


# Descriptive epidemiology study of hand injuries sustained in Gaelic football referred to a hand therapy service over 1 year

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## ABSTRACT

**Objectives** Gaelic football requires ball handling, such as bouncing, fist passing and catching. To date, no research has examined the types of injuries sustained to the hand in this sport. This study aims to establish the types of orthopaedic hand injuries sustained in Gaelic football.

**Methods** This was a retrospective descriptive epidemiology study of Gaelic football-related hand injuries treated at a hand therapy unit. The nature of injuries was categorised along with collated variables on player demographics and injury profiles. Potential correlations between injury and continuous demographic data were analysed using the Mann-Whitney U and Kruskal-Wallis tests. Pearson's  $\chi^2$  test was used for categorical data ( $p < 0.05$ ).

**Results** 287 referrals were identified. Most players were men ( $n=189$ ; 65.9%), and the average age was 17 (IQR 14–25). Most fractures were to the volar base of the middle phalanx ( $n=110$ ; 42.8%). Significant differences were found between the age of male and female players with fractures under 18 ( $p < 0.05$ ), the distribution of left and right-hand fractures by age ( $p < 0.05$ ), the distribution of fractures by bone type ( $p < 0.05$ ) and also between sex and affected ray ( $p < 0.05$ ), bone type ( $p < 0.05$ ) and mechanism of injury ( $p = 0.05$ ).

**Conclusion** This study established the types of musculoskeletal hand injuries sustained by players in Gaelic football. Considering developmental, anthropometric and rule differences between male and female players across the age range may explain variations in injuries. This data can help devise injury prevention and management strategies for Gaelic football.

## INTRODUCTION

Gaelic football is a national sport of Ireland governed by the Gaelic Athletics Association (GAA) and the Ladies Gaelic Football Association. It is a field game where players may only carry the ball for a maximum of four consecutive steps, after which the ball must be toe-tapped or bounced once after each toe-tap. The ball can be passed to other players with a fist, toe-tap or released for a kick.<sup>1</sup> The game involves handling the ball by kicking,

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Existing research presents information on the frequency of hand injuries in Gaelic football but no specific information on injury types.

## WHAT THIS STUDY ADDS

⇒ This study provides specific information on the types of hand injuries seen in the sport along with differences between men and women and also children and adult players.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Further research is required to understand the variances in player injury profiles and the most effective injury prevention and management strategies.  
⇒ Dissemination of these findings through engagement with relevant sporting bodies is necessary to provide the current knowledge along with supporting clinical advice and education.  
⇒ The high incidence of intra-articular fractures to the base of the middle phalanx highlights the need for players to seek medical attention to help prevent chronic instability and deformity.

catching and disposing of the ball from other players by tackling. It is played by men and women from the ages of 7 onwards with a focus on non-competitive and then competitive play above 12 years.<sup>2</sup> Senior-level football is played by men and women from the age of 18 and over. As a contact sport, injuries are commonly observed.

Aitken and Court-Brown (2008) found that the highest incidence of hand injuries presenting to a Scottish emergency department (ED) over the course of 1 year resulted from football (soccer and Gaelic football).<sup>3</sup> Phalangeal fractures were the most typical fractures observed across sports, with the first and fifth rays being the most affected.<sup>3</sup> Studies specifically exploring Gaelic football injuries in adults imply that most injuries occur to the lower limb,<sup>4–8</sup> with hand injuries



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in two studies reported as occurring in 3.5%<sup>5</sup> and 4% of cases.<sup>4</sup> Similarly, in a study of 292 adolescent men who play Gaelic football, lower limb injuries dominated, while hand and wrist injuries accounted for 12% of the total.<sup>9</sup> A recent meta-analysis of injuries in Gaelic football supports the trend that most injuries are to the lower extremity (70%).<sup>10</sup> However, in a study of children aged 5–15, upper limb injuries were the most common, accounting for 68% in an analysis of 409 cases that presented to an ED.<sup>11</sup> This study also found that when compared with rugby and soccer, children participating in Gaelic football were more likely to sustain a hand injury. The authors hypothesise that hand injuries in younger players may be due to developing skills that entail jumping, catching and dispossessing a ball at frequent high speeds.

