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Injuries in International Men's Sixes Lacrosse: Injury Surveillance of the British Lacrosse Men's National Team During a 9-Month Training Cycle Leading up to and Including The World Games 2022

World Lacrosse Sixes (Sixes) is a new format of lacrosse. The new format began in 2018 following World Lacrosse being officially recognized by the International Olympic Committee. The first set of official playing rules for Sixes followed in 2021. World Lacrosse's objective is to continue to grow the sport worldwide by increasing access and appeal to lacrosse, balancing competition at major international events and fit within the 21st Century Olympic Framework.[20]

■ **OBJECTIVE:** To describe the injury epidemiology of a men's national Sixes lacrosse team across training and competition.

■ **DESIGN:** Prospective observation study.

■ **METHODS:** This study prospectively observed injuries that occurred within a training and competition cycle of the British Men's National Lacrosse team. Data were collected by the team physiotherapist, injury incidence was calculated, and data categorized into injury type, body part, and mechanism.

■ **RESULTS:** Forty-three injuries occurred during Sixes competition. Injury incidence varied between practice and tournaments. Twelve percent of all injuries were time loss. Two thirds of the time, players continued playing following intervention. One in every 5 injuries was treated with self-management strategies. Injuries most frequently occurred in competitive matches (65%). Most injuries were sustained through a contact mechanism (49%) or an overload mechanism (37%). The most frequent injuries were contusions (26%) and muscle injuries (26%). The lower limb was the most frequently injured area (63%), with the lower leg predominantly being the most affected part of the lower limb (63%).

■ **CONCLUSIONS:** To our knowledge, this is the first epidemiology study of Sixes lacrosse injuries. Further research is required to better understand the epidemiology and risk factors for injuries in Sixes lacrosse. *JOSPT Open 2023;1(1):1-7 Epub: 19 June 2023. doi:10.2519/josptopen.2023.0008*

■ **KEY WORDS:** *epidemiology, lacrosse, Injury Surveillance*

Traditional men's field lacrosse is a full-contact sport played with 10 players on each team. Injury surveillance has gained research attention due to growing levels of participation and international competition.[4,7,14,18] A recent systematic review demonstrated that common injuries reported within men's field lacrosse occur within the lower leg/ankle/foot, head, shoulders, and hand. A plethora of studies within this review demonstrate that the most common mechanisms of injury are from contact with another player or with equipment.[14] This is consistent with findings from 2 studies that analyzed injury data from international men's lacrosse World Championships in 2010 and 2018, where contact injuries were most prevalent compared to noncontact injuries. Both studies also revealed that contusions were the most common type of injury, followed by ligament sprains and muscle strains.[7,18]

The formation of the Sixes format of lacrosse comes with some significant changes to the rules and general gameplay. This is summarized in **TABLE1**. These rule changes may impact how injuries occur and what types of injuries may be seen in Sixes lacrosse. The majority of injury scenarios in men's field lacrosse occurred during settled offensive play and body-to-body contact with midfielders.[6] The parameters of this are different within Sixes lacrosse by the implementation of a 30-second shot clock, reducing the time of settled play; smaller field size, reducing the time/distance required to carry the ball; and crucially, the removal of forceful body-to-body checking

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TABLE 1
Table of Major Rule Differences Between Men's Field Lacrosse and Men's Sixes Lacrosse (Adapted From World Lacrosse[20])

