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Injury surveillance in community cricket and the exploration of insurance claims systems

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This thesis is presented for the degree of

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Abstract

The aims of this industry funded PhD thesis were 1) To understand the injury causes, trends and burden in community cricket and 2) To examine the Cricket Australia National Club Risk Protection Program (NCRPP) insurance scheme for suitability as an injury surveillance tool for community cricket.

This thesis sought to identify and understand the injury profile of community cricketers through existing literature and injury datasets, being, Victorian Injury Surveillance Unit (VISU) hospital data, Accident Compensation Corporation (ACC) and NCRPP insurance claims data. This thesis also undertook a novel assessment of data validity and completeness from various sources, against industry standards of the Australian Sports Injury Data Dictionary (ASIDD) and cricket injury consensus statements (consensus).

Existing literature using insurance claims data to report sports injury indicated high levels of validity and completeness were possible. Review across all sources of published, community-level, cricket-related injury data revealed acute medically-treated injuries were most commonly fractures, dislocations, sprains and strains. The most common body regions requiring hospital attendance were the wrist/hand and head. The majority of hospital-treated injuries were due to being struck by the ball. The majority of prospectively collected injury data involved junior and/or adolescent players and most often involved bowling cohorts, although fielding was the most commonly reported activity of injury onset. The majority of studies had an unclear likelihood of bias. Reporting completeness was moderate when compared to the ASIDD core items and consensus, with injury mechanism an area requiring improvement.

The ACC provided data, on all cricket-related injury claims, showed high validity with the core items of the ASIDD and the cricket injury consensus statements. The ACC data showed soft tissue injuries were the most common injury nature with bowling the most common activity at injury onset. Lower back and shoulder sprains/strains were the most commonly injured body regions. Four-percent of claims involved lost work time. The NCRPP, collecting specifically organised cricket-related injury not covered by a universal healthcare system, showed fractures to the hands/fingers/thumb and knee sprains were the most common injuries. Fielding was the most common activity at injury onset. Twenty-five percent of claims received loss of income (LOI) payments with knee injuries representing the highest injury burden (weeks LOI/year).

The NCRPP system showed a high level of validity in injury data collection measured against the ASIDD and consensus. The NCRPP data showed a high level of completeness compared to the core items of the ASIDD and a moderate level in comparison with the consensus. The NCRPP system was judged to be useful as a potential injury surveillance system against the Centre for Disease Control (CDC) guidelines. Recommendations for improvements to the system include: 1) Addition of medical diagnosis/history; 2) Inclusion of injury side; 3)

Inclusion of new/recurrent injury; 4) Allowance for multiple injuries being recorded separately; 5) Rationalisation of the injury nature terms (e.g. tear/rupture); 6) Reintroduction of injury mechanisms; 7) Addition of protective equipment usage; 8) Introduction of fielding positions; 9) Adopting required input fields in online forms to better capture injury data.

Additional research is required to help validate the representativeness of the NCRPP injury data. Future research into community-level cricket injury would also be better served with a community-level injury surveillance consensus statement.

Declaration

I certify that this thesis does not, to the best of my knowledge and belief:

i. incorporate without acknowledgment any material previously submitted for a degree or diploma in any institution of higher education;

ii. contain any material previously published or written by another person except where due reference is made in the text of this thesis; or

iii. contain any defamatory material.

Signed: __ [redacted] ____________

Geordie McLeod

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Contents

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List of Abbreviations

ACC = Accident Compensation Corporation

ACC45 = Accident Compensation Corporation electronic claims form No. 45

ACRISP = Australian Centre for Research into Injury and its Prevention

ACT = Australian Capital Territory

A&E = Accident and Emergency

AMS = Athlete Management System

ASIDD = Australian Sports Injury Data Dictionary

AS/NZS = Australian Standard/New Zealand Standard

BS = British Standard

C = Core data item (ASIDD)

CA = Cricket Australia

CDC = Centre for Disease Control

DSIC = Dunedin Sports Injury Clinic

ECB = England and Wales Cricket Board

ED = Emergency Department

EFISS = Evaluation Framework for Injury Surveillance Systems

EM = Exposure Measure

F = Female

GP = General Practitioner

HA = Hospital Admission(s)

HCID = Hockey Canada Insurance Database

HREC = Human Research Ethics Committee

ICD-10-AM = International Classification of Diseases 10th Edition, Australian Modification