Existing research on injuries in Gaelic football has exclusively provided macro details on the types of injuries categorised by body part. There is a shortage of data on the specific types of injuries sustained in relation to hand injuries. Hand injuries are common in other ball sports that require frequent catching, such as netball,<sup>12</sup> basketball<sup>13</sup> and Australian football.<sup>14</sup> A lower incidence of all injuries to the hand has been reported in Rugby,<sup>15</sup> possibly due to the differing full-body contact nature of this sport. This study aims to establish the types of musculoskeletal (MSK) hand injuries sustained by players while participating in Gaelic football. This will contribute to the knowledge of injuries in Gaelic games and guide injury prevention strategies.

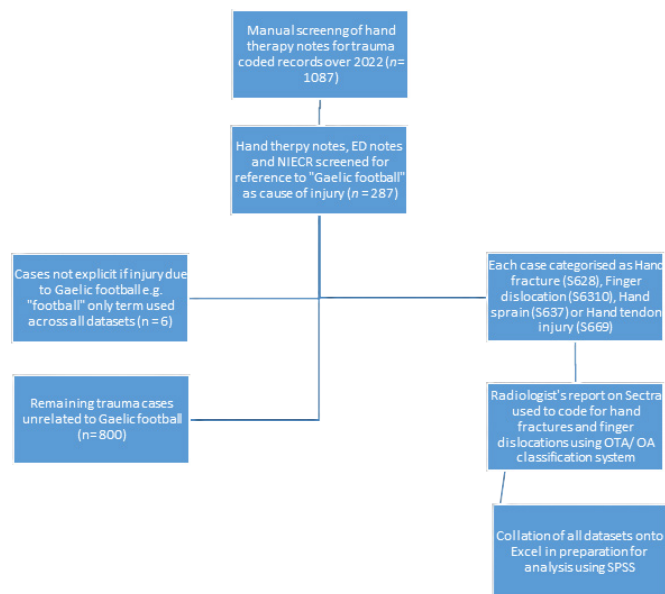
## METHODS

### Design

This was a retrospective descriptive epidemiology study of Gaelic football-related hand injuries (distal to the carpal bones) sustained by all players treated at a hand therapy unit in an acute hospital in Northern Ireland over the year 2022. This service caters to a population of 388 688 people<sup>16</sup> and a catchment area including 90 Gaelic sports clubs with an estimated 42 719 players of Gaelic sports (provided by Ulster GAA). The hand therapy service receives referrals directly from the hospital ED, MSK hub and fracture clinics. An orthopaedic surgeon reviews X-rays and triages patients to hand therapy or fracture clinic if the injury is complex. All flexor tendon injuries and extensor tendon injuries proximal to zone 3 are managed at the regional plastic surgery unit, and paediatric fractures that require surgery (under the age of 14) are managed at the regional Royal Hospital for Sick Children and therefore were not included in this study.

### Procedure

Records of patients referred to hand therapy in 2022 (figure 1) were initially reviewed by the chief investigator, an occupational therapist working in the hand therapy service and a pre-registration occupational therapy student first to ascertain that the patient had sustained a hand injury and screen out those referrals for chronic conditions. The total number of trauma cases was



**Figure 1** Schematic diagram of the data collection process. AO/OTA, Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association; ED notes, emergency department notes; NIECR, Northern Ireland Electronic Care Record.

calculated and screened to determine if the injury was due to Gaelic football. The nature of injuries was categorised using the International Classification of Diseases, tenth revision (ICD-10) 2019 codes,<sup>17</sup> and for specificity in categorising hand fractures and dislocations, the Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association (AO/OTA) system was used.<sup>18</sup> The AO/OTA system does not have a code to describe if fractures are to the dorsal or volar aspect of the bone, clinically important information in the context of the base of middle phalanx fractures where the management of such fractures differs. Therefore, all intra-articular fractures to the base of the middle phalanx were categorised further as volar or dorsal. Collated variables from selected cases included age, sex, hand dominance, occupation (categorised using the International Standard Classification of Occupations),<sup>19</sup> source of referral, side of injury, the month of injury and treatment approach (ie, conservative or surgery), number of therapy sessions along with AO/OTA codes were recorded on Microsoft Excel 2016.

