

Injuries in Collegiate Ladies Gaelic Footballers: A 2-Season Prospective Cohort Study

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Context: Although Ladies Gaelic football is one of the most popular female sports in Ireland, just 2 previous injury surveillance studies have been completed, and both were retrospective in nature. **Objective:** To prospectively examine the injury incidence and injury profile in collegiate Ladies Gaelic football over 2 seasons. **Design:** Prospective cohort study. **Setting:** College. **Patients (or Other Participants):** Adult Ladies Gaelic footballers from one collegiate institution (season 1: n = 50, season 2: n = 82). **Intervention(s):** All time-loss injuries that occurred were recorded by certified athletic therapists and student-athletic therapists and trainers over 2 seasons. **Main Outcome Measures:** A standardized injury report form was used to record the injury onset, mechanism, location, nature, and outcome. Injury incidence proportion, repeat incidence proportion and total, match and training injury rates, and their 95% confidence intervals were calculated. The frequencies and proportions were also calculated. **Results:** The match and training injury rates were 42.48 and 7.93 injuries per 1000 hours, respectively. A low repeat incidence proportion per season was noted (11.7% and 0.0%). The injuries were predominantly acute (74.68%) and noncontact (66.25%), with hamstring injuries (21.52%) and strains (36.71%) the most frequent location and nature of injuries noted. Strains (104.92 d absent per 1000 h) and knee injuries (106.46 d absent per 1000 h) led to the greatest injury burden. Further investigations were not frequently required, with an X-ray and magnetic resonance imaging ordered in 8.00% and 6.67% of the cases, respectively. Surgery was completed following one injury. **Conclusions:** This is the first study to provide prospective injury data on Ladies Gaelic football. Priority needs to be given to preventing hamstring and knee injuries due to their occurrence and negative impact on player availability to play. Collegiate Ladies Gaelic football teams should be encouraged to implement an injury-prevention warm-up, such as the GAA15+, at training and matches.

Keywords: female athletes, female Gaelic football, sports injury, injury surveillance, injury epidemiology

Ladies Gaelic football, a commonly played Irish national female sport, is one of the fastest-growing female sports in Europe.¹ Although predominantly played in Ireland, there are also international clubs worldwide, with a total membership of ~200,000 (personal communication Ladies Gaelic Football Association). It is a multidirectional contact field game, whereby 2 teams of 15 players compete to score a goal for 3 points (under the crossbar) or a point (over the crossbar) with a round ball.²⁻⁴ Ladies Gaelic football is similar to Gaelic football played by males and is played on the same field dimensions, with some minor rule differences. For example, in the female game, players can directly pick up the ball from the ground, and shoulder-to-shoulder charges are prohibited. Players are required to run, sprint, jump, catch, turn, kick, solo (while running, the player must kick the ball back into their hands after every 3 steps), tackle, and hand-pass the ball while competing.^{2,5} Collegiate Ladies Gaelic football games last for 60 minutes, and over 30 collegiate institutions take part in competitions between October and April.⁶ These competitions occur primarily in Ireland, but there is current expansion of collegiate Ladies Gaelic football in the United Kingdom.⁶

Like any high-intensity contact field game, injuries may occur, which can lead to negative physical, psychological, and financial effects. Best practice indicates that injury prevention strategies should be based on prospective injury surveillance.⁷ Thus, inadequate injury surveillance, along with the lack of an injury prevention