ICC = International Cricket Council

ICISS = International Classification Injury Severity Score

ID = Injury Definition

IIR = Injury Incidence Rate

IOC = International Olympic Committee

JECS = Juniors Enjoying Cricket Survey

JRS = Jardine Risk System

JLT = Jardine Lloyd Thompson

LOI = Loss of Income

M = Male

MA = Medical Attention

MTL = Match Time Loss

N = No

n = number of case/claims/injuries/participants

N/A = Not Available

NCRPP = National Club Risk Protection Program

NHDD = National Health Data Dictionary

NISU = National Injury Surveillance Unit

NMDS = National Minimum Data Standards

NR = Not Reported

NSW = New South Wales

NT = Northern Territory

NZ = New Zealand

O = Optional data item (ASIDD)

O/A = Overall

P = Partial

PPE = Personal Protective Equipment

PRIS = Professional Riders Insurance Scheme

PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analysis

QLD = Queensland

R = Recommended data item (ASIDD)

RSCH = Royal Sussex County Hospital

SA = South Australia

SD = Standard Deviation

SM = Severity Measure

SR = Strongly Recommended data item (ASIDD)

SSA = School Sports Association (Australia)

TAI = Tendo-Achilles Injury

TL = Time Loss

TRIPP = Translating Research into Injury Prevention Practice

U15, U17 etc. = Under 15 years, Under 17 years of age etc.

USA = United States of America

USS = United States Swimming

VAED = Victorian Admitted Episode Dataset

VEMD = Victorian Emergency Minimum Dataset

VISU = Victorian Injury Surveillance Unit

WA = Western Australia

WDP = Work Days Paid

Y = Yes

95% CI = 95% Confidence Intervals

Research Outputs

Articles published or accepted for publication

- McLeod G, O'Connor S, Morgan D, Kountouris A, Finch CF, Fortington LV, Prospective reporting of injury in community-level cricket: A systematic review to identify research priorities. Journal of Science and Medicine in Sport, 2020: In Press, https://doi.org/10.1016/j.jsams.2020.04.023
- McLeod G, O'Connor S, Morgan D, Kountouris A, Finch CF, Fortington LV, Medical-attention injuries in community cricket: a systematic review. BMJ Open Sport and Exercise Medicine, 2020;6:e000670. doi:10.1136/ bmjsem-2019-000670

Presentations

- Medically treated cricket injuries in Victoria: a 15 year review of emergency department presentations and hospital admissions. Sports Medicine Australia Conference, October 23-26, 2019.
- A 15 year assessment of cricket-related hospital admissions and emergency department presentations in Victorian males from 2002/03 to 2016/17. Cricket Australia Sports Medicine and Sports Science Conference, April 9, 2019.
- Injuries in organised community cricket, how much do we know. A systematic review. Federation University Australia HDR conference, July 26, 2018.
- Using insurance claims for injury surveillance in community cricket. Presentation for confirmation of candidature of current PhD, Federation University Australia, May 21, 2018.

Conference submissions

- McLeod G, Finch CF, Kountouris A, Fortington L, Community cricket injuries in Australia. A descriptive analysis of 12 years of insurance claims data 2007/08 to 2018/19. Abstract submission for presentation at the IOC Injury Prevention Conference, Monaco, 2020.
- McLeod G, Finch CF, Kountouris A, Fortington L, Feasibility of using Insurance Claims Data for Injury Surveillance in Community Cricket in Australia. Abstract submission for presentation at the IOC Injury Prevention Conference, Monaco, 2020.
- McLeod G, Morgan D, Kountouris A, Finch CF, Fortington L, Medically treated cricket injuries in Victoria: a 15 year review of emergency department presentations and hospital admissions. Abstract submission accepted for presentation at the 2019 Sports Medicine Australia Conference, October 2019.
- McLeod G, O'Connor S, Morgan D, Finch CF, Fortington L, Kountouris A, Injuries in organised community cricket, how much do we know. A systematic review. Abstract

submission accepted for presentation at the Federation University Australia HDR conference, July 26, 2018.

- McLeod G, O'Connor S, Morgan D, Finch CF, Fortington L, Kountouris A, Injuries in organised community level cricket, how much do we know? A systematic review. Abstract submission accepted for poster submission at 2018 Sports Medicine Australia Conference.