Rule Differences Between Men's Field and Sixes Lacrosse		
Men's Field (International Rules)	**Sixes**	**Difference**
Field size: 110 × 60 m	Field size: 70 × 36 m	Smaller field size
Squad size: 23 players, 10 on field	Squad size: 12 players, 6 on field	Smaller squad size
International game time: 60 min, 4 × 15-min quarters Domestic game time: 80 min, 4 × 20-min quarter	Game time: 32 min, 4 × 8-min quarters	Shorter game time
No shot clock. A team that is "stalling" must keep the ball in the offensive zone.	30-s shot clock	Shorter periods of possession, higher turnover of possession
Forceful body-to-body contact in a legal manner is permitted.	Forceful body-to-body contact is not legal.	Reduced forceful body-to-body contact
No rule against forming a wall or stacking to block a shot.	Defenders cannot form a wall or stack to block the goal.	Reduced chance of a defensive player being struck by a ball

from legal play.[5] There is also likely to be differing physical demands required for the 2 formats; there are studies emerging, which document the match demands of field and Sixes lacrosse,[1,19] although this is yet to be explored in detail. These changes make any direct extrapolation or assumptions regarding injury incidence from the field format into Sixes potentially invalid.

There is an absence of musculoskeletal problems epidemiology data and injury surveillance in Sixes lacrosse. Prospective epidemiological data may allow Sixes lacrosse teams to implement strategies to reduce the risk of injuries, particularly as the Sixes format grows and develops to potentially feature in future editions of the Summer Olympic Games. Therefore, the aim of this descriptive epidemiology cohort study was to identify and investigate the prevalence of injuries in Sixes lacrosse within a training cycle and competition of the British Lacrosse Men's National Lacrosse team.

METHODS

Data were collected over a 9-month training cycle, which concluded at the end of the World Games in 2022. Twenty elite nonprofessional men's Sixes lacrosse players from the British Men's Lacrosse team were included, due to rotation and availability of players among training and competitions. Individuals consented to injury data being collected and used in this study. Ethical approval was granted by the University of Leicester Ethics Board. Baseline demographic information was collected including playing experience, previous orthopaedic procedures, previous injuries, and medical conditions. In total, data were collected over 10 training sessions in the United Kingdom (UK), 2 European tournaments, precompetition training camp in the United States of America (USA), and the World Games 2022 (USA). An injury was defined as any physical problem regardless of its consequence,[8] and injuries were only included in the study if it occurred by playing Sixes lacrosse. Injuries reported that were sustained through other formats of lacrosse and other sports were excluded.

Reported injuries were subclassified into medical attention injuries (injuries assessed and treated by the physiotherapist without ceasing play) or time-loss injuries (injuries resulting in ceasing play). Reported problems were all assessed by the lead physiotherapist, and data were collected according to the Strengthening the Reporting of Observational Studies in Epidemiology Extension for Sports Injury and Illness Surveillance (STROBE-SIIS) checklist.[2] Data were inputted onto a database and analyzed using Microsoft Excel (Microsoft Corp, Redmond, WA, USA). The injury incidence was calculated to determine the incidence of injury per 1000 hours of play using the following formula:

Incidence = Number of injuries/(Exposure in time × number of players at event) × 1000.

This was done for training sessions and tournaments. The corresponding 95% confidence intervals were calculated for the injury rates based on the assumptions of a normal approximation to a Poisson distribution.

RESULTS

Throughout the training cycle, 12 players (60%) reported at least 1 injury. There was a total of 43 reported injuries among the squad of 20 players that were deemed to be a result of playing Sixes lacrosse. Of these, 5 (12%) injuries involved time loss, 29 (67%) injuries were non–time loss with intervention from the physiotherapist (ie, rehabilitation, strapping, manual therapy, and hot/cold therapy) and 9 (21%) of the injuries were non–time loss and only required self-management. Throughout the cycle, 12 (28%) injuries occurred during practice sessions, 3 (7%) during match warm-ups, and 28 (65%) during competitive matches. **FIGURE 1** identifies the timing during the training cycle these injuries occurred, as well as the mechanism of injury that occurred.

The injury incidence throughout the training and competition cycle for the Sixes lacrosse team at different events is

FIGURE 1
Injury occurrence during the British Lacrosse Sixes Men's Training Cycle.