### Statistical analysis

Categorical variables were summarised using frequency and percentages. SPSS V.25 was used to determine the normality of continuous data using Shapiro-Wilkes ( $p < 0.05$ ), and an. Any correlations between injury and continuous demographic data were analysed using the Mann-Whitney U test for non-normally distributed data, and the Kruskal-Wallis test was used to analyse more than two independent variables. Pearson's  $\chi^2$  test was used for categorical data ( $p < 0.05$ ), with Cramer's V used to analyse effect size.

## Materials

Hand therapy notes, ED and MSK hub referrals were primarily used to extract relevant data. The electronic systems Sectra workstation IDS7 V.24.2 and the Northern Ireland Electronic Care Record were used to extract any missing data. Injuries due to Gaelic football were identified by screening all data sources for the words 'Gaelic football' or 'GAA football' in the text. Sectra was used to refer to the radiologist's report to classify fractures. The STROBE<sup>20</sup> initiative and CHecklist for statistical Assessment of Medical Papers<sup>21</sup> were used.

## Equity, diversity and inclusion

This study's geographical region of interest was a high-income country with no representation from middle or low-income countries. The authors included men and women from different fields of expertise, including senior and less experienced researchers.

## RESULTS

A total of 1087 trauma referrals were received, with 287 (26.4%) cases stating that hand injuries were due to Gaelic football participation. In six referrals, it was unclear if the injury was due to Gaelic football as the word 'football' was only used in the data sources. 16 players presented with more than one injury during a single attendance (n=303 injuries). 18 players required surgery (6.2%), requiring a median of 3.5 days (IQR 1.25–5.75) therapy sessions, higher than those who received conservative treatment (median days=2 (IQR 1–3)).

## Player profile

Most players were men (n=189; 65.9%) and students (n=179; 62.4%) (online supplemental material 1). Most

players were right-hand dominant (n=221; 77%). Further demographic data is presented in [table 1](#).

## Injury profile

[Table 2](#) and online supplemental material 2 (month of injury) presents data on injury profile. Most injuries occurred to the fifth ray (n=104; 34.3%) and middle phalanx (n=145; 47.9%). [Figure 2](#) illustrates the frequency of fractures by each bone in the hand. There was a high number of proximal phalangeal fractures to the little finger, accounting for 15.4% of all hand fractures.

Most middle phalanx fractures were intra-articular and occurred at the base of the bone (n=128; 92.1%) with an even distribution across all fingers (online supplemental material 3: OTA classifications). Further analysis showed most bases of middle phalanx intra-articular fractures were to the volar base, accounting for 86% (n=110) of these injuries.

All tendon injuries (n=6) (S669) were zone 1 extensor tendon ruptures. Finger sprains (n=14) were evenly distributed across rays, with the middle phalanx and proximal interphalangeal joint most commonly affected, accounting for 78.6% (n=11) of sprains. The distribution of dislocations to each joint is illustrated in [figure 3](#). 16 players sustained multiple injuries, with 9 occurring to adjacent rays, 4 within one ray and 3 with injuries dispersed across the hand.

## Age

The average age of players was 17 (IQR 14–25). Age distribution was non-normal (p=0.00) due to positive skewness and remained non-normal after attempting log<sup>10</sup> transformations. A non-normal distribution remained when age was also analysed as categories of under 18 (p=0.00) and 18 and over (p=0.00). There was no significant difference in age between all male and female players who sustained a fracture (U=6266.00, p=0.22) or those over 18 (U=1305.00, p=0.47). However, there was a significant difference between the age of male and female players with fractures under 18 (U=1614.50, p=0.04), with the average age of male players being 14 (IQR 12.5–16) compared with 13 (IQR 12–15) for female players ([figure 2](#)).