Awards

- Early Career Research Award: ASICS Best Paper – Sports Injury Prevention. Sports Medicine Australia Conference, October 26, 2019.

Chapter 1 Introduction

1.1 Background

November 14th, 2014 was a day that the cricket world stood still. An injury and subsequent death of an elite Australian cricket player lead to an outpouring of grief and disbelief in almost equal measures, from the cricketing fraternity and the general public alike.

> *"It was just a game of cricket, and I think that, to me, I just can't get my head around that part of it." Anon. member of public (1)*

For the elite level of the game, this injury and consequent fatality, was extremely rare (2). Such an event had not been seen in the previous 20 years since Cricket Australia, the peak national body for cricket in Australia, had been routinely recording injuries amongst their contracted national and state level players. Subsequent investigations found that, in the last 30 years in Australia, fatalities associated with playing organised cricket at all levels were rare (3). Five deaths were associated with a direct impact from the ball. However, only one of those deaths occurred at the elite level of the game.

Cricket Australia maintains a comprehensive coverage of injuries to its contracted players through a national injury surveillance system. The Brukner et al (3) study highlighted there was much less known about fatalities at the community level of cricket. In Australia, there is no specific national or state-based sports injury surveillance system for community level participants. Current information about sports injuries must be collated, ad hoc, from administrative datasets such as those collected by hospitals and insurers or from independent collections such as those gathered by research conducted in specific settings, such as sports clubs or associations.

Cricket Australia, through partnership with insurer JLT-Sport (now Marsh), has had an insurance scheme in place for community cricket as a part of its National Club Risk Protection Programme (NCRPP) since 2002 (4). The insurance scheme allows members and volunteers of associations and clubs to claim for a portion of the non-Medicare (government funded) costs associated with injury treatment where related to cricket or the running of a cricket club. The scheme also covers some portion of lost income associated with the injury were applicable.

The lost income provision of the NCRPP is particularly pertinent for community level players as the sport they play is not their primary place of work. Elite level players, where contracted, are essentially full time cricketers and the cricket field is their place of work. Community level players' motivations for playing cricket may range from just having a go to competitive and performance based, but in the majority they are based on fun and enjoyment followed by social reasons (5). Being physically active is important for all ages and injury has been shown to be a barrier for participation at the community level in sports (6). Also important is how an injury may affect a participants' work life, where future participation may be dictated by the level at which an injury might affect income (7).

Within Cricket Australia's 2017 strategic plan, an increase in participation at all levels of the game is seen as one of the major pillars (8). From a public health point of view, the majority of the injury burden of cricket is likely to occur within the community level as the vast majority of cricketers in Australia play at this level; around 684,000 registered players at the 2018/19 Cricket Australia census (personal communication: Ash Hepburn, Cricket Australia). With an increase in participation, there is a concurrent increase risk for injury occurrence.

Sports injuries cover a wide range of types and severities. These injuries can also be assessed by a wide range of medical and allied health practitioners. The frequency of sports injuries is often conceptualised in an injury pyramid or triangle (depicted later in Figure 3). The apex of the pyramid represents the most severe and correspondingly less common injuries. Most sporting injuries are of a lower severity and are allocated in the lower tiers of the pyramid. At the elite level, injury prevention aims to maintain the best performing team on the field at all times in order to maximise the team's winning potential. At the community level, injury prevention is as much about maximising participation and therefore promoting healthy activity and social interactions.

In this light, Cricket Australia and JLT-Sport/Marsh jointly instigated and funded this PhD project, in conjunction with the Australian Centre for Research into Injury in Sport and its Prevention (ACRISP), to better understand injuries in community level cricket and how the NCRPP may be utilised as an injury surveillance tool for future injury prevention strategies.

1.2 Research aims

The intention of this PhD project was to identify opportunities to promote player safety in community cricket. For this, there were two primary aims, in line with stakeholder expectations:

Aim 1: To understand the injury causes, trends and burden in community cricket. This includes the nature, frequency and severity of injuries sustained by community cricketers.

Aim 2: To examine the NCRPP insurance scheme for suitability as an injury surveillance tool for community cricket.