implementation strategy,⁸ in a sporting population can be a barrier to successful injury prevention. Research to date has focused primarily on male Gaelic footballers, with previous injury examinations in male adolescent,⁵ collegiate,² and elite⁹ players. Male collegiate Gaelic football has also demonstrated a higher injury rate than US collegiate soccer or rugby.² However, just 2 retrospective studies have examined injuries in Ladies Gaelic football. Brown et al,³ using an online survey, noted that 74.3% of 70 Ladies Gaelic footballers from one US-based team previously sustained an injury while playing Gaelic football. The injuries primarily occurred to the fingers (22.5%), ankle and foot (19.4%), and knee (10.2%), whereas muscular injuries (35.5%) were most frequent. Crowley et al⁴ implemented a review of insurance claims submitted to the governing body in one region in Ireland for one season and noted an injury rate of 2.4 injuries per 1000 hours. Lower-extremity injuries were most frequent (58%), particularly to the knee. However, retrospective surveys may be limited by recall bias, and analysis of insurance claims may overestimate more severe injuries. Thus, longitudinal prospective research is required to truly measure the injury burden that occurs in Ladies Gaelic football.

This study aimed to be the first to prospectively capture injury incidence in collegiate Ladies Gaelic footballers over 2 seasons and to determine the onset, location, mechanism, nature, and outcome of these injuries.

Methods

Adult female Gaelic footballers (season 1: n = 50, season 2: n = 82) who actively participate in Ladies Gaelic football in one Irish

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collegiate institution were recruited. Ethical approval was received by the local university's research ethics committee. A prospective cohort study was implemented over 2 collegiate Gaelic football seasons.

Time-loss injuries were captured in this study and defined as "any injury that prevents a player from taking a full part in all training and match play activities typically planned for that day, where the injury has been there for a period >24 hours from midnight at the end of the day that the injury was sustained."^{9,10} Severity was defined according to days lost from play and was subclassified as minor (≤ 7 d), moderate (8–21 d), and severe (>21 d).^{2,11} An injury of the same type and site as an injury following a full return to play was defined as a recurrent injury and was subclassified as an early recurrent (<2 mo), late recurrent (2–12 mo),¹² or persistent injury.²

All training and matches were attended by student-athletic therapists and trainers who had completed at least 1 year of clinical placement prior to the collegiate season and passed all classes related to injury assessment. If an injury occurred during collegiate Gaelic football, they were assessed at that time by the student. All injured participants were then referred by the student-athletic therapist and trainer to a free on-campus clinic, managed by student-athletic therapists and trainers, but supervised at all times by clinicians (certified athletic therapists and physicians), who confirmed the diagnosis. A standardized injury report form previously used for male adolescent⁵ and collegiate² Gaelic footballers was completed by the student-athletic therapist and trainer following every injury. Injury onset, mechanism, type, nature, region, location, outcome, and quarter of the session the injury occurred was noted in the injury report form. The matches last 60 minutes at the collegiate Ladies Gaelic football level, and due to pitch demand in the collegiate institution, all training sessions were an hour in duration. Any further investigations required and time lost from collegiate Ladies Gaelic football were added to the injury report form following their return to play. The primary researchers held a meeting with students on a weekly basis and reviewed and revised all forms. In the event that the injured player failed to present for the recommended referred session, the form was reviewed by the primary investigators (certified athletic therapists). The injured player was contacted to ensure the injury was accurately reported, and if the injured player received a diagnosis from another clinician (ie, from their local club), the diagnosis was checked against the diagnosis provided by the student-athletic therapist and trainer to ensure it was consistent. Training and match hours were noted by the student-athletic therapists and trainers on a weekly basis.

All forms were collected on a weekly basis by the primary investigators and transferred, stored, and managed in Excel (2018, version 16.12; Microsoft Corporation, Redmond, WA). Hard copies of the data were stored in the primary investigator's locked office in a locked cabinet. All data were analyzed in both Excel and SPSS (2017, version 25.0; IBM Corp, Armonk, NY). The incidence proportion was calculated by the number of injured participants who sustained at least 1 injury divided by the number of participants at risk of injury (ie, total number of participants).¹³ The number of injured participants who sustained more than 1 injury over the course of one season was divided by the number of injured participants over that season to calculate the repeat incidence proportion.¹³ The injury rates were measured according to injuries per 1000 total exposure hours (inclusive of both training and match hours), injuries per 1000 training hours, and injuries per 1000 match hours. Poisson distribution was performed to calculate their