There was a significant difference in the distribution of left and right-hand fractures in players, with the average age of players with right-hand fractures being 18 (IQR 15–26) compared with 16 (IQR 13–22) for players with left-hand fractures, (U=6295.00; p=0.02) even though there was no significant difference between players with fractures under and over 18 in the distribution of hand dominance ( $\chi^2$  (1)=0.0950, p=0.76). There was also a difference in the distribution of fractures by bone type across the age range (H=22.04; p=0.00). Post hoc analysis using pairwise comparison showed that these differences were between proximal and middle phalanx fractures (p=0.01), proximal and distal phalanx fractures (p=0.02) and proximal phalanx and metacarpal fractures

**Table 1** Demographics of cases

	Median	(IQR)
Average age		
Total	17	(11)
<18	13	(4)
≥18	25	(10)
	n=	%
No. of cases	287	
Age		
<18	145	50.5
≥18	142	49.5
Sex		
Male	189	65.9
Female	98	34.1
Hand dominance		
Right	221	77
Left	32	11.2
Unreported	34	11.8

**Table 2** Demographics of injury

Total cases		287	
Total injuries		303	
		Median	IQR
Number of therapy sessions	Face-to-face	2	2
		n=	%
Postal advice		65	22.6
Source of referral	MSK	104	36.2
	ED	55	19.2
Fracture clinic		128	44.6
Nature of Injury (ICD-10 code)	Hand fracture (S628)	260	85.8
	Finger dislocation (S6310)	23	7.6
	Hand sprain (S637)	14	4.6
	Hand tendon injury (S669)	6	2
	No. of players with multiple wrist hand injuries (S69.7)	16	5.6
Treatment approach	Conservative	269	93.8
	Surgery	18	6.2
Side of injury	Right	157	54.9
	Left	130	45.1
Mechanism of injury	Fall	11	3.8
	Ball collision	124	43.2
	Hyperextension injury	22	7.6
	Jersey	2	0.7
	Kick	19	6.6
	Player collision	9	3.1
	Tackle	6	2.1
	Unspecified	94	32.8
ED, emergency department; ICD-10, International Classification of Diseases, 10th revision; MSK, musculoskeletal.			

( $p=0.000$ ) with the average age of players with proximal phalanx fractures less than other bone types. The average age of players with proximal, middle, distal and metacarpal fractures were 14 (IQR 12–18), 17 (IQR 14–26), 19 (IQR 15–25) and 22.5 years (IQR 17.25–28.75), respectively.

### Sex

Across all injuries, there was no relationship between sex and hand dominance ( $\chi^2$  (1)=2.06,  $p=0.36$ ) or between sex and injured side ( $\chi^2$  (1)=0.12,  $p=0.73$ ). There was a significant relationship between sex and affected ray ( $\chi^2$  (4)=17.18,  $p=0.00$ ), with male players presenting with more injuries to the first (15.9% vs 8.2%) and fifth ray (40.2% vs 23.5%). Female players presented with more injuries to the second (23.5% vs 15.4%), third (20.4% vs

9.5%) and fourth ray (24.5% vs 19.0%). Using Cramer's V, this effect size was moderate (0.25).

For hand fractures, there was a significant relationship between sex and bone type ( $\chi^2$  (3)=11.55,  $p=0.01$ ) with a moderate effect size (0.22). Male players presented with more metacarpal (11.2% vs 7.0%), proximal phalanx (31.7% vs 16.3%) and distal phalanx (11.8% vs 9.3%) fractures, while female players presented with more middle phalanx fractures (67.4% vs 45.3%). This was the most common bone fracture across both sexes.