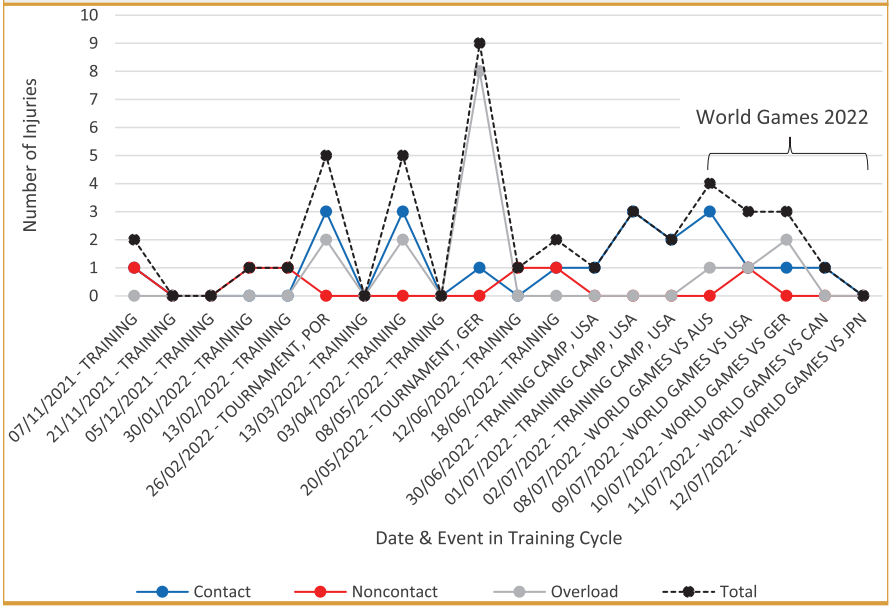


TABLE 2
Summary of Injury Incidence With and Without Time-Loss Injuries Throughout the Training Cycle at Different Significant Events

Event	Injuries Reported	Time-Loss Injuries Reported	Number of Players	Number of Sessions	Exposure (Total Hours)	Exposure × Number of Players	Injuries per 1000 h	Time-Loss Injuries per 1000 h
Training (UK)	12	3	20	11 practices	55	1100.0	10.9 (95% CI: 4.7, 17.1)	2.7 (95% CI: 0.0, 5.8)
Tournament (Portugal)	5	0	20	5 matches	2.65	53.0	94.3 (95% CI: 11.6, 177.0)	0
Tournament (Germany[a])	9	0	11	6 matches	3.18	35.0	257.3 (95% CI: 89.1, 425.1)	0
Training Camp (USA)	6	2	12	3 matches, 6 practices	7.59	91.1	65.9 (95% CI: 19.9, 133.8)	22.0 (95% CI: 0.0, 52.4)
World Games (USA)	11	0	12	5 matches, 2 practices	4.65	55.8	197.1 (95% CI: 80.6, 313.6)	0

[a]*Five of the 11 players at this tournament were also competing for a box lacrosse team over the duration of the tournament.*

highlighted in **TABLE 2.** This acknowledges the changes in the squad number at these events due to the squad selection process leading up to the World Games and differing exposure hours.

Injury Location

Throughout the training cycle, the lower limb was most commonly injured, accounting for 27 (63%) of the total injuries. This was followed by 8 (19%) upper-limb injuries. Head/neck and trunk/back were equal with 4 (9%) injuries each. **FIGURE 2** represents the proportion of injuries at different body regions and parts. The lower leg accounted for 17 (63%) injuries within the lower limb; this was followed by the knee and the upper leg with 4 (15%) each. Typical injuries observed in the lower leg (n = 17) were related to calf muscle injury and Achilles tendinopathies with 7 (41%) and 6 (35%) injuries respectively. Meanwhile, upper leg (n = 4) complaints were typically because of hamstring issues (n = 3) and lateral thigh discomfort (n = 1).