95% confidence intervals (CIs). Significant differences between injury proportions and injury rates were identified if the 95% CI of the variables did not overlap. Injury burden was calculated to provide an inclusive estimate of the probability of an injury occurring and the severity of an injury and was calculated according to days absent per 1000 hours.¹⁴ Descriptive statistics were performed for all other variables. Wilson score 95% CIs were calculated for all proportions. Missing data were noted in some of the variables, and the proportion was calculated based on the available number of responses.

Results

A total of 81 injuries occurred over the course of 2 seasons in 75 players in the study. The incidence proportion revealed that 57.6% sustained an injury over the course of the study (Table 1). A repeat incidence proportion of 11.7% (4.8–27.9) was noted in year 1, and no injured participants sustained a second injury in year 2. Injuries during matches were significantly more common than in training (42.48 vs 7.93 injuries per 1000 h).

Injuries were predominately acute (74.68% [74.47–74.90], with 25.32% [25.19–25.44] gradual onset injuries). Mostly, non-contact injuries occurred (66.25% [66.05–66.45]). Strains (36.71% [36.56–36.86]) and sprains (17.72% [17.62–17.83]) were frequent (Table 2). Strains (104.92 [95.90–114.78] d absent per 1000 h), sprains (59.73 [53.03–67.28] d absent per 1000 h), and fractures (54.44 [48.06–61.67] d absent per 1000 h) led to the greatest injury burden (Table 1).

New injuries were prevalent (72.50% [72.29–72.71]; Table 3). Running and sprinting was the most common mechanism of injury (37.97% [37.82–38.13]), and injuries were most common in the final quarter of the match or training session (33.33% [33.14–33.52]; Table 3). Most injuries occurred during the season (75.00% [74.76–75.25]).

Lower-limb injuries were predominant (67.09% [66.89–67.29]) and led to the greatest injury burden (276.17 [261.30–291.90] d absent per 1000 h; Table 4). Hamstring injuries were most frequent (21.52% [21.40–21.63]), followed by the knee (12.66% [12.57–12.75]), quadriceps (11.39% [11.31–11.48]), and ankle (10.31% [10.05–10.21]). However, knee injuries led to the greatest injury burden (106.46 [97.37–116.39] d absent per 1000 h), followed by hamstring (66.12 [59.05–74.05] d absent per 1000 h) and ankle injuries (39.89 [34.49–46.15] d absent per 1000 h).

The injuries were typically moderate (37.18% [37.03–37.33]) and severe (37.18% [37.03–37.33]), with 25.64% [25.51–25.77] of the injuries being mild. The mean days absent from sport was 23.54 (33.38). Only one injury required surgery, and this occurred during the season. Most injuries did not undergo further investigations; however, 8.00% [7.93–8.07] required an X-ray, and 6.67% [6.60–6.73] required a magnetic resonance imaging.

Table 1 Incidence Proportion and Injury Rate

	Injury rate	95% confidence interval
Incidence proportion	57.6%	46.3–71.6
Total injuries to 1000 h	17.85	14.36–22.20
Match injuries to 1000 h	42.48	32.01–56.37
Training injuries to 1000 h	7.93	5.44–11.57

Table 2 Nature of Injury and Injury Burden (n = 79)