With an understanding of what cricket injuries are happening at the community level, and an understanding of the advantages and limitations of an existing insurance database, it was intended that this PhD project would provide specific advice for improvements or optimisation of the NCRPP system. In turn, the insurance system would then be better able to highlight injury prevention priorities that can be actionable through safety measures and monitored for effectiveness in an ongoing manner.

1.3 Research questions

The two fundamental research questions to be investigated in this project are:

Question 1: What are the injuries reported in community level cricketers?

Question 2: Can an insurance claims system be used for injury surveillance in community cricket?

1.4 Frameworks for injury prevention and surveillance in sport

Van Mechelen et al (9) suggested a four stage model for sports injury prevention in 1992. In 2006, Finch (10) proposed an updated concept for injury prevention research: the Translating Research into Injury Prevention Practice (TRIPP) framework. The six stages of TRIPP (Figure 1) have been designed as a comprehensive framework for injury prevention research.

The underpinning aspect of both the four stage model and the TRIPP framework is high quality injury surveillance - highlighted in Figure 1. Injury surveillance is required, not just to establish the problem, but also to monitor the effectiveness of preventative measures once they are implemented. To be effective, an injury surveillance system needs to be ongoing, simple to administer, reliable, sustainable, timely and informative to those who need to know, and act upon, the outcomes (11, 12). Ideally, surveillance systems should not only focus on capturing data, but also promotes pathways for the data that is being provided back out to stakeholders (12).

Stage[1]	Description
1	**Injury Surveillance – important as a fundamental baseline for understanding what the problem is as well as evaluating implementation of preventative measures.**
2	**Establish aetiology and mechanisms of injury**
3	Develop preventative measures
4	"Ideal conditions" / scientific evaluation
5	Describe intervention context to inform implementation strategies
6	Evaluate effectiveness of prevention measures in implementation context

[1] Stages 1 and 2 are the focus of this PhD project.

Figure 1. *The stages of the Translating Research into Injury Prevention Practice (TRIPP) framework – highlighting Stage 1 and 2 – Injury Surveillance (adapted from Finch (10))*

In addressing the first aim of this PhD, TRIPP stage 1 was the focus in investigating what can be learned from existing sources of knowledge on injury in community cricket. It is possible some aspects of stage 2 may be identified through this process.

In addressing the second aim of this PhD, stages 1 and 2 of TRIPP were the focus in assessing the validity and data completeness of the NCRPP insurance scheme. The validity and completeness has been measured against international industry standard sports injury data collection item guidelines, the Australian Sports Injury Data Dictionary (ASIDD) (11) and the cricket injury surveillance consensus statement published in 2005 and updated in 2016 (13, 14).

The ASIDD was designed to provide much needed guidance for sports injury data collection (15). Thirty-one data items are noted, seven of which were classified as core items, that should be present in all sports injury data collection (refer to Appendix A for outline of all of the ASIDD data items). The cricket injury consensus statement was designed to standardise the reporting of cricket-specific injury, primarily in elite level cricket, with reference to community level cricket in the 2016 update (13, 14).

1.5 Research context

The underlying questions and aims of this PhD are related to, and underpinned by, injury surveillance. It therefore focusses on the injuries associated with community cricket and the injury surveillance opportunities afforded through existing insurance systems. In order to provide context to this thesis, the following section summarises a brief history of cricket from an injury prevention standpoint. The definition of community cricket used within the research is then presented, followed by how injury surveillance has been undertaken at the elite level of the game and under what guidance it has proceeded.

1.5.1 A brief history of cricket and injury prevention

Cricket is fundamentally a bat and ball sport played between two teams (further explanation of the game is found in Appendix B). Cricket probably evolved from numerous games and historians have ascribed and argued the merits of a plethora of possible names for these, from Tip-cat, Cross-wicket, Cricce, Handyn and Handoute, Club ball, Cat and Dog, Stool ball, Stoball, Creag, Criquet, Crekettes, Krickstoel, and Crosse being among the many options (16-20). Cricket's origins and early development may also have stemmed from many different countries, with France, Belgium, Scotland and Ireland all implicated, but it was in England that the seed took root and prospered. Cricket spread to the British colonies and is largely played in and between Commonwealth countries today. England is still where the seat of control is regarding the game's rules (or laws); through the Marylebone Cricket Club (MCC), first established in 1787. The changing nature of the game over its many years of development has had an effect on the injuries sustained by its players, officials, grounds-persons and even spectators.