Mechanism of Injury

Overall, there was a higher incidence of contact injuries (n = 21, 49%,) compared to overload injuries (n = 16, 37%) and noncontact injuries (n = 6, 14%). The contact injuries were caused by an opposing player (n = 10, 48%,), ball (n = 7, 33%), stick (n = 3, 14%), and the ground (n = 1, 5%). Contact injuries were the most diverse among affected body regions, affecting the head & neck (n = 4, 19%,), lower limb (n = 8, 38%,), trunk & back (n = 2, 10%), and upper limb (n = 7, 33%). Overload injuries (n = 16) were observed to be most prevalent among the lower limb (n = 14, 88%). Only 6 injuries occurred as a result of a noncontact mechanism of injury, the majority of these taking place in the lower limb (n = 5, 83%). Contact injuries primarily resulted in contusions and noncontact injuries resulted in strains, whereas overload injuries were a common cause of muscle and tendon discomfort (**FIGURE 3**).

Type of Injury

The most common type of injury reported during the training cycle was muscle spasms/discomfort and contusions accounting for 11 (26%) injuries each (**FIGURE 4**). Muscle injury was characterized by pain within the main muscle belly but did

FIGURE 2
Total injuries by body region and body part.

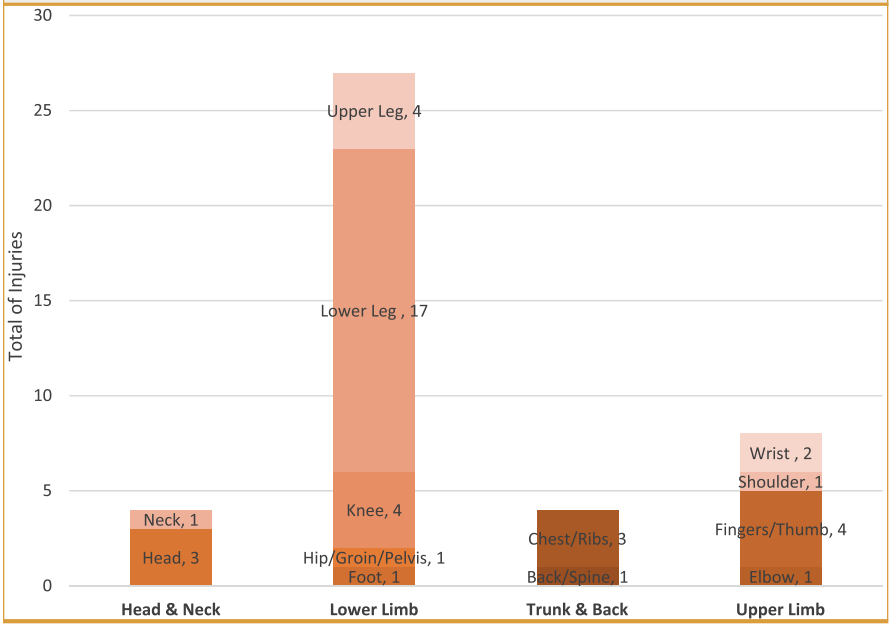
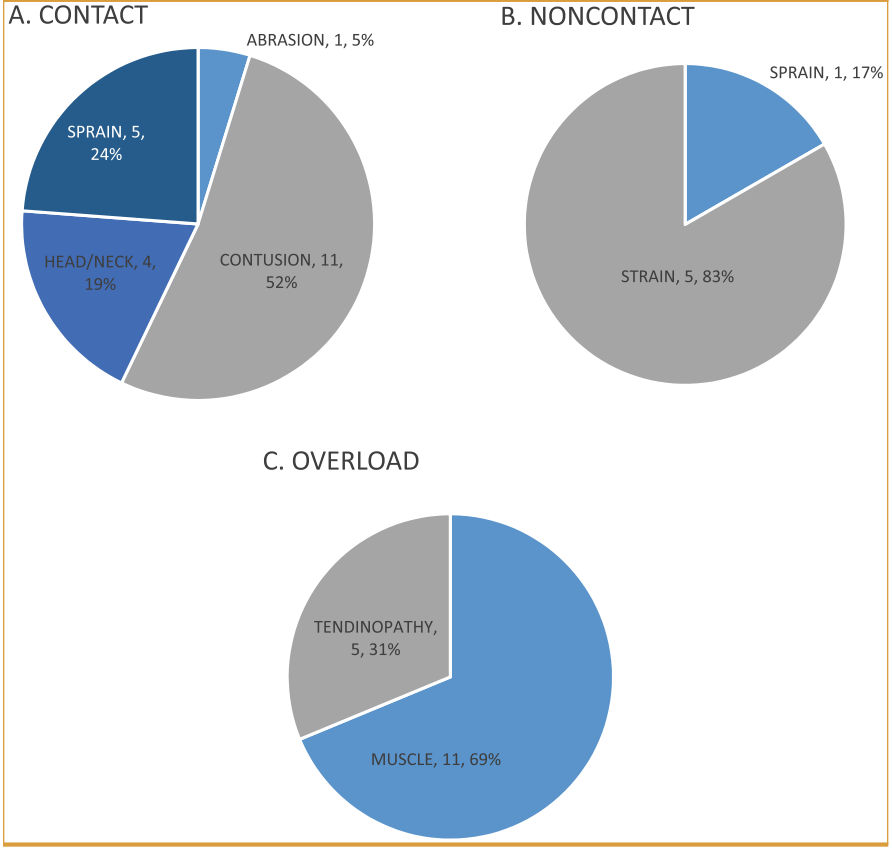