Nature of injury	n	% (95% confidence interval)	Injury burden ^a (95% confidence interval)
Strain	29	36.71 (36.56–36.86)	104.92 (95.90–114.78)
Sprain	14	17.72 (17.62–17.83)	59.73 (53.03–67.28)
Concussion	7	8.86 (8.79–8.93)	24.91 (20.71–29.95)
Fracture	6	7.59 (7.53–7.66)	54.44 (48.06–61.67)
Muscle tightness	5	6.33 (6.27–6.39)	24.47 (20.31–29.47)
Tendinopathy	5	6.33 (6.27–6.39)	26.01 (21.71–31.15)
Cartilage/labral tear	4	5.06 (5.01–5.12)	32.62 (27.77–38.32)
Contusion	4	5.06 (5.01–5.12)	11.02 (8.35–14.54)
Bone bruising	2	2.53 (2.49–2.57)	3.31 (1.99–5.48)
Lacerations	1	1.27 (1.24–1.29)	2.64 (1.50–4.66)
Other	2	2.53 (2.49–2.57)	–

^aDays absent per 1000 h.

Discussion

To the authors' knowledge, this is the first study to examine Ladies Gaelic football injury incidence prospectively. Just under 3 in 5 players sustained an injury in the study, which is lower than previously reported in a retrospective study of Ladies Gaelic footballers (74.3%)³ and higher than a prospective study of male collegiate players (47.4%).² When exposure is taken into account, a similar training injury rate was found between both females and males (7.9 vs 7.3 injuries per 1000 h), respectively.

Table 3 New/Recurrent Timing and Mechanism of Injury

	No.	% (95% confidence interval)
New and recurrent injuries, n = 80		
New	58	72.50 (72.29–72.71)
Early recurrence, <2 mo	3	3.75 (3.70–3.80)
Late recurrence, 2–12 mo	7	8.75 (8.68–8.82)
Persistent/ongoing	12	15.00 (14.91–15.09)
Timing of injury, ^a n = 60		
Warm-up	6	10.00 (9.90–10.10)
First quarter	6	10.00 (9.90–10.10)
Second quarter	14	23.33 (23.18–23.49)
Third quarter	14	23.33 (23.18–23.49)
Fourth quarter	20	33.33 (33.14–33.52)
Mechanism of injury, n = 79		
Running/sprinting	30	37.97 (37.82–38.13)
No specific activity	8	10.13 (10.05–10.21)
Landing	6	7.59 (7.53–7.66)
Tackling	6	7.59 (7.53–7.66)
Being tackled	6	7.59 (7.53–7.66)
Falling	6	7.59 (7.53–7.66)
Kicking	5	6.33 (6.27–6.39)
Turning	5	6.33 (6.27–6.39)
Jumping/catching	4	5.06 (5.01–5.12)
Blocking	3	3.80 (3.75–3.85)

^aExcludes overuse injuries.

However, the injury rate for total (17.9 injuries per 1000 h) and match injuries (45.5 injuries per 1000 h) were higher in collegiate Ladies Gaelic footballers than males (12.6 and 25.1 injuries per 1000 h), respectively.² This higher injury rate is in contrast with previous research in collegiate soccer, where competition and training injury rates were similar.¹⁵ A far higher injury rate was noted in the current study (17.9 injuries per 1000 h), compared with a previously reported injury rate in Ladies Gaelic football over one season (2.4 injuries per 1000 h).⁴ This is most likely due to the fact that Crowley et al⁴ examined injury claims made to the Ladies Gaelic Football Association only, which likely underrepresents the true injury occurrence. A lower repeat incidence proportion was noted in the present study (11.7% and 0.0%) compared with male collegiate Gaelic footballers (25.2%). Previous qualitative research has found that females are more likely than males to show concern about how their injury will impact their future health,¹⁶ which may make them more likely to complete and adhere to a comprehensive rehabilitation program and avoid returning to play until they are ready to do so. A significantly higher match injury rate compared with training was noted in the current study, similar to previous finding across male adolescent,⁵ collegiate,² and elite Gaelic footballers.⁹ This is most likely due to the greater intensity of play during matches.⁵ These findings highlight the clear necessity for the introduction of injury preventative programs to address the high injury incidence during matches.

