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Original Research

The Epidemiology of Injury in British American Football University Sport: A Single Site Prospective Cohort Study

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Background and aim

American Football is a developing sport in the United Kingdom. Establishing injury rates is the first part of any injury prevention strategy. To date, medically reported injury rates amongst British American Football (AF) university athletes are limited. Therefore, this study aimed to estimate the prevalence, severity, mechanism and period of game related injury in a British university AF team over one season.

Methods

Twenty-four male university AF players were observed. The consensus statement on injury definitions in rugby union (2007) and the Community Rugby Injury Surveillance and Prevention (CRISP) programme were followed. Several injury factors were measured (e.g., injury site, type, severity, mechanism etc.). One variable chi squared tests (x^2) calculated if expected values were significantly different from observed values.

Results

Thirty-two injuries were sustained across the 9-game season, a clinical incidence of 0.75. Contact injures accounted for 68.8% of all injuries. Common sites of injury were the knee (21.9%) and shoulder (15.6%), whilst ligament (25%), muscle (21.9%) and haematoma (21.9%) injuries were most frequent types. Forty percent (12/32) of injuries had moderate severity.

Conclusion

This is the first prospective medically reported cohort study to estimate the prevalence, severity, mechanism and period of injury in a single British university AF team. Findings are comparable to studies from the United States, with injures due to contact being the most frequent. Further research is needed however to determine whether these findings are representative of wider British university leagues.

Practical Implications

The data generated from this study allows the multidisciplinary sports science team to focus injury risk reduction strategies by region and injury type.

INTRODUCTION

In the United Kingdom (UK), American Football (AF) is governed by the British American Football Association (BAFA). The game is played at various levels, with athletes competing in the British University and Colleges (BUCS) since 2012.[1] In 2019, student BUCS AF membership was reported at 4,230, with 81 registered teams.[1]

BUCS classifies both the Premiership and Division 1 as performance divisions, focusing on creating an elite environment on and off the field. Comparably lower divisions are participation focused.[1] British AF university-level sport is age equivalent to collegiate football played in the United States (US) in the National Collegiate Athletic Association (NCAA), however the level of competition is not comparable for various reasons. Primarily, a large proportion of British players will first play AF at university, unlike in the US where players begin at youth or pee wee level (aged 5 or 6).[2] Secondly, the level of support provided to British athletes is far inferior to their US counterparts. In the UK, significant differences in medical support, training facility quality, institutional funding and adherence to emergency medical procedures have been observed.[3]

Injury prevention models have been designed to guide the efforts of injury risk reduction. Previously, Van Mechlen et al.[4] outlined four stages to injury prevention in sporting

populations: 1) investigate the extent of the problem; 2) identify the mechanisms of injury; 3) introduce a preventative strategy and 4) evaluate the effectiveness of this preventative strategy. More recent injury prevention strategies designed for team sports takes a 3 phased approach of evaluation, identification and intervention.[5] Epidemiological studies are used to understand if injury problems exist in different populations. A vast number of epidemiological studies have been conducted in NCAA football, including the ongoing NCAA Injury Surveillance Programme which has been running since 1982.[6] Findings suggest injury rates are higher in competition than practices with common injuries occurring at the knee, ankle and shoulder/clavicle regions.[7] To date, there is only one publication in the UK which estimated injury rates in the BUCS AF game.[2] This study reported that 51.5% of injuries occurred in games.[2] Furthermore, UK players with a history of concussion are twice as likely to acquire a concussion compared to those athletes with no concussion history and suffer more severe injuries than their US collegiate athletes.[2] Whilst this provides a valuable insight into injuries among UK university players, data was self-reported and therefore the level of insight and application is limited. To the authors knowledge there is no specific injury classification system for AF. Therefore, the aim here was to be the first medically reported study to estimate the prevalence, severity, mechanism and period of game related injury in a single British university AF squad over the course of one season, utilising the first phase of the Team-Sport Injury Prevention (TIP) cycle[5] and Community Rugby Injury Surveillance and Prevention (CRISP) programme, an established injury surveillance model used in other sport codes in the UK.

METHODS AND MATERIALS

DESIGN

A single-site prospective cohort design was conducted during the BUCS premiership division during the 2019-20 season from 3rd November 2019 to 1st March 2020. Male university student athletes from one university AF programme were invited to take part in the study. Prior to participating, athletes provided verbal and written consent and ethical approval was gained from Hartpury University Research Ethics Committee.

