

ORIGINAL RESEARCH

Wrist, hand and finger injuries in Australian football: A prospective observational study of emergency department presentations

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Abstract

Objectives: Investigate the characteristics of wrist, hand and finger (WHF) injuries in Australian footballers presenting to EDs and determine if injury profiles differed between females and males, and between children and adults.

Methods: In this prospective observational study that took place during an entire football season, patients attended 1 of 10 EDs in Victoria, Australia with a WHF injury sustained while playing Australian football. Data were extracted from patient medical records by trained researchers. Data included injury type (e.g. fracture), body part (e.g. metacarpal) and mechanism of injury. Males *versus* females, and children *versus* adults were compared using chi-squared tests or Fisher's exact tests.

Results: In total, 528 patients had a WHF injury, of which 105 (19.9%) were female and 308 (59.2%) were children. Fractures and sprains were the most common injury types (45.3% and 38.6%, respectively). Fingers were more often injured than wrists or hands (62.5%, 23.5% and 15.0%, respectively). Ball contact was the most common mechanism of injury (38.1% of injuries). Females were more likely than males to (i) have a sprain/strain injury, (ii) injure a finger (rather than wrist or hand) and (iii) injure themselves through ball contact. Children were more likely to injure their wrists, have a sprain/strain injury, or be injured falling to the ground. Adults were more likely to dislocate a joint or injure their hands.

Conclusions: Differences in injury type, location and mechanism between

Key findings

- Wrist, hand and finger injuries are common Australian football injuries.
- Fractures and sprains were the most common injury-types.
- Fingers were more frequently injured than wrists and hands (metacarpals) and contact with the ball was the most common mechanism of injury.

females and males, and children and adults, suggest an opportunity for customised injury prevention and management strategies by sex and age.

Key words: Australian football, emergency medical services, female footballers, sports-related injury.

Introduction

Australian football (AF) is a high-intensity contact team sport which places substantial physical demands on players' bodies.¹ It is one of the most popular sports in Australia, with over 1.7 million adults and children participating in 2019.² The game has seen rapid growth in female participation with one in three players now being female.²

AF has one of the highest injury rates of Australian sports and recreation activities.³ Upper limb injuries are the most common reason for injured AF players to present to

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hospitals and EDs, of which wrist, hand and finger (WHF) injuries are the most prevalent, representing up to one-third of AF-related ED presentations.^{3–5} Sex differences have been observed for AF-related WHF injuries.⁵ In a study of 1635 players presenting to EDs with AF-related injuries, females were almost 50% more likely to present with a hand or finger injury than males.⁵

Despite the prevalence of AF-related WHF injuries, detailed information regarding these injuries is lacking.⁴ Studies have typically reported WHF injuries as a single category, without describing the specific anatomical structure/s injured. Similarly, the mechanism of injury is unknown. Given the crucial role of the WHF in daily function, a detailed understanding of injuries is urgently required to enable the design and implementation of evidence-based injury prevention and management programmes.

The aim of the present study was to investigate AF-related WHF injuries in patients who presented to EDs for management. Specifically, we investigated (i) the type of injury (e.g. fracture), (ii) the body part injured (e.g. fifth metacarpal) and (iii) the mechanism of injury. Secondary aims were to determine if injury profiles differed between females and males, and according to age (adult *vs* child), and whether patients received surgical management of the injury.

Methods

The study was prospective and observational. Patients attended 1 of 10 EDs in Southwest Victoria with a WHF injury sustained while playing AF, either during a game, training or social play. All patients, regardless of age, who presented to a study site between January and October 2019 with a WHF injury were included. The data collection period included both the pre-season and entire AF season. Patients were part of a larger study investigating AF injuries.⁵

Eligible patients were identified by keyword searches (e.g. 'football', 'footy', 'Aussie rules' and 'AFL') of electronic medical records, and

patients with a WHF injury selected. Data were extracted by trained researchers from patients' electronic medical records using a predefined data collection template. Data were entered directly into REDCap, which is an online data capture and management tool designed specifically for research.⁶

Variables of interest included age, sex, injury type, body part injured, mechanism of injury and whether the patient required admission to hospital and/or surgery.

Data were summarised using descriptive statistics such as means, standard deviations (SDs) and proportions. Females were compared to males using chi-squared tests or Fisher's exact tests where appropriate. Injury types were also compared by age (child <18 years *vs* adult ≥18 years) using chi-squared tests or Fisher's exact tests where appropriate. Tests were considered significant if $P < 0.05$. Data were analysed using Microsoft Excel (version 16.44) and SPSS (IBM SPSS Statistics for Windows, version 26.0).

Ethical approval was obtained from relevant Human Research Ethics Committees (ref. 18/178) and prospectively registered at ANZCTR.⁷

Results

Of the 1635 patients who presented to an ED with an AF-related injury, 528 (32.3%) had a WHF injury, of which 105 (19.9%) were female and the average age was 19.4 (SD 8.6) years (Table 1).

