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Risk factors for hand injury in hurling: a cross-sectional study

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ABSTRACT

Objectives: Hurling is Ireland's national sport, played with a stick and ball; injury to the hand is common. A decrease in the proportion of head injury among emergency department (ED) presentations for hurling-related injury has coincided with voluntary use of helmet and face protection since 2003. A similar decrease in proportions has not occurred in hand injury. We aim to quantify hurling-related ED presentations and examine variables associated with injury. In particular, we were interested in comparing the occurrence of hand injury in those using head and face protection versus those who did not.

Design: This study utilised a retrospective cross-sectional study design.

Setting: This study took place at a university hospital ED over a 3-month period.

Outcome measures: A follow-up telephone interview was performed with 163 players aged ≥16 years to reflect voluntary versus obligatory helmet use.

Results: The hand was most often injured (n=85, 52.1%). Hand injury most commonly occurred from a blow of a hurley (n=104, 65%), and fracture was confirmed in 62% of cases. Two-thirds of players (66.3%) had multiple previous (1–5) hand injuries. Most patients 149 (91.4%) had tried commercially available hand protection, but only 4.9% used hand protection regularly. Univariate analysis showed a statistically significant association between wearing a helmet and faceguard and hand injury; OR 2.76 (95% CI 1.42 to 5.37) p=0.003. On further analysis adjusting simultaneously for age, prior injury, foul play and being struck by a hurley, this relationship remained significant (OR 3.15 95% CI 1.51 to 6.56, p=0.002).

Conclusions: We report that hurling-related hand injury is common. We noted the low uptake of hand protection. We found that hand injury was significantly associated with the use of helmet and faceguard protection, independent of the other factors studied. Further studies are warranted to develop strategies to minimise the occurrence of this injury.

ARTICLE SUMMARY

Article focus

- The mandatory use of head and face protection in the Irish sport of hurling over the past 10 years has been accompanied by a marked decrease in the presentation of head and facial injuries to the emergency department (ED).
- These improved figures have not been seen in hand injury, where presentations to the ED have remained high, despite the availability of a commercially available hand protection device.
- This study was designed to quantify the occurrence of hurling-related hand injury presenting to the ED, to examine some of the variables associated with hurling-related hand injury, as well as to investigate the impact these injuries had on work and sports participation and to assess player attitudes to commercially available hand protection.

Key messages

- This work emphasises the high proportion of hand injury among hurling-related injury presentations to the ED, which continues in hurling.
- This study highlights a number of factors related to hand injury and poses some questions as to the behavioural changes that may accompany the introduction of safety equipment.
- This work shows a statistically significant association between helmet and face-guard use and hand injury among hurling-related injury presentations to the ED.

Strengths and limitations of this study

- This study is one of the first to address player attitudes towards, and acceptance of, available hand protection in hurling. A causal relationship between the use of protective equipment and injury at a remote site is not established, but this work poses a number of questions, which warrant further study.
- The retrospective nature of the self-recorded data was obtained by telephonic interview but initial ED presentation was gathered prospectively with follow-up performed to investigate injury causation.
- The 82% response rate may have resulted in selection bias within the responses.

INTRODUCTION

Hurling is the national sport of Ireland and it is also played throughout the world, among members of the Irish diaspora in North America, Europe, Australia, New Zealand, South Africa and Argentina.[1] Thought to predate Christianity, hurling has been a distinct Irish pastime for at least 2000 years; stories of the hurling feats of

Irish mythological heroes such as Setanta are recorded in ancient 12th century texts such as *Lebor Laignech* (The Book of Leinster).[2] One of Ireland's native Gaelic sports, it shares much with Scottish *shinty*,[3] *cammag* played on the Isle of Man and Bando in Wales and England.[4] Hurling was played in Ireland in ancient times by teams representing neighbouring villages. Games involved hundreds of players, which would last several hours or even days. In 1904, hurling was an unofficial demonstration sport in the St Louis Summer Olympic games and in the final; Chicago (Fenian FC) defeated St Louis (Innisfails FC).[5]

Reputedly one of the fastest team field sports, this amateur game is played by two teams of fifteen players who compete for a leather-bound ball (*sliotar*) using a metre-long piece of ash wood (*hurley*) as a bat (figure 1). The standard hurling pitch is 135–145 m long and 80–90 m wide. Two posts, which are set 6.4 m apart, and connected above the ground by a crossbar set at a height of 2.5 m, form the goals at each end. A ball hit over the bar is worth one point. A ball that is hit under the bar is called a *goal* and is worth three points.[6]

Hurling differs from field hockey and lacrosse in that the *sliotar* can be caught in the hand and carried for not more than four steps, struck in the air or struck on the ground with the hurley. Further, when the ball is struck for longer distances, one of the greatest arts of the game is to jump and field the ball- while opponents are free to strike the ball with their hurley (figure 1). The player may kick or slap the ball with an open hand (the hand pass) for short-range passing.