PROCEDURE

Injury surveillance was performed over the entirety of one season which equated to 9 competitive games, with all injuries diagnosed and recorded by one certified university medical staff who was a professionally accredited Graduate Sports Therapist with 5 years and 10 seasons (university and senior level) of graduate experience within the sport. Anthropometric data was not gathered due to limited access to the team outside of game day. On-field training and competition exposure was not calculated due to the lack of availability of sport science staff at every session. The following definition of injury was used: “a physical complaint reported to medical staff by a player regardless of whether it resulted in time-loss or not”.[8] Only injuries which occurred during competition were recorded and therefore absences due to illness or injuries outside of games were omitted. Time loss was defined as “absence from participation in match play or training”.[8] The date of the game or training where a player was ready to return to play was defined by the number of days missed. Readiness to return to play was solely determined by the team’s Graduate Sports Therapist. Severity of injury was grouped as slight (0-1 days), minimal (2-3 days), mild (4-7 days), moderate (8-28 days), severe (>28 days), "career-ending and “non-fatal catastrophic injuries”.[8] Injury severity was defined as “time (days) lost from competition and practice from the date of injury to the date the player was deemed to have regained sufficient physical fitness to be able to return to play”.[8] Both contact and non-contact injuries were recorded. A contact injury was defined as an injury sustained during contact with another player or object e.g., a ball, whereas a non-contact injury was defined as an injury sustained where there was no physical contact with another player or injury e.g., change of direction. Details on injury type and location were recorded using methods outlined by Fuller et al.[8] Ground conditions (grass or artificial turf), weather conditions and injury period were also recorded.[9] Where a player reported two different playing positions, the dominant position (in terms of playing time, as reported by the player) was listed.

DATA AND STATISTICAL ANALYSIS

Data analysis was conducted using Microsoft Excel version 2012 and SPSS for Windows version 28.0.1.1. Descriptive statistics were used to report injury tally frequencies of severity, anatomical site, type of injury, mechanism of injury, affected side, playing position, weather conditions, injury period and ground conditions. One variable chi squared tests (x^2) were used to calculate if expected values were significantly different from observed values for the following variables: playing position, ground conditions, injury period, weather conditions, injury type, affected side, injury site and severity of injury. Statistical significance was set at $p < 0.05$.

RESULTS

In a team of 24 players, a total of 32 injuries were sustained in 20 male 1st team players, providing a clinical incidence of 0.75. Initially planned as an 11-game season, the season was reduced to 9 games due to the COVID pandemic.

Contact injuries accounted for 68.8% (22/32) of all injuries. No fatal or career-ending injuries were reported. Of the 32 injuries sustained, the largest proportion of injuries were reported as moderate severity (40.6%, 12/32). Table 1 shows injury incidence by severity. A one-variable chi squared test found a significant difference between expected and observed values in severity x^2 (4, n= 32) = 10.188, p = 0.03.

The most frequently injured site was the knee (21.9%, 7/32) followed by the shoulder (15.6%, 5/32). The third most

Table 1. Injury severity, Injury mechanism, type and site of injury.

Injury	Frequency (Injury Tally)
Total	100 (32)
Severity	
Slight (0-1 days)	18.8 (6/32)
Minimal (2-3 days)	6.3 (2/32)
Mild (4-7 days)	15.6 (5/32)
Moderate (8-28 days)	40.6 (12/32)
Severe (>28 days)	18.8 (6/32)
Mechanism of injury	
Blocked	3.1 (1/32)
Blocking	18.8 (6/32)
Hit by object e.g., ball	6.3 (2/32)
Tackled	9.4 (3/32)
Tackling	28.1 (9/32)
Other Contact	3.1 (1/32)
Non-contact	12.5 (4/32)
Unknown	12.5 (4/32)
Other	6.3 (2/32)
Injury Type	
Concussion	3.1 (1/32)
Dislocation	6.3 (2/32)
Fracture	3.1 (1/32)
Haematoma	21.9 (7/32)
Ligament sprain	25.0 (8/32)
Meniscus	3.1 (1/32)
Muscle strain	21.9 (7/32)
Nerve	3.1 (1/32)
Other	3.1 (1/32)
Pain/undiagnosed	9.4 (3/32)
Injury Site	
Ankle	3.1 (1/32)
Lower leg	6.3 (2/32)
Knee	21.9 (7/32)
Thigh	9.4 (3/32)
Hip/groin	3.1 (1/32)
Lumbar region/Sacrum	3.1 (1/32)
Neck/cervical spine	3.1 (1/32)
Shoulder	15.6 (5/32)
Sternum	3.1 (1/32)
Upper arm	3.1 (1/32)
Elbow	3.1 (1/32)
Wrist	6.3 (2/32)
Fingers	3.1 (1/32)
Thumb	9.4 (3/32)
Head/face	6.3 (2/32)

frequent injured sites were the thumb (9.4%, 3/32) and thigh (9.4%, 3/32). A one-variable chi squared test found no significant difference between expected and observed values in injury site x^2 (14, n= 32) = 20.500, p = 0.11 (Figure 1 and Table 1).