Fracture was the most common injury type, accounting for 45.3% of injuries (Table 1). Sprain/strain was the second most common injury type (38.6% of injuries) and was more likely in females than males ($P < 0.05$). Fingers were more commonly injured than the wrist and hand (metacarpals). Females were more likely to injure their fingers than males ($P < 0.05$).

Regarding fractures ($n = 239$), fingers were the most commonly fractured region, accounting for 48.1% of WHF fractures (Table S1). The little finger was the most fractured digit, and the proximal phalanx the most fractured finger bone. Females

were more likely than males to fracture the middle finger ($P < 0.05$).

Regarding sprains ($n = 204$), fingers accounted for almost three-quarters of WHF sprain injuries, with the thumb being the most injured digit (32.4% of finger sprains), most commonly at the metacarpophalangeal joint (MCPJ) (89.9%) (Table S2). The MCPJ and proximal interphalangeal joint (PIPJ) accounted for a similar proportion of finger sprains (32%, respectively). The index finger and PIPJ were more commonly injured in females compared to males ($P < 0.05$).

Regarding dislocations ($n = 77$), most were interphalangeal joints (IPJ) ($n = 67$, 87%), particularly the PIPJ (82% of IPJ dislocations) (Table S3). The little finger was the most commonly dislocated digit (39.0% of dislocations). The lunate was dislocated in two patients, the carpometacarpal joint (CMCJ) thumb in one patient, and the MCPJ in seven patients. There were no differences in the proportion of males and females with regard to which finger or joint was dislocated.

Contact with the ball while attempting to catch, mark or tap/punch was the most common mechanism of injury, accounting for 38.1% of WHF injury, and was more likely to occur in females than males ($P < 0.05$) (Table 2). When considering finger injuries in isolation, ball-contact caused two-thirds (66.5%) of injuries (when the mechanism was known). Wrist injuries were mostly because of a fall to the ground (65.8% of injuries), and hand injuries were most commonly caused by a collision with another person, including being kicked (46.3%).

Children represented three-fifths of ED presentations (Table 3). Regarding injury type, children were more likely to have a sprain/strain injury than adults (46.1% *vs* 28.2%, $P < 0.05$), whereas adults were more likely to dislocate a joint (22.3% *vs* 9.1%, $P < 0.05$), usually an IPJ. Children and adults had a similar proportion of fractures (43.5% *vs* 47.7%, $P > 0.05$). Regarding body-region injured, there were no differences in the proportion of finger injuries between children and adults

TABLE 1. Injury types and body region injured

	Female (n = 105)	Male (n = 423)	Total (n = 528)
Age, years (average, SD)	21.9 (9.8)	18.7 (8.1)	19.4 (8.6)
Injury location/context			
Game	64 (61.0%)	226 (53.4%)	290 (54.9%)
Training	20 (19.0%)	53 (12.5%)	73 (13.8%)
Social play (park, home and school)	14 (13.3%)	68 (16.1%)	82 (15.5%)
Not stated	7 (6.7%)	76 (18.0%)	83 (15.7%)
Injury acuity†			
1	0	0	0
2	5 (4.8%)	18 (4.3%)	23 (4.4%)
3	18 (17.1%)	54 (12.8%)	72 (13.6%)
4	62 (59.0%)	263 (62.2%)	325 (61.6%)
5	20 (19.0%)	88 (20.8%)	108 (20.5%)
Injury type‡			
Bone fracture	42 (40.0%)	197 (46.6%)	239 (45.3%)
Sprain or strain	55 (52.4%)*	149 (35.2%)*	204 (38.6%)
Dislocation	11 (10.5%)	66 (15.6%)	77 (14.6%)
Laceration/skin wound	2 (1.9%)	15 (3.5%)	17 (3.2%)
Bruising/contusion	1 (1.0%)	10 (2.4%)	11 (2.1%)
Tendon rupture	0	11 (2.6%)	11 (2.1%)
Body region injured‡			
Wrist	22 (21.0%)	102 (24.1%)	124 (23.5%)
Hand	10 (9.5%)	69 (16.3%)	79 (15.0%)
Finger	75 (71.4%)*	255 (60.3%)*	330 (62.5%)
Thumb	11 (10.5%)	63 (14.9%)	74 (14.0%)
Index	18 (17.1%)*	33 (7.8%)*	51 (9.7%)
Middle	20 (19.0%)*	41 (9.7%)*	61 (11.6%)
Ring	9 (8.6%)	46 (10.9%)	55 (10.4%)
Little	25 (23.8%)	89 (21.0%)	114 (21.6%)

% = proportion of presentations for each gender or total presentations. * $P < 0.05$, 2×2 chi-squared test, female versus male. †Australasian Triage Scale category according to ACEM criteria. ‡More than one option possible per patient.