In a 1984 study of emergency department (ED) presentations due to hurling injuries, Crowley and Condon[7] noted that 28% of presentations were facial and head injuries and 36% were hand injuries. Nine years later, following the voluntary introduction of helmet and face protection, the absolute number of presentations to ED due to hurling injury had almost halved.[8] The ratio of presentations of site of injury had also changed with 20% of presentations due to head injury and 56% due to hand injury. This relative rise in hand injury was also noted in a further study by Kiely *et al*.[9]

The most widely used, dedicated hand protection for hurling that was commercially available was the Ashgard glove by O'Dare (figure 2). This is constructed of neoprene and elasticised fastenings; this apparatus focuses primarily on protecting the metacarpal bones. This was the most commonly used device at the time of our study. Anecdotally, and in discussion with other physicians caring for the hurling community (personal communication Professor M G Molloy), we observed relatively poor levels of use of this equipment, despite published ED injury presentations and recommendations.[8 9]

This study aims to quantify the occurrence of hurling-related hand injury presenting to the ED and examine the variables, which may be associated with hand injury. In particular, it aims to assess the association of helmet and facial protection with the occurrence of hand injury in this population, and to describe the impact that this has had on time lost from play and work.

MATERIALS AND METHODS

Consecutive hurling-related injuries over a 3-month period, July to September, in 2006 presenting to the ED of a university hospital were recorded. At the time of each patient's assessment, a questionnaire was completed by their treating emergency room physician regarding the nature and circumstances of their injury and their subsequent investigations and management.

In total, 430 hurling-related injuries presented to the ED in the defined period. Owing to the enforcement of the use of a helmet and face protection by many juvenile clubs (catering for players of 16 years and younger), we excluded this population (n=231). This enabled a true reflection of equipment use in the adult/voluntary setting. The remaining 199 patients were contacted for a telephone interview. Prior to the interview, patients were contacted by telephone to give their consent to their participation in the study. Interviews were completed within 90 days of initial presentation to the ED (mean 68 days (15–88)). The participants also received background information about the study based on the Ethics Committee approval as well as a plain language statement. Telephone calls followed a scripted protocol to avoid investigator bias. The questionnaire consisted of questions focusing on:

- Site of injury
- Mechanism of injury
- Protective equipment in use at the time of injury
- Previous injury
- Previous use of protective equipment
- Reasons for discontinuing use of protective equipment.

Those who had tried but discontinued hand protection were given five potential options as to why they discontinued use of hand protection:

- Discomfort
- Ineffective protection
- Limitation in performance
- Poor aesthetics
- Expense.

Those players who had discontinued the use of hand protection were asked if they would consider trialling different protection if it were to become commercially available.

Previous injury was defined as a physical injury, suffered while playing hurling, resulting in at least one game missed. To aid analysis of the data, upper limb injuries were classed as proximal or distal. A proximal upper limb injury occurred at the wrist or in the upper limb proximal to the wrist (forearm, elbow or shoulder) and a distal upper limb injury described all upper limb injury distal to the wrist. An injury which resulted from an action of an opposing player which was penalised by the referee was documented as 'foul play'.

Figure 1 Typical action in a game; a player rises to catch the *sliotar* despite the attention of opponents. Courtesy of Dan Sheridan, Inpho photography.

We were particularly interested in exploring the use of protective equipment and whether or not this impacted on injury presentations to the ED. Based on the hypothesis that use of protective equipment has been linked to increased levels of 'risky behaviour', we focused particularly on those with serious hand injury and whether they used helmet and face protection.

The study proposal was approved by the Clinical Research Ethics Committee of the Cork Teaching Hospitals.