FIGURE 3
Proportion of type of injury by mechanism of injury.



not have a discrete mechanism of injury or characteristics of a muscle strain within the history or presentation. Thus, it was considered to be a result of overload. Contusions occurred as result of contact. The 5 time-loss injuries that resulted in ceasing play were as follows: hamstrings strain (n = 2), wrist sprain (n = 1), and head injury (n = 2). The 2 head injuries were removed from play for further sport-related concussion assessment.[16]

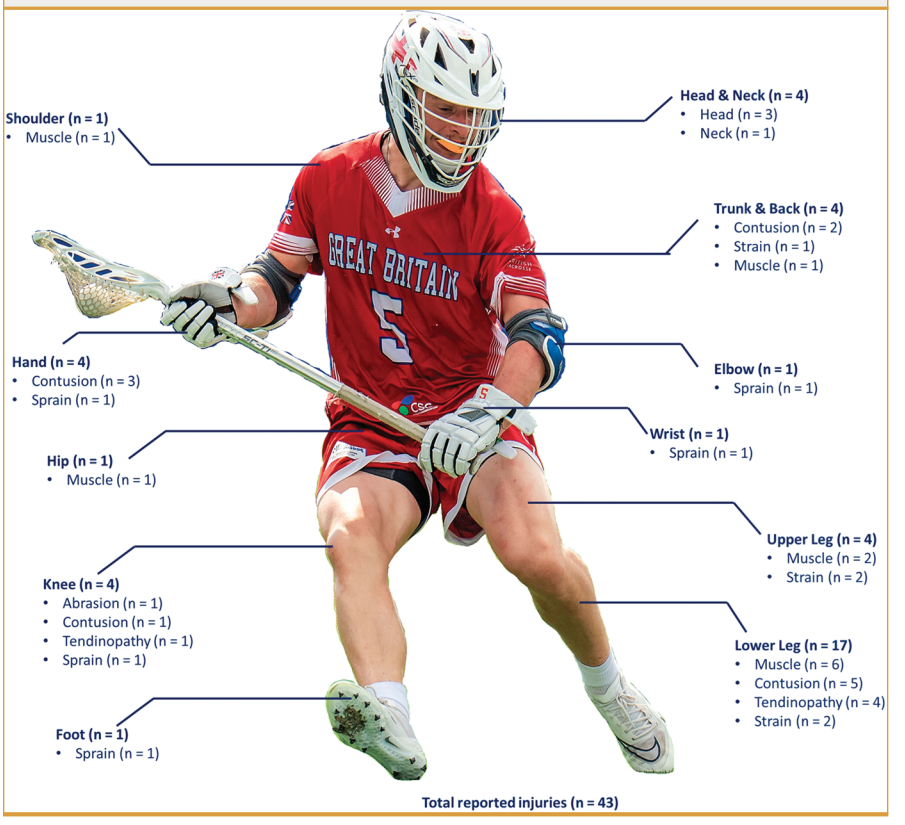
DISCUSSION

We provide a preliminary insight into the injury profile associated with Sixes lacrosse. Injury incidence within the cohort was somewhat high, but there were few time-loss injuries in Sixes lacrosse. Injury incidence was greater during match competition compared to training and the most common mechanism of injury during Sixes lacrosse was through contact, commonly resulting in contusions and sprains. This was followed by overload injuries resulting in muscle injury and tendon pain. The time-loss injuries were hamstring strains from a noncontact mechanism (n = 2), wrist sprain (n = 1), and head injury assessments (n = 2) from body contact mechanisms.

Body Region

The lower limb was the most commonly injured region, particularly the lower leg involving the gastrocnemius, soleus, and/or Achilles tendon. This is consistent with observations made in the men's field game[14,18]; however, conflicting evidence reports that other areas of the lower limb to be more commonly affected such as the knee.[7,9] The high frequency of lower-leg injuries may be due to the volume of acceleration, deceleration, and sprinting required in Sixes lacrosse,[19] as this has been identified as a common risk factor for lower-leg injuries.[13] This is an important issue for future research to identify

FIGURE 4
Types of injury per body region.



the characteristics and risk factors for lower-leg injuries in Sixes lacrosse.

Mechanism of Injury

The most common mechanism of injury during Sixes lacrosse was those sustained through contact, often resulting in contusions. Noncontact injuries primarily resulted in sprains, whereas tendinopathies and fatigue-induced muscle injuries were a result of overload. It is widely considered that the risk factors for these types of injuries can be addressed and the risk of these injuries can be reduced.[3,10]