(64.0% vs 60.5%, $P > 0.05$); however, children were more likely to injure their wrists (27.9% vs 17.2%, $P < 0.05$), with fractures and sprains accounting for 55.6% and 44.4%, respectively, of all wrist injuries. Adults were more likely to injure their hands (23.2% vs 9.1%, $P < 0.05$), with metacarpal fractures accounting for 74.7% of all hand injuries. Regarding mechanism of injury, children were more likely

than adults to injure themselves falling to the ground, accounting for 24.4% and 15.9% of injuries, respectively ($P < 0.05$). No other differences regarding mechanism of injury were significant between children and adults.

Most patients (95.3%) were discharged directly to their usual residence from the ED. Sixteen patients were admitted to hospital, of whom 13 had surgery for fracture and/or

wound management. Overall, 55 (10.4%) patients had surgery; 13 following their direct admission from the ED to hospital, and 42 returning for surgery, usually following outpatient review.

Discussion

The present study is the first to provide a detailed characterisation of AF-related WHF injuries that present

to EDs. In summary, one-third of patients presenting to EDs with an AF-related injury had a WHF injury. Fractures were the most common injury type and, together with sprain/strains, accounted for over four-fifths of injuries. Fingers were more commonly injured than the wrist or hand, accounting for almost two-thirds of injuries. Contact with the ball was the most common mechanism of injury. Females were more likely than males to be injured through ball contact, more likely to

injure a finger than wrist or hand, and more likely to be diagnosed with a WHF sprain/strain. Children were more likely than adults to present with a WHF injury, injure their wrists, have a sprain/strain injury, or sustain the injury falling to the ground. Adults were more likely to dislocate a joint or injure their hands (metacarpals). One in 10 patients required surgery.

The WHF is the most injured body region in patients presenting to EDs with an AF-related injury.^{3,5} Despite

this, and compared to other injuries such as ACL ruptures, WHF injuries have received little research attention and are inadequately described. In our study, almost 50% of WHF injuries were bone fractures, which could incur substantial functional consequences for patients and carers, affecting work, school, home and/or sport participation for weeks or months. For example, a wrist fracture would require a person to miss up to 12 weeks of AF, which for some players, would be a season ending injury and also affect performance at school/work and home. Soft tissue injuries (sprains/strains) were the second largest diagnostic group which, except for ligament or tendon ruptures, would usually have a faster recovery and less functional consequence than fractures. One in five patients required surgical intervention, typically to repair fractures, ligaments and tendons, reflecting the seriousness of the injury and the significant healthcare resources required to maximise healing and reduce the risk of long-term functional deficits.

TABLE 2. Mechanism of injury

Contact point	Female (n = 105)	Male (n = 423)	Total (n = 528)
Ball	50 (47.6%)*	151 (35.7%)*	201 (38.1%)
Person	23 (21.9%)	102 (24.1%)	125 (23.7%)
Ground	18 (17.1%)	92 (21.7%)	110 (20.8%)
Goal post	0	1 (0.2%)	1 (0.2%)
Unknown	14 (13.3%)	77 (18.2%)	91 (17.2%)

* $P < 0.05$, 2×2 chi-squared test, female *versus* male.

TABLE 3. Children versus adults

	Children (n = 308)	Adults (n = 220)	Total (n = 528)
Injury type†			
Bone fracture	134 (43.5%)	105 (47.7%)	239 (45.3%)
Sprain or strain	142 (46.1%)*	62 (28.2%)*	204 (38.6%)
Dislocation	28 (9.1%)*	49 (22.3%)*	77 (14.6%)
Laceration/skin wound	3 (1.0%)	14 (6.4%)	17 (3.2%)
Bruising/contusion	6 (1.9%)	5 (2.3%)	11 (2.1%)
Tendon rupture	4 (1.3%)	7 (3.2%)	11 (2.1%)
Body region injured†			
Wrist	86 (27.9%)*	38 (17.2%)*	124 (23.5%)
Hand	28 (9.1%)*	51 (23.2%)*	79 (15.0%)
Finger	197 (64.0%)	133 (60.5%)	330 (62.5%)
Mechanism (contact point)			
Ball	113 (36.7%)	88 (40.0%)	201 (38.1%)
Person	69 (22.4%)	56 (25.5%)	125 (23.7%)
Ground	75 (24.4%)*	35 (15.9%)*	110 (20.8%)
Goal post	1 (0.3%)	0	1 (0.2%)
Unknown	21 (6.8%)	8 (3.6%)	29 (5.5%)

* $P < 0.05$, 2×2 chi-squared test, children *versus* adults. †More than one option possible per patient.