Statistical analysis

Tests for normality were performed using the Shapiro-Wilks test. All variables in the analysis were normally distributed and therefore described using means and SDs. Proportions were compared using χ^2 tests. Univariate associations of upper limb injury were examined using logistic regression analysis. The presence, strength, independence and significance of upper limb injury with the use of a helmet with faceguard were quantified using logistic regression. This was adjusted simultaneously for age, previous hand injury, being struck directly by a hurley and foul play. Variables that were significant using Pearson's χ^2 test were included in the multivariate logistic regression model as were those variables that were deemed to be clinically important. The final model examines the association of upper limb injury with the use of a helmet and face-guard, adjusted simultaneously for age, previous hand injury, being struck directly by a hurley and foul play. The factors

Figure 2 Typical action showing players with a helmet, helmet and face protection, and hand protection; the Ashgard hand glove is shown in inset. Courtesy of Dan Sheridan, Inpho photography.

Table 1 Patient demographics, protection used and injury severity

Patient characteristics	Total n=163 (%)	Hand injury n=100 (%)	No hand injury n=63 (%)	p Value
Age (years)				
Range	17–39	17–33	17–39	
Mean (SD)	23.51 (4.1)	23.51 (4.2)	23.52 (4.1)	
Gender				
Female	17 (10)	10 (10)	7 (11)	
Male	146 (90)	90 (90)	56 (89)	
Site injured				
Distal upper limb	85 (52.1)	85		
Proximal upper limb	15 (9.2)	15		
Lower limb	30 (18.4)		30 (48)	
Axial	33 (20.3)		33 (52)	
Protection used				
Helmet with faceguard	106 (65)	74	32 (51)	0.002
Hand protection	8 (5)	4	4 (6)	NS
Injury severity				
Fracture	74 (45.4)	60	14 (22)	<0.001
Variables associated with injury				
Foul play	26 (15.9)	16	10 (16)	NS
Struck by a hurley	104 (63.8)	74	30 (60)	NS
Previous hand injury	82 (50.4)	57	25 (40)	0.03

associated with hand injury were analysed by comparing those with confirmed upper limb injury (n=100) with those injured elsewhere (n=63). Analysis was performed using SPSS V.12 with a two-sided type one error rate of 0.05 (Chicago, Illinois, USA).

RESULTS

Hurling-related injuries for 430 patients were reviewed from 3172 consecutive sports injuries presenting in the defined period. Of the 199 identified and suitable patients, 27 participants were uncontactable, and nine declined to participate. The total response rate was 82% of possible participants. Data on 163 patients were included.

Interviews were conducted with 17 women and 146 men (n=163). Average time to follow-up was 39 weeks (range 28–48 weeks) post injury. Patient's ages ranged from 17 to 39 years (mean 23.52 year). The majority of injuries occurred in organised competition or supervised practice (n=155, 95%).

Injury site and mechanism of injury

The most commonly injured site (table 1) was the upper extremity distal to the wrist (85, 52.1%) followed by the lower limb (30, 18.4%) with 27 head injuries (16.6%). A statistically significant number of the distal upper limb injuries sustained from a blow of a hurley were fractures (n=46/74, 62%), compared to soft tissue injury (laceration and ligamentous injury) (n=28/74, 38%, Pearson's χ^2 p<0.001). The most commonly injured digits were the first (n=16, 35%) and the fifth (n=15, 33%) (table 2). The metacarpal bones were most commonly fractured (n=17, 37%), followed by the proximal phalanges (n=15, 32%), whereas the middle phalanx was least likely fractured (n=4, 8%) and the distal phalanx was fractured in 10 cases (22%).

Previous injury

Most patients had suffered at least one injury in the past (n=116, 71.2%), two-thirds of patients had between one and five previous injuries (n=108, 66.3%). Eight patients (4.9%) had more than six previous injuries. Fifty per

Table 2 Univariate associations with hand injury in hurling

	Upper limb injury n=100	No upper limb injury n=63	OR (95% CI)	p Value
Helmet with a faceguard (n=106)	74 (69.8%)	32 (30.1%)	2.76 (1.42 to 5.37)	0.003
Previous hand injury (n=82)	57 (69.5%)	25 (30.5%)	1.88 (1.46 to 4.94)	0.032
Age less than the mean—24 years (n=52)	31 (59.6%)	21(40.4%)	1.05 (0.56 to 1.97)	0.88
Struck by a hurley (n=104)	74 (71.2%)	30 (28.8%)	2.31 (1.23 to 5.22)	0.009
Foul play (n=26)	16 (61.5%)	10 (38.5%)	1.01 (0.43 to 2.4)	0.983

cent (n=82) of patients had previously suffered an upper limb injury, 39% (n=64) had suffered a prior head injury and a fifth (20.9%, n=34) had experienced both. One-third (35%) of those presenting with a fracture to the hand or fingers had suffered a prior fracture to the area. A history of previous upper limb injury was associated with further injury of the area, OR 1.31 (95% CI1.02 to 1.68).