Table 2. Injury period and weather conditions.

Injury	Frequency (Injury Tally)
Total	100 (32)
Injury Period	
First Quarter	15.6 (5/32)
Second Quarter	12.5 (4/32)
Third Quarter	37.5 (12/32)
Fourth Quarter	18.8 (6/32)
Warm Up	6.3 (2/32)
Unknown	9.4 (3/32)
Weather Conditions	
Cloud	6.3 (2/32)
Dry	18.8 (6/32)
Rain	65.6 (21/32)
Sun	9.4 (3/32)

Of all injuries, the left side (46.9%, 15/32) was more commonly injured than the right side (37.5%), anterior aspect (3.1%, 1/32), posterior aspect (3.1%, 1/32) and no significant aspect (9.4%, 3/32). A significant difference between expected and observed values was found in affected injured side x^2 (4, n= 32) = 27.375, p = <0.001.

The three most common injury types were ligament sprains (25%, 8/32), muscle strains (21.9%, 7/32) and haematomas (21.9%, 7/32). Medial Collateral Ligament (knee) injuries were the most common injury sustained (15.6%, 5/32) (Table 1 and Figure 1). A one-side chi squared test found a significant difference between expected and observed values in injury type x^2 (8, n= 32) = 26.500, p = <0.001.

Contact injures accounted for 68.8% of all injuries. The player initiating contact appeared to sustain more injuries (46.9%, 15/32). Tackling injury incidence was higher (28.1%) than injury incidence due to being tackled (9.4%). Injuries due to initiating blocking was higher (18.8%) than injuries due to being blocked (3.1%) (Table 1).

Of all injuries, the most common weather condition at the time of injury event was rain (65.6%, 21/32), dry conditions (18.8%, 6/32) and sunny weather (9.4%, 3/32). A one-variable chi squared test found a significant difference between expected and observed values in weather conditions at the time of injury x^2 (3, n= 32) = 29.250, p = <0.001 (Table 2).

The most common period for injury was the third quarter of the game (37.5%, 12/32). A one-variable chi squared test found a significant difference between expected and observed values in injury period x^2 (5, n= 32) = 11.875, p = <0.037 (Table 2).

A greater number of injuries occurred on artificial turf (90.6%, 29/32) compared to grass ground conditions (9.4%, 3/32). When comparing the expected and observed values in ground conditions at the time of injury, a significant difference was found x^2 (1, n= 32) = 21.125, p = <0.001. These findings are not unexpected as a higher proportion of games were played on artificial turf, therefore there is

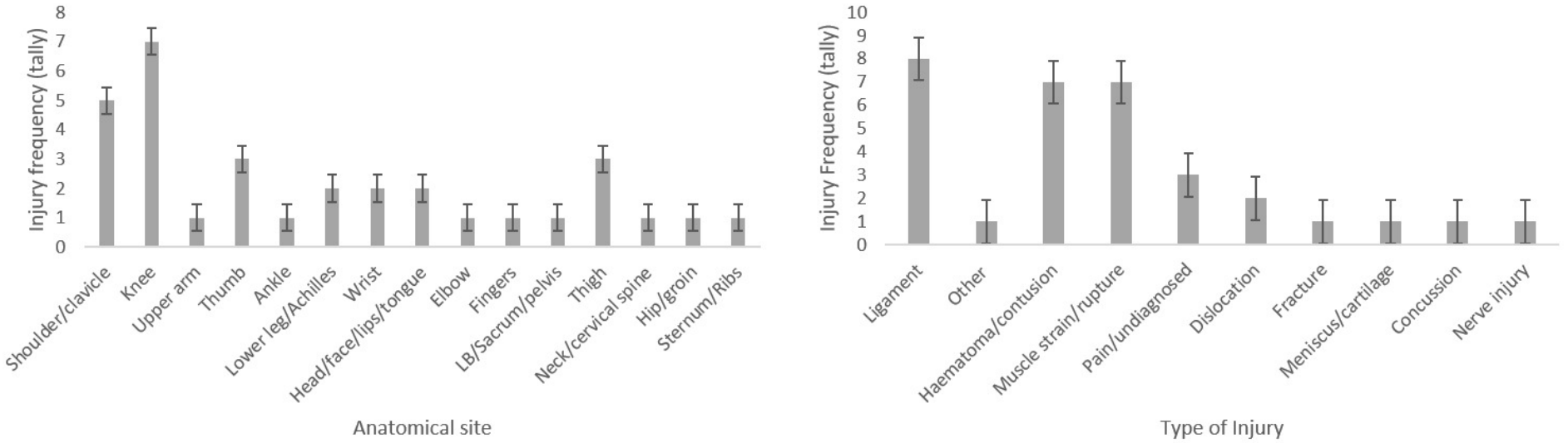

Figure 1. Anatomical site by frequency and Type of injury by frequency.