There was a significant relationship between sex and mechanism of injury ( $\chi^2$  (7)=16.26,  $p=0.02$ ) with a moderate effect (0.24). Female players were more likely to sustain injuries from ball collisions (50% vs 39.7%), finger hyperextension (10.2% vs 6.3%) and kicks (10.2% vs 4.8%) compared with male players who presented more with injuries due to falls (5.3% vs 1%), player collisions (4.8% vs 0%) and tackles (2.6% vs 1%). Ball collisions accounted for most injuries across both sexes.

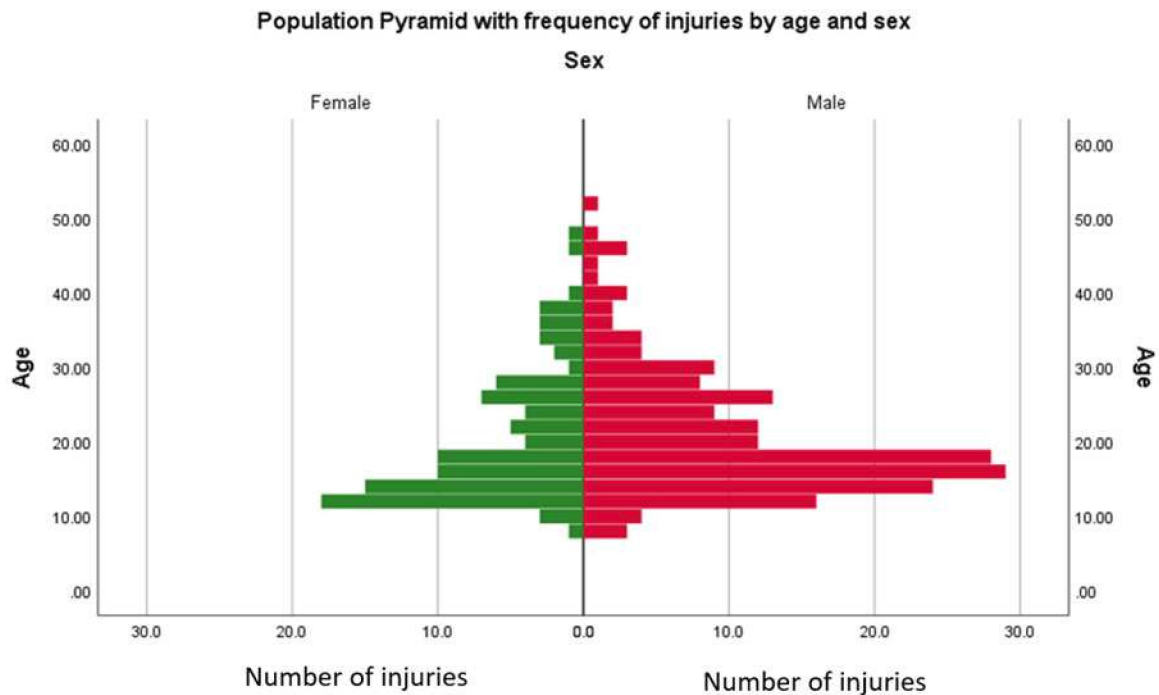
### DISCUSSION

The aim of this study was to establish the types of MSK hand injuries sustained by players while participating in Gaelic football. The most common of these were intra-articular fractures to the volar base of the middle phalanx, with the little finger being the most commonly affected. This is in keeping with the literature with injuries at this location commonly observed in athletes who participate in ball sports,<sup>22</sup> and the little finger is reported as one of the most common digits injured across all sports.<sup>3</sup>

This is the first study to investigate hand injuries sustained in Gaelic football. However, data may not capture all injuries sustained, as some, such as dislocations to the proximal interphalangeal joint, may have been relocated at the pitch side and never presented to the hospital. This can be an issue as patients may only present when issues such as pain, stiffness or oedema have not been resolved.<sup>23</sup> This issue should be considered in Gaelic football because this was the most common injury in this study.