Within the collegiate field game in North America, half of injuries were a result of contact, one third were due to noncontact, and 1 in 10 was due to overuse.[9] This suggests similarities in the mechanism of injury between Sixes lacrosse and collegiate field lacrosse for contact injuries. However, the 2 formats differ in the proportion of noncontact and overload injuries, where noncontact injuries are more prevalent in field lacrosse, and overload injuries are more prevalent in Sixes. The increase in overload injuries may be due to players participating in multiple formats of the game and therefore increasing their training load. Strategies to reduce the risk of overload and noncontact injuries in Sixes lacrosse players may be pertinent.

Injury Incidence

The injury incidence fluctuated between tournaments and training events, although this should be interpreted with caution due to the small number of incidences, events, and sample size, the large confidence intervals for these rates.

The high injury incidence in this in competition may be due to the fixture scheduling of international Sixes tournaments involving consecutive games over a short period of time. This is considered to be a factor contributing to the risk of injuries in an international men's field lacrosse tournament, as this has a similar congested competition schedule format.[7] Additionally, due to the squad sizes in Sixes being restricted to 12 players, it is unsurprising that the injury incidence was high compared to an international men's field teams and American collegiate teams, with their squads of 23 players and up to 50 players in their respective rosters. Another aspect to consider is that the player exposure in this study considered the time the players spent playing Sixes lacrosse. The majority of the squad also spent time training and competing in other formats of the game (box and field lacrosse), in addition to other sports for some, thus increasing their risk of injury through increased exposure, higher training and playing loads,[12] and fatigue.[17] Although, there are schools of thought that this may actually reduce the risk of injury if the training loads are consistent.[12]

The highest injury incidence was reported at the second European tournament. However, it is worth noting that five of the 11 players competing at this tournament were simultaneously also competing in a box lacrosse tournament, potentially increasing player load exposure and physical demands along with increased physicality associated with box lacrosse. Furthermore, the squad carried one less player (11) compared to that of a standard Sixes tournament squad (12), further increasing player load. At this tournament, overload-induced calf pain was the most common injury.