Throughout the history of cricket, there has always been recognition of some inherent risks of injury. Rule and law changes within the game have created space between fielders, wicket-keepers and batters to reduce the possible collision aspects (deliberate or incidental) of the earlier forms of the game. Cricket has also evolved with protective equipment that has in many ways made the game far safer, but the inherent combative nature of the sport will always create risks (21). In many ways the game has changed over time and yet in many ways the game and particularly some of its injury consequences have not (e.g. susceptibility to hand injuries (22)). Cricket legend Sir Donald Bradman said that: "it is the responsibility of all those that play the game (the custodians) to leave the game in a better state than when they first became involved." (23) The same could (and indeed should) be said for the administrators of the game, particularly in terms of the well-being of the participants that it relies upon to foster the sport. In applying this responsibility, there must be a careful path taken between the slope of healthy participation and the chasm of catastrophic injury, and for cricket this has been seen to be a matter of millimetres in design and fit of protective equipment. Protective equipment has once more become a focus for assessment and implementation point of view, and it is argued that appropriate policy and guidelines on usage are just as important as the equipment they are intended to promote (24).

Table 1 shows a timeline of events across the history of cricket from 1702 to modern day, highlighting changes in laws or playing conditions, protective equipment and the impact of injury prevention.

Table 1. *Timeline of cricket-related events, laws/playing conditions and protective equipment development and associated injury prevention effects*

Year	Changes in laws and/or playing conditions	Protective equipment	Injury prevention effects
1702	Removal of 'block hole' or 'popping hole' at the wicket.		For run outs, instead of batter having to place bat in hole before the fielder placed the ball, the fielder now only had to disturb the stumps. Created a separation of batter and fielders to prevent "serious hand injuries" (22).
1731	Boundary introduced (25).		Helped separate spectators from players.
1744	First documented rules/laws of the game (18).		Possibly helped reduce injuries from fights or unruly spectators where betting was involved (25).
1771	Restriction on the width of the bat to 4 ¼ inches (108 mm) (18).		-
1774	Official laws of the game drawn up (18).		-
1774-1780	Third (middle stump) introduced (coded into laws in 1785) (16, 17)	Primitive batting pads emerging.	Batters began using their legs to cover the stumps to prevent being bowled, leading to the Leg Before Wicket (LBW) law being introduced (22).

Table 1 (cont).

Year	Changes in laws and/or playing conditions	Protective equipment	Injury prevention effects
1787	Batters not allowed to obstruct fielders while running between wickets (17).		Prevented physical collisions and accidental, or otherwise, striking of fielder by the batter with their bat. The possibly first recorded, cricket-related death, occurred due to such an incident in 1624 (17).
1788	Rollers, covering and watering the pitch allowed between innings (25).		May have improved pitch conditions, although rollers and coverings would have rudimentary.
1816	Underarm bowling deemed to be the only allowed method of delivery although no law was made (16, 18).		Concern was the increase in speed and bounce afforded by the newer actions may endanger batters (16).
1825-1835		Early forms of batting gloves began emerging – essentially Indian rubber strips glued to the fingers of gloves	Marginal, if any, benefits in protecting fingers: "The old players could show finger-joints of most un-genteel dimensions; and no wonder, for a finger has been broken even through tubular India-rubber" (26)
1834		1st recorded use of batting pads in Australia (27).	
1835	Round arm bowling allowed (16).		Arguably increased the development of modern batting technique. Also likely increased the speed and height of deliveries off the pitch (16).
1841		'Engineered' pads using cane strips developed (26, 28).	Provided much more protection to batters and wicket keepers legs.
1840s		Primitive wicket keeping gauntlets developed – likely thick leather gloves (26).	May have helped lessen bruising as bowling became faster with round arm methods.
1855		'Protectors' of the abdomen developed (22, 28).	Likely provided rudimentary protection.
1856			Australian rules football developed as a winter sport to improve cricketer's fitness as rugby was deemed too rough (27).
1864	Overarm bowling legalised (17).		Several bowlers categorised as dangerous by the end of the 1860s, possibly due to short pitched bowling, but also possibly due to a period of "anything went", where some bowlers took to throwing (17).
1870	Heavy rollers used for the first time (17).		Helped provide better pitch preparation, however also became a new injury hazard for grounds persons, cricketers and bystanders (3, 27, 29).
1872	First experiments with covering of pitches prior to matches in England (17).		-
1873	Sight screens first used (22).		Helping batters pick up the ball from the bowlers hand at delivery: "much inconvenience arises in a match by spectators standing in the eye of the ball" (22).
1884	Boundary codified into laws (25).		Ensuring the playing area was separated from bystanders and spectators.
1910	Covers for pitches used more commonly in Australia (30).		May have improved the quality of pitches.
1932	Bodyline series: Australia v England, where short pitched bowling tactics were directed at the batter's body.		Intimidating bowling tactics outlawed locally in Australia after copy-cat tactics were used in club competitions in South Australia and there was a rise in head injuries in junior cricketers in Sydney (31). There was also a coincidence of peak traumatic cricket-related deaths in Australia (3) in the 1930s.