The general injury profile of female collegiate Gaelic footballers was similar to male collegiate Gaelic footballers,² with acute injuries (74.68%), noncontact (66.25%), running/sprinting (37.97%), strains (36.71%), lower-limb injuries (67.09%), and hamstring injuries (21.52%) most frequently noted. Strains also led to the greatest burden of injury (104.9 d absent per 1000 h), as similarly observed in male collegiate Gaelic footballers (113.8).² This is largely expected, as the general demands of Ladies Gaelic football is comparable with the male game. A slightly lower proportion of injuries occurring during tackling or being tackled was noted in the current study (15.18%), compared with male players (20.6%);² this may be due to the reduced physical contact and absence of shouldering during the female game. While the proportion of hamstring injuries was similar to elite male Gaelic footballers (21%),¹⁷ it was higher than previously reported in Ladies Gaelic footballers (8.2%)³ and male collegiate Gaelic footballers (15.5%).² This is in contrast to previous research in collegiate soccer, where male players were 64% more likely to

Table 4 Region and Location of Injury (n = 79)

	No.	% (95% confidence interval)	Injury burden ^a (95% confidence interval)
Head/neck	10	12.66 (12.57–12.75)	31.74 (26.96–37.37)
Head	8	10.13 (10.05–10.21)	27.55 (23.12–32.83)
Face	1	1.27 (1.24–1.29)	3.53 (2.16–5.76)
Eye	1	1.27 (1.24–1.29)	0.66 (0.21–2.05)
Ear	0	0 (0–0)	–
Neck	0	0 (0–0)	–
Upper limb	11	13.92 (13.83–14.02)	55.10 (48.68–62.37)
Shoulder	1	1.27 (1.24–1.29)	1.32 (0.59–2.94)
Upper arm	0	0 (0–0)	–
Elbow	2	2.53 (2.49–2.57)	9.26 (6.84–12.53)
Forearm	3	3.80 (3.75–3.85)	21.38 (17.52–26.09)
Wrist	2	2.53 (2.49–2.57)	18.73 (15.15–23.17)
Hand and fingers	3	3.80 (3.75–3.85)	4.41 (2.84–6.83)
Trunk	3	3.80 (3.75–3.85)	7.93 (5.72–11.00)
Ribs and chest	0	0 (0–0)	–
Upper back and thoracic spine	0	0 (0–0)	–
Lower back	1	1.27 (1.24–1.29)	4.41 (2.84–6.83)
Pelvis	1	1.27 (1.24–1.29)	1.54 (0.74–3.24)
Buttock	1	1.27 (1.24–1.29)	1.98 (1.03–3.81)
Lower limb	53	67.09 (66.89–67.29)	276.17 (261.30–291.90)
Hip	2	2.53 (2.49–2.57)	9.26 (6.84–12.53)
Groin	2	2.53 (2.49–2.57)	7.05 (4.99–9.97)
Quadriceps	9	11.39 (11.31–11.48)	31.30 (26.55–36.89)
Hamstrings	17	21.52 (21.40–21.63)	66.12 (59.05–74.05)
Knee	10	12.66 (12.57–12.75)	106.46 (97.37–116.39)
Shin	3	3.80 (3.75–3.85)	12.78 (9.88–16.54)
Calf	1	1.27 (1.24–1.29)	1.10 (0.46–2.65)
Ankle	8	10.31 (10.05–10.21)	39.89 (34.49–46.15)
Foot and toes	1	1.27 (1.24–1.29)	2.20 (1.19–4.10)
Other	2	2.53 (2.49–2.57)	–

^aDays per 1000 h.

sustain a hamstring strain.¹⁸ Thus, analysis on the specific match play demands of Ladies Gaelic football and further investigation on hamstring injury etiology in this female sport should be a key focus. The burden of injury experienced due to hamstring injury was also greatest in female collegiate Ladies Gaelic footballers (66.1 d absent per 1000 h) than male collegiate (38.6)² and elite Gaelic footballers (57.2).¹⁷ Thus, improving eccentric hamstring strength in female Gaelic footballers is of high priority, as preventative interventions that include exercises such as the Nordic hamstring curl have been shown to reduce hamstring injury risk in female youth¹⁹ and adult soccer players.²⁰ Further research examining the effectiveness of improving hamstring eccentric strength and its impact on hamstring injury incidence in Ladies Gaelic football should also be completed. While Nordic curls are included in 2 injury-prevention warm-ups developed for male and female Gaelic football (GAA 15+²¹ and Activate warm-up²²), the uptake of these strategies in Ladies Gaelic football is unknown.