Elsewhere, AF was the most common cause of sports-related WHF injuries presenting to EDs, and produced a median healthcare cost of AUD\$3328 when admission to hospital was required.⁸

All WHF injuries were because of contact or collision with another object such as a ball, person or ground, which contrasts with other non-contact injury types such as muscle strains which are common lower limb injuries in AF.^{9,10} Ball contact was the most common cause of WHF injury, which can occur during marking, catching, punching or tapping. Injury prevention measures, such as ensuring correct technique, might help reduce the number of ball-contact injuries. Marking or catching the ball without fingers pointing directly at the ball is an example. Elsewhere, an injury prevention programme for handballers that focused on proper technique, neuromuscular control, balance and strength, found that those in the intervention group had less than half the number of finger injuries than the control group.¹¹ The intervention included a high proportion of lower limb and trunk exercises, as well as balance activities while handling a ball, such that the reduction in finger injuries was attributed to improved body control and ball skills, thereby reducing misdirected or uncontrolled ball contact with fingers. Falling is another frequent cause of AF injury,¹² contributing 20% of WHF injuries in our study, which might also be amenable to injury prevention strategies. Scase *et al.* taught junior AF players skills in landing, falling and recovery and found less injuries in the intervention group.¹² Because one in seven WHF injuries occurred at training in our study, injury prevention measures should address risks during both training and games.

Gender differences for AF-related injuries have been reported previously in some studies, most commonly for ACL injuries and concussion.¹³ Our study found gender differences for WHF injuries for injury type, body-part injured and mechanism of injury. The reasons for these differences are speculative

but could include gender differences in who chooses to present to EDs with a WHF injury, game style and technique differences, and biological differences. For example, our data indicated that females had more sprain/strain injuries than males; this might indicate that females sustain this type of injury more often than males, and/or that females are more likely to seek ED care for this injury. Females had more finger injuries and were more likely to be injured from ball-contact – improper technique during catching or marking, such as having fingertips pointing directly at the ball, could partially explain this finding. Biological differences have been suggested to explain gender differences in sports-related injuries such as concussion and ACL ruptures;^{14,15} however, their role in WHF injuries is unknown.

More children than adults in our study presented to EDs with AF-related WHF injuries, which is consistent with other studies reporting AF-related upper limb injuries in EDs.³ This finding might represent (i) a higher proportion of children playing AF, (ii) an increased risk of children incurring WHF injuries, and/or (iii) a higher propensity for children and their carers to seek ED care for WHF injuries. Children represent up to half of participants playing organised AF,¹⁶ which, together with social participation at school, home and so forth, could account for the higher proportion of children being injured and presenting to our EDs. Children were also more likely to be diagnosed with a sprain/strain injury, whereas adults were more likely to present with a dislocated joint, which suggests children and their carers had a higher propensity to present with relatively less serious WHF injuries than adults. Children were more likely to injure themselves falling to the ground, which could explain the higher proportion of wrist injuries in children. Differences in game style and physical maturity between children and adults could also contribute to differences in injury rates and types, although there is currently no evidence exploring this possibility in AF.

The present study is the most detailed description of AF-related WHF injuries to-date and the first to compare across genders and age. We collected data across an entire AF season for all presentations to 10 EDs in our region including adults and children, and the dataset probably represents the most serious AF-related WHF injuries that occurred in our region. The data do not represent all WHF injuries, some of which would have been self-managed by players or managed in non-ED healthcare settings. We identified eligible patients via key word searching electronic medical records; patients without these keywords would have been missed in the present study. We did not collect playing hours, therefore incidence rates, such as the number of injuries per 1000 player hours, could not be estimated. Missing data, particularly for mechanism of injury, creates uncertainty about some results. We did not follow-up patients, hence the long-term consequences of injury remain unknown; the social and economic consequences of AF injuries are presented elsewhere.¹⁷

Conclusion

AF-related WHF injuries are common yet until now have been inadequately described. The present study provides a detailed description of the more serious WHF injuries as represented by EDs presentations. Fractures and sprains were the most common injury types, fingers were more frequently injured than wrists and hands (metacarpals) and contact with the ball was the main mechanism of injury, especially for fingers. Differences in the type and mechanism of injury between females and males, and between children and adults, suggest that injury prevention and management strategies for WHF injuries might benefit from gender and age-specific components to maximise benefits.

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Author contributions

SDG conceived the study. All authors contributed to the study design. LA, KK and SDG extracted data. LA and SDG completed data analysis. SDG wrote the first draft of the manuscript. All authors critically appraised the results, reviewed the manuscript and approved the final version.

Competing interests

None declared.

Data availability statement

Data are available from the authors upon reasonable request.

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Supporting information

Additional supporting information may be found in the online version of this article at the publisher's web site:

Table S1. Fractures.

Table S2. Sprains.

Table S3. Dislocations.