The model of injury causation that considers intrinsic and extrinsic risk factors for injury in sport<sup>24</sup> may help understand the statistical differences of injuries by ray and mechanism between male and female players. An intrinsic factor could be anthropometric differences between the sexes, such as the second-to-fourth-digit ratio, whereby the second digit is shorter than the fourth in men. In contrast, in women, the second digit is the same length or longer than the fourth.<sup>25</sup> In this study, female players presented with a higher incidence of second, third and fourth injuries than males. For example, when high-catching a ball, the longer second ray of female players compared with male players may result in it being more exposed to hyperextension injuries.

The average age of players injured over 18 was 25 (IQR 21–31). This age is similar to the average age of both men (27.2 years) and women (24.8 years) inter-county players from a survey of 1579 players in 2022,<sup>26</sup> implying age is

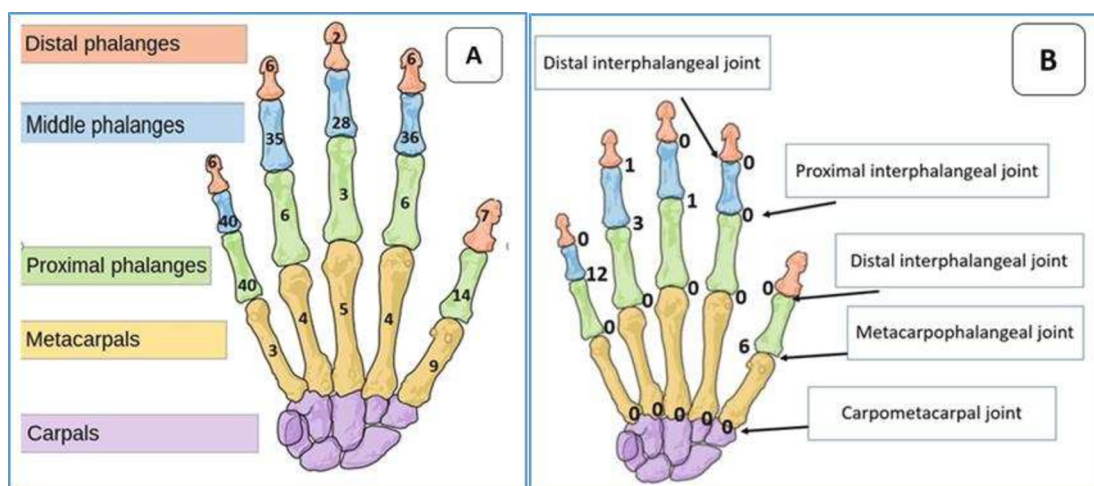


**Figure 2** Population pyramid with the frequency of injuries by age and sex.

not a risk factor for hand injuries in older adult players. A statistical difference between the average age of injury in female and male players under 18 was observed, with male players being slightly older (14 (IQR 12.5–16)) compared with female players (13 (IQR 12–15)). Differences in ball skills between male and female children have been well documented.<sup>27–31</sup> Catching skills are reported to continually develop from age 5 and plateau by 14.<sup>32</sup> As so many injuries in this study are related to catching a ball, one possible hypothesis is that girls are more susceptible to these injuries at an early age as these manual skills develop. However, as the development of male and female ball skills converges in the early teens,

boys, as they grow, start to be exposed to new injuries due to the more physical components of the male game.

Injuries to the left hand affected younger players more on average (16 (IQR 13–22)) than the right hand (18 (IQR 15–26)). In a review of 1003 hand injuries, Beaton, Williams and Moseley found that right-hand injuries in people aged 12 were more common than left.<sup>33</sup> A report of hand injuries in an older population (over 65) reported that injuries were more common on the left side.<sup>34</sup> With reference to these studies and the results of this study, it appears that many variables influence the frequency of injury to left and right hands, including age, sex, the cause of injury and hand dominance. Further research is



**Figure 3** (A) Distribution of fractures to each bone of the hand (total number=260) and (B) distribution of dislocations to each joint of the hand (total number=23). Image credit: [https://commons.wikimedia.org/wiki/File:Scheme\\_human\\_hand\\_bones-ca.svg#](https://commons.wikimedia.org/wiki/File:Scheme_human_hand_bones-ca.svg#). This image has been adapted by providing new text box labels and numbers to indicate location and frequency of injuries.

required to understand this relationship in the context of Gaelic football.