Table 3. Playing position at time of injury.

Injury	Frequency (Injury Tally)
Total	100 (32)
Playing Position	
Offence	**59.4 (19/32)**
Centre	3.1 (1/32)
Guard (Left)	3.1 (1/32)
Guard (Right)	3.1 (1/32)
Offensive Tackle	9.4 (3/32)
Tight end	6.3 (2/32)
Quarter Back	3.1 (1/32)
Running Back	18.8 (6/32)
Wide Receiver	9.4 (3/32)
Wing Back	3.1 (1/32)
Defence	**37.5 (12/32)**
Corner-back	6.3 (2/32)
Defensive end	18.8 (6/32)
Middle Line-backer/Outside Line-backer	9.4 (3/32)
Safety	3.1 (1/32)
Special Teams	**3.1 (1/32)**
R1 Kick Off	3.1 (1/32)

greater exposure to this ground condition compared to grass.

There was no significant difference between observed and expected playing position x^2 (13, n= 32) = 17.875, p = <0.162. Within the offence group, running backs had the highest percentage of injuries (18.8%) and within the defensive group, the defensive end position had the highest incidence of injuries (18.8%) (Table 3).

DISCUSSION

PRIMARY FINDINGS

The aim of this study was to complete the first prospective cohort study estimating the prevalence, severity, mechanism and period of injury in a single BUCS AF team over the course of one season. A total of 32 injuries were sustained during a 9-game season. Knee injuries (21.9%) and ligament sprains (25%) were the most common site and type of injuries, respectively. Contact injuries accounted for 68.8% of all injuries whilst just under half of all injuries were moderate in severity (40.6%). Due to the size of the data set, type of injury by location was not reported.

LOCATION/TYPE

The most frequently observed injury site in the present study was the knee (21.1%) followed by the shoulder (15.9%), thumb (9.4%) and the thigh (9.4%). British University AF shoulder injuries were higher than in the US,[10] yet it should be noted this US injury data was collected from a wider pool of individuals across both games and training which may limit direct comparison. The findings are consistent with previous findings in UK university athletes where knee injuries (20%) were the most injured body part followed by the shoulder (17%) and hand (13%) among those who participated in a similar 9 game season.[2] Injuries to the thumb are also not uncommon within the National Football League (NFL) with most injuries occurring during tackling and blocking activities.[11] Therefore, a greater number of injuries at the shoulder and hand could be indicative of greater exposure to tackling, blocking or catching technique.[12] Consistent with other literature in the UK,[2] the most common types of tissue injury were ligament sprains (25%), muscle strains (21.9%) and haematomas (21.9%). Similar incidences of ligament sprains, muscle strains and haematomas have been reported in US collegiate and high school football competitions.[10] These injuries highlight the demand for further research understanding injury risk factors.

SEVERITY AND MECHANISM OF INJURY

The largest proportion of injuries (40.6%) were classified as moderate severity. These findings are not consistent with prior studies in BUCS athletes which indicated the most common time loss as severe (greater than 4 weeks).[2] It should be noted that Bayram et al.[2] used a self-reporting methodology for data collection, in contrast to the current study where data was collected by a medical practitioner. Additionally, participants in this study had access to a medical practitioner who made decisions on return to play timeframes. This discrepancy between studies may have led to inaccurate recall reporting of injury length.[13] Most competition injuries in US athletes were reportedly season-ending,[10] suggesting the severity of injuries seen in British athletes is less than US athletes. It should be noted however, that there are several factors such as equipment development and rule changes which may contribute to the differences seen between 2005 and 2020.