The proportion of knee injuries observed in the current study (12.66%) is similar to those previously reported in Ladies Gaelic football (10.2%),³ female collegiate soccer (15.4%),²³ male collegiate (14.1%),² and elite Gaelic football (11.3%).⁹ However, knee

injuries led to the greatest injury burden in female players (106.5 d absent per 1000 h) and led to a greater negative impact than noted in male Gaelic footballers (80.8 d absent per 1000 h).² Thus, prioritizing the prevention of knee injuries by introducing strategies such as increasing lower limb strength, neuromuscular control, balance, and teaching appropriate change of direction and landing drills is recommended. A concussion accounted for 8.86% of injuries and led to 24.91 days absent per 1000 hours of exposure. Concussions have been largely unreported in previous research in male Gaelic footballers,^{2,9} and the current study established a slightly higher proportion than women's collegiate soccer (5.2%)²³ and women's Australian football players (6.0%).²⁴ Concussions have been shown to be more frequent in females than males in collegiate soccer and basketball,²⁵ and females also tend to be at greater risk for postconcussive symptoms,²⁶ with symptoms often lasting longer.²⁷ In fact, recent research in female adult Gaelic games (Gaelic football and Camogie) players noted that over half would not report a suspected concussion during a championship match and 27% did not report their most recent suspected concussion.²⁸ Thus, educating players and coaches on the appropriate management and rehabilitation of concussions is important.

Injuries increased as the training or match progressed, with most occurring in the final 15 minutes (33%), similar to that previously noted in male adolescent (36.0%),⁵ collegiate (48.5%),² and adult (29.3%) Gaelic footballers.²⁹ Similarly, moderate and severe injuries were also more frequent later in games and practice in adult European female soccer players,³⁰ suggesting that fatigue may play a role in sustaining an injury in these populations. Cumulative fatigue should also be considered, as recent research in collegiate student-athletes has noted that a greater incidence of anterior cruciate ligament injuries were noted after halftime later in the season.³¹

Athletic therapy and training students assisted with the data collection in this study. As this is a community sport, medical professionals are rarely present for all training and matches, which limited the data collection. However, all injuries were referred to an on-campus clinic, which was supervised by medical professionals, and if the injured player was attended by a different clinician, the injury was confirmed prior to inclusion in the study. This study examined injuries in collegiate Ladies Gaelic football from one university. Future research is required in other Ladies Gaelic football populations, such as club and elite players, and also across multiple collegiate institutions.

Conclusions

Injuries are frequent in collegiate Ladies Gaelic football, with 3 in 5 players sustaining an injury over the course of the study. The findings of this study indicate that priority should be given to preventing hamstring and knee injuries in particular, due to their frequency and the negative impact they have on player availability. There are injury-prevention warm-ups available and designed for use in Gaelic football that have been shown to reduce the risk of injury³² and should be completed at training and matches. The authors recommend that the Ladies Gaelic Football Association design and use an implementation strategy to enhance the likelihood of these injury-prevention programs being adopted and maintained by coaches and players which can, consequently, lead to an actual reduction in injury incidence in this sport.

Acknowledgment

The authors declare that they have no competing interests. The authors would like to thank the DCU Dóchas Éireann Ladies Gaelic football players and management for their assistance during data collection, in particular interim Head of Gaelic games Mr Paul O'Brien.

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