Most injuries were due to ball collisions, followed by 'hyperextension injuries'. It is likely that 'hyperextension injuries' also refer to ball collision injuries, as this mechanism of injury is commonly observed when catching a ball and typically results in a volar base of middle phalanx fracture.<sup>23</sup> Combining these two categories would account for just over half of all injuries.

The significant relationship between sex, mechanism and type of injury may also be due to extrinsic factors such as the variances in rules between women's and men's football. Male players must lift the ball from the ground using their feet, while female players can lift the ball from the ground using their hands, exposing their hands to a higher risk of being kicked. Men's football allows shoulder-to-shoulder and deliberate body contact; however, both these actions will result in a free, yellow or red card in women's football. These small differences enable men's football to be more physical, leading to a greater propensity for hand injuries due to falls, tackles and player collisions. The higher incidence of injuries to the fifth and first rays in male players could also result from more physical contact, as these border rays are more vulnerable to being grasped or struck by other players during tackles. The average age of players with metacarpal fractures was 22.5 (IQR 17.25–28.75), and it affected male players more than female players. Metacarpal fractures to the neck and shaft are observed usually due to a punch, torsion, axial loading or a direct blow<sup>35</sup> and to the base due to a 'violent' high force such as a fall,<sup>36</sup> implying these injuries are also a result of the more physical male game as these players enter adulthood.

## Limitations

Data analysed in this study was from 2022, a time when most COVID-19 restrictions in Northern Ireland had come to an end. However, adult players may have been deconditioned, and younger players may have been disadvantaged in developing fundamental movement skills. This may have influenced the number of injuries observed in this study. This study does not capture fractures that required surgical intervention of players under 14, and it is also likely that many of these injuries do not present in hospital departments, limiting an estimation of incidence reporting.

## Clinical implications

The Translating Research into Injury Prevention Practice (TRIPP) framework recommends that initial injury surveillance is conducted to understand the aetiology and mechanisms of injuries sustained in a specific sport to ensure an appropriate implementation of injury prevention programmes.<sup>37</sup> Regarding hand injuries in Gaelic football, the TRIPP framework<sup>32</sup> and the modified Haddon matrix could assist in developing comprehensive injury prevention programmes and help researchers identify gaps in knowledge.

Using external joint supports in sports has been identified as an effective means to prevent injury.<sup>38</sup> Gloves are worn in Gaelic football for grip and are not specifically used for injury prevention.<sup>1</sup> One important consideration is that grip, sensibility, dexterity and range of movement can be reduced when gloves are used compared with the bare hand.<sup>39</sup> Their potential as an injury prevention device in this sport requires further investigation.

It is possible that these injuries are not preventable in most cases due to the nature of the game. However, with the reported high incidence of 'simple' injuries to the proximal interphalangeal joint, which can lead to chronic issues, this study reinforces the need for players to seek medical attention as soon as possible to prevent possible long-term complications.

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**Contributors** DH, LR, SM and LW all contributed to the planning of this study. DH and DD were responsible for data collection. All authors contributed to the analysis and reporting of this research. DH was the lead investigator and guarantor.

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**Competing interests** None declared.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**Patient consent for publication** Not applicable.

**Ethics approval** This study complied with the Research Governance Framework for Health and Social Care and Good Clinical Practice and was approved by the Research and Development Office in the Southern Health and Social Care Trust.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** Data are available upon reasonable request. Anonymised data relating to this study can be made available upon reasonable request.

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