Injures due to contact were the most frequent (68.8%), which is comparable to findings in US high-school and collegiate athletes.[10] The present study reports however that those players initiating contact via tackling (28.1%) or blocking (18.8%) received more injuries those receiving the contact (i.e., players blocked or tackled) which could be due to a lack of skill in these techniques.[10]

PLAYING POSITION

Over half of all injuries (59.4%) occurred in offensive playing positions. Across both offensive and defensive positions, running backs (18.8%) and defensive ends (18.8%) suffered the most injuries. These findings in the running back position are consistent with prior research in US collegiate AF.[10] In this field position, running plays were the leading cause of injury through voluntary and inadvertent collisions.[10] Previously, it was reported that defensive linemen had the highest rate of injury, significantly higher than their offensive linemen counterparts, in a sample of BUCS athletes.[2] Reasons for these injury rates in defensive ends may be due to level of experience. Many UK AF athletes be-

gin playing AF at university,[2] thus their tackling experience may be less developed which could lead to poor tackling technique and subsequent injury.[10]

ENVIRONMENTAL FACTORS

Despite the proposed benefits of artificial turf such as reducing ground maintenance costs, there is evidence of increased risk of game-related injuries on artificial turfs in AF when compared with natural grass.[14,15] Our findings echo this, with almost all injuries (90.6%) occurring on artificial turf, suggesting that ground conditions contribute to the occurrence of injuries. However, as a high proportion (7/9) of games were played on artificial turf, we cannot accurately determine which ground type is more likely to increase the risk of injury.

More injuries occurred in rainy conditions (65.6%) which differs to some previous studies which were conducted in dry, warm and low humidity conditions.[16,17] It might be that competing in wet conditions increases the likelihood of slipping or decreases the ability to decelerate and thus control the body, leading to a decrease in player performance. As our data was collected in the UK's winter months when the climate is typically cooler and wetter, we are unable to compare findings to warmer, drier temperatures. Resultantly, we cannot accurately determine if certain weather conditions increased the likelihood of injury occurrence.

PERIOD OF INJURY

Causative factors for injury have been linked to fatigue due to a decline in energy availability causing a lack of neuromuscular control[18] and susceptibility to muscular injury.[19,20] Our study found most injuries occurred in the second half (56%). This concurs with previous studies[21] however it should be noted from our results that a greater number of injuries occurred in the third quarter (37.5%) which follows half time, a period when athletes should be resting, reducing the effects of fatigue. Athlete's muscle and core temperatures decline during half-time periods which can significantly impair sprint performance at the start of the second half of play.[22] A warm-up is vitally important for increasing tissue temperature in peripheral limbs, improving muscle function[22] and reducing risk of injury.[23] As such, these findings may indicate that players half-time warm up was insufficient, leading to more injuries in the third quarter rather than the fourth when players would have been subjected to a shorter rest timeframe between periods. Furthermore, player rotations could have occurred in the fourth quarter when other players may be showing signs of fatigue. This however is speculative as no measurements of fatigue were collected by the research team. As there are no clear substitutions in AF it is possible player rotations contributed to injuries per game period. Future research should investigate the current practice of half-time warm-ups, player rotations and injury rates in the second half of play which may provide a rationale for the implementation of specific injury reduction programmes. Additionally, future studies could explore the use of wearable tracking technology to monitor game related load in relation to injury.

LIMITATIONS

This single site cohort study collected data across one 9-game season and therefore may not be representative of the wider league. Furthermore, this study did not evaluate injury incidence or burden which would have strengthened the analysis of this data. This however is the first known single site study which can provide a valuable starting point for future multi-cohort studies.

Future longitudinal multi-cohort studies will provide a broader understanding of the injury profile within BUCS AF. Whilst this study examined environmental factors which may have contributed to injury, future injury surveillance could look at the influence of equipment (e.g., football cleats, athletic tape, gloves), physical player characteristics, limb dominance and time of injury within the season on injury rates. Finally, this study adopted a rugby injury surveillance method since there is no known consensus method for injury epidemiology in AF. A standardised procedure to record injury epidemiology in British AF would allow uniform data collection across teams.

CONCLUSION

To our knowledge, this is the first prospective medically reported cohort study to estimate the prevalence, severity, mechanism and period of injury in a single BUCS AF team. Further research is needed to determine whether these findings are representative of the wider British university leagues. The authors hope this research will provide a grounding for future research in this area, including the development of injury risk reduction programmes, player training considerations and coaching education.

FUNDING

No funding was received for this work.

CONFLICTS OF INTEREST/COMPETING INTERESTS

ET and ASB are members of the British American Football Association Sport Science and Medicine Committee. This work is in no way influenced by this association.

AVAILABILITY OF DATA AND MATERIAL

Only data available within the publication is available.

AUTHOR CONTRIBUTIONS

ET was the lead author and conceptualised the study. All authors contributed to the design and proof reading of the manuscript.

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