Protection used

Only 8 (4.9%) used hand protection (Ashgard by O'Dare, figure 2), while 149 (91.4%) had tried it in the past. Helmet with face protection was used by 65% (n=106). At the time of the study, helmet and faceguard use was voluntary in adult participants. Previous trial of a helmet with face-guard and hand protection was reported by 154 (94.5%). Given this high trial-rate with poor uptake, respondents were asked why they had discontinued its use. Most respondents (n=123, 75.4%) described poor utility citing issues such as bulkiness and diminished dexterity. More than half (n=95, 58.3%) felt that protection was inadequate, rendering the hand protection ineffective. When asked about the potential interest in new protective equipment, 121 (74.2%) felt they would try a newly designed glove.

Univariate associations with hand injury

Univariate analysis of the variables associated with hand injury demonstrated a statistically significant association between prior injury, wearing a helmet and faceguard and being struck by a hurley. The latter two relationships persisted on multivariate analysis, independent of the adjusted variables (table 2).

Impact of hand injury

A week or more of play was lost by 152 (93.3%) of those injured, whereas 89 (54.6%) lost more than 4 weeks. Owing to their injuries, 71 (43.6%) people missed work, with 26 (16%) people missing more than 4 weeks of work (table 3).

Table 3 Logistic Regression analysis of the association of hand injury with helmet and faceguard use (OR, 95% CI)

Category	OR (95% CI) for upper limb injury	p Value
Helmet with faceguard	3.15 (1.51 to 6.56)	0.002
Struck by a hurley	1.99 (1.24 to 3.8)	0.013
Age from mean	0.82 (0.4 to 1.68)	0.59
Previous hand injury	1.73 (0.90 to 2.6)	0.73
Foul play	1.32 (0.49 to 3.5)	0.98

DISCUSSION

We report that in this retrospective cross-sectional study of 163 hurling players presenting to a university hospital emergency department with hurling-related injury, hand injury was significantly associated with the use of helmet and facial protection, independent of age, previous hand injury, being struck directly by a hurley and foul play. While we cannot demonstrate causality in this cross-sectional study, this finding raises interesting questions regarding the epidemiology of hurling-related hand injuries in the era of voluntary helmet and face protection use in hurling.

Published data on the incidence of hurling-related hand injury are sparse. The available literature, however, suggests that while the occurrence of head and facial injury in hurling has fallen, the proportion of players presenting with hand injury remains essentially unchanged. Crowley *et al*[8] reported that 52% of ED presentations for hurling injury were injuries to the hand. Eight years later, this proportion was similar at 56%, and is comparable to the 62% observed in the current study. Despite hand injury being a common occurrence, only 8% of adults reported the use of commercially available hand protection, similar to the 9.8% reported by Kiely *et al*[9] in a 2003 study. No rules are enforced in hurling regarding the use of hand protection. In the USA, the National Collegiate Athletic Association (NCAA) dictates that gloves be worn in intercollegiate stick-handling sports (men's lacrosse, women's lacrosse and men's ice hockey).[10–12] These sports have many similarities to hurling. The major difference between these sports and hurling is that the puck or ball is not handled by outfield players. Therefore, a bulky glove may be worn without affecting dexterity or impeding play. The technical requirements of a hand protection device in hurling therefore differ and, at the time of the study, had not gained acceptance among those players presenting to the ED.