The World Games tournament saw the second highest injury incidence with 11 injuries in 5 consecutive games. The majority of these were lower leg injuries (n = 6)

as a result of tendinopathy (n = 3), contusion (n = 2), and strains (n = 1). Most other injuries were contusions at other body regions as a result of contact. This aligns with similar types of injuries seen in previous World Games events for other sports. For example, in the 2013 World Games, contusions were the most common type of injury observed followed by overuse injuries across all sports.[15] Similarly in the 2012 Olympic Games, overuse injuries were most common and contact injuries were prevalent in team sport events.[11] Despite lacrosse not featuring in any of these multisport events, comparison of injury risk may be a factor for consideration in its inclusion in future multisport events, in the interest of the athlete's health and safety.

Limitations

This study is representative of the population of elite nonprofessional lacrosse players in the UK; it is the first cohort study of its kind within Sixes lacrosse and may begin to inform risk mitigation strategies for national teams.

However, this study is not without its limitations. Firstly, the sample size in this study is small and may not represent other squads from other countries such as North America. Secondly, injury severity was limited to only assessing if the injury had ceased play immediately. Total time loss was not calculated and may not reveal the true extent of the severity of the time-loss injuries. This was due to players returning to their domestic clubs and returning to play outside of Sixes training. Lastly, there is crossover of players that play different formats of lacrosse, being members of the Sixes lacrosse squad, field lacrosse squad, and box lacrosse squad within the UK nations. This will likely impact injury risk and attainment, which may make it difficult to differentiate if an injury was the result of 1 format of lacrosse or another.

Application and Future Research

These findings suggest that Sixes lacrosse presents with an expectedly high risk of injury particularly during competitive matches and that the lower leg has the highest incidence. There is potentially an increased risk of overload injuries from playing a high volume of Sixes lacrosse, particularly alongside other formats of the game. This may help inform athletes, coaches, officials, medical staff, governing bodies, and tournament organizers of the risks of participation in multiple formats of the game and should induce collaboration between coaches of players involved across the different formats. This may be problematic in a nation with a small player pool such as the UK. Although the time-loss injury incidence was low in Sixes, these injuries may have a detrimental effect on performance. Future research to investigate injury epidemiology in a wider population of Sixes lacrosse players, injury severity, and modifiable risk factors is required to develop targeted strategies aimed at reducing the risk of injuries associated with international Sixes lacrosse.

CONCLUSION

In Men's National Sixes Lacrosse, there was a high incidence of injuries but few time-loss injuries. Injury incidences fluctuated throughout the surveillance cycle, and most injuries occurred during competitive matches. The lower limb was the most commonly injured body region in Sixes lacrosse, with the lower leg being most prevalently affected. The majority of injuries occurred via a contact mechanism and overload. ■

KEY POINTS

FINDINGS: Low severity lower leg injuries, such as muscle and tendon pain, were the most common injuries and were associated with no time loss. Hamstring strains and head injury assessments were associated with the most time loss from lacrosse.

IMPLICATIONS: This is the first injury surveillance study assessing international Sixes lacrosse and was completed over a 9-month training cycle for a national men's team. The epidemiologic data from this study can serve as baseline data for future injury surveillance and inform injury risk mitigation interventions.

CAUTION: The main limitations of this study is the small sample size, which limits the generalizability of results at this time.

STUDY DETAILS

AUTHOR CONTRIBUTIONS: M.C. was the lead writer of the manuscript, responsible for study design, data collection, and analysis. N.R., T.W., and S.O. were critical reviewers of the manuscript and approved final version.

DATA SHARING: All data relevant to the study are included in the article or are available as supplementary files.

PATIENT AND PUBLIC INVOLVEMENT: There was no patient and/or public involvement in the design, conduct, interpretation, and/or translation of the research.

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