study. Using the Hootman 4-step injury prevention model to (1) identify the problem, (2) establish etiology/mechanisms, (3) implement interventions, and (4) reevaluate the effect, appropriate review and modifications to rules and protective equipment could be implemented.^{8,12} Further study is therefore recommended, including video analysis of injuries if possible, such as that used by Caswell et al³ in relation to head injuries sustained in women's lacrosse. More recently, a study analyzing video footage of high school men's lacrosse demonstrated that all concussions occurred during player-on-player contact. The authors stressed the importance of reinforcing the rules of the game to reduce contact with the head.^{9,10} Dick et al⁵ suggested that future research is needed to identify ways to reduce the number of injuries in male collegiate lacrosse players. In particular, they focus on players' protective equipment, which, with the exception of helmet design, has

not evolved significantly over the last generation.^{2,12} The findings of this study would support this claim. At present, companies appear to be working toward more flexible and lightweight equipment, which could be argued to be compromising protection offered. With further evidence, companies could be encouraged to develop appropriate protective equipment, and governing bodies may wish to implicate rules to make greater protection mandatory. Based on the information obtained through this study, one area that needs specific attention is shoulder protection and greater protection from contusion injuries in general.

Furthermore, the higher incidence of game-based injuries suggests the need for appropriately trained and equipped medical coverage at games and trainings. This may not be possible at a grassroots level, but should be encouraged at all tournaments, especially on an international stage.^{7,12} Awareness of the difference in FIL rules and potential injury differences will in turn assist those planning and covering these events to be better prepared.

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