Previous injury patterns reported by patients may provide some insight into the role of an individual's behaviour in exposure to further injury. We report that 50% of patients had previously suffered an upper limb injury, 39% had suffered a prior head injury, with 21% experiencing both in the past. Sixty-five per cent of this cohort wore helmet and face protection voluntarily, demonstrating risk awareness regarding potential head and facial injury. A similar usage of hand protection was not observed. Why the majority of players would adopt head and face protection while discontinuing hand protection use cannot be addressed in this cross-sectional study. This may be explained in part by the large emphasis placed on head protection[7 8 13] by the sports body and injury commentators. Little emphasis has been placed on hand injury and protection.[9] The utility and function of commercially available hand-guards may also play a role. The Ashgard model was described as 'uncomfortable' and 'bulky' by players, and did not protect beyond the first phalanx; 30% of fractures were

Figure 3 The more recent Mycro Long Finger Glove offering greater protection to the phalanges.

seen beyond this site (n=14). A more anatomically correct model (Mycro Long Finger Glove) has been available on the market in more recent times (figure 3). This glove protects the metacarpals and offers greater protection for the phalanges, utilising hardened plastics over the phalanges—providing protection without loss of dexterity.

The significant relationship of a number of variables such as helmet use; being struck by a hurley and previous hand injury may represent altered behaviour on behalf of both the injured party and the party causing the injury. It could be argued that the use of a helmet and face protection has altered player behaviour leading to a more hazardous playing style. The concept of risk 'compensation' or 'homeostasis' has been debated following the introduction of many safety measures in many sports such as American football,[14 15] cycling[16] and even on the introduction of the automobile seat belt.[17 18] In American football, the evolution of the helmet over 50 years from a leather helmet to a metal and plastic hardshell helmet with faceguard drastically changed tackle patterns. The 'spear tackle' saw players tackle with the head rather than the shoulder—this was accompanied by a dramatic rise in catastrophic brain and cervical spine injury. Banning the spear tackle and ensuring helmet specifications led to a 42% decrease in brain and spinal injury over a 5-year period.[15] It has been argued that cyclists are less likely to ride cautiously when wearing a helmet owing to their feeling of increased security.[16] A level of perceived safety has been postulated to lead to increased levels of 'risky behaviour'[18]—in hurling, it could be postulated that a helmet with face protection increases the likelihood that a player will attempt a more risky aerial catch such as seen in figure 1.

A majority of the injuries reported in this study occurred during organised competition or supervised practice at club events. The apparent success of the introduction of head and facial protection occurred because this level of regular supervision allows the enforcement of mandatory use laws. Initially, the use of a helmet and facial protection was made mandatory for all players under 18, then all players under 21 in 2003 and 2005, respectively. We studied our group in the period prior to 2010 when it became mandatory to wear this protection for all players. Players are not insured to train or play at their clubs without the correct head and face protection. Further prospective studies evaluating the effect of hand protection on the occurrence of hurling-related hand injury are warranted to determine if the mandatory use of such protective equipment would result in a comparable decrease in injury.

These data describe the impact of upper limb and hand injury both on return to sport and time lost from work. Almost one-fifth of all hurling–related hand injuries resulted in more than 4 weeks off from work. Though upper limb injury is often regarded as being less serious than head injury such as eye injury, studies have shown that the hand is likely to take longer to return to pre-injury activity than injury to other parts of the body.[19 20] Trybus *et al*[20] showed that more than 50% of hand injuries presenting to a specialist centre suffered persistent post-traumatic disability.

The limitations of this study included the retrospective nature of the self-recorded data obtained by telephonic interview; however, the initial ED presentation data were gathered prospectively with follow-up performed to investigate factors associated with these injuries. The 82% response rate that may have resulted in selection bias within the responses—non-responders might have had different attitudes regarding hand protection. This work investigates hurling-related hand injury presenting to the ED (and compares with other studies gathering data by the same means); it may therefore bias the analysis towards serious injury. Two prospective studies on 74 and 127 players revealed hand injury rates of 33% and 15.2%, respectively.[21 22] These lower rates may represent a 'dilution' of more serious injury among less serious, minimal time loss injury. This work emphasises the high occurrence of hand injury, which remains in hurling. The study has attempted to highlight factors associated with this, and, we feel, poses some important questions as to the behavioural changes that may accompany the introduction of safety equipment. Answers to these questions may help to inform future decisions regarding safety equipment use in hurling.

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Contributors ÉF is responsible for the overall project and is the guarantor. He contributed to the study design, data collection, data analysis and writing. PM contributed significantly to analysis and writing. BC contributed to the data collection and analysis. AK contributed to the data collection and analysis. JE contributed significantly to the analysis and writing. FS contributed significantly to the study design, data analysis and writing. MGM contributed significantly to the study design, data analysis and writing.

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