Table 1 (cont).

Year	Changes in laws and/or playing conditions	Protective equipment	Injury prevention effects
1933		English batter, Patsy Hendren, pioneered the first head protection with a bespoke padded cap against the West Indies (32).	The concept was roundly criticised by the puritans at the time and failed to take off.
1933		Chest padding likely introduced around this time (32).	Likely a result of the bodyline effect and rise of the short pitched delivery.
1950s		English county player, Dickie Dodds, experimented with wearing part of a riding helmet under his cap (32).	The idea did not progress.
1963	The front foot no-ball rule was introduced, replacing the back foot no-ball rule (33).		Argued as a possible cause for the increase of lumbar and foot stress fractures in bowlers from the 1970s onward, due to the proposed resultant change in bowling actions because of the new rule (33).
1960s – 1970s		Keeper pads and gloves improved.	Keeping pads were trimmed down to provide more comfort and reinforced dermal padding added to gloves for additional finger protection (28).
1960s	First experimentation with shorter formats of the game with 40 and 60 limited over matches in England (34).		
1971	First international one day limited over match (35)		
1977		English players experiment with skull caps.	The idea didn't take off, but the thinking progressed, leading to the first helmets.
1977-78		First full protective helmets worn in World Series Cricket matches in Australia and then in Test cricket, by batters and close in fielders (36).	Began a trend that has arguably reduced the incidence of serious traumatic head injury in cricketers since (3).
1980s		New lightweight polyurethane batting pads with Velcro straps replace old style cane strip style (28, 37).	Improvements to protection and comfort.
1981		British standard BS 6183-1 introduced for protectors, gloves and pads.	
Early 1990s	Intimidating (dangerous) bowling enshrined into laws of the game, limiting bowlers to two short pitched balls an over in test cricket (38).		Designed to minimise the risk of batters being struck, especially less skilled batters.
1990s	Increase in match schedules and more limited over cricket played.	Fitness and professionalism of elite players increased (39).	More desperate fielding techniques introduce new injury risks, such as diving and sliding in the field (39, 40).
1997		Australia, New Zealand introduce standard for 'protective headgear for cricket' (AS/NZS 4499) (41)	
1998		British standards introduced standard for cricket helmets, BS 7928 (42).	300g force transmission allowable even though 250g force shown to be associated with mild concussion (43).
1998		Batting gloves technically (lab conditions) able to prevent finger fractures from high speed deliveries (~ 140 km/h) (37).	Difficulty balancing comfort and usability over protection. Players not helping themselves by choosing comfort (or sponsorship) over more effective designs (39).
1999	Studies began into fast bowler workload issues (44)		Aimed to examine the relationship between workload and injury in fast bowlers (44).
2000	English Cricket Board (ECB) introduce mandatory wearing of helmets to all U18 players (45).		
2000-01		BS 6183-1 withdrawn and replaced by BS 6183-3 (pads) and BS 6183-4 (gloves)	
2000-02	Cricket Australia (CA) introduce mandatory wearing of helmets for all U18 players (46).		Some evidence of policy effectiveness shown in study of junior cricketers in NSW, Australia, where head injuries dropped from 62% to 4% over three year period, 2002/03 to 2004/05 (46).

Table 1 (cont).

Year	Changes in laws and/or playing conditions	Protective equipment	Injury prevention effects
2001/02	Boundary ropes introduced into elite level games to avoid player injury with boundary fence, based on injury surveillance of Australian elite level players (47).		No further injury fence collision injuries in the Australian side in the next 5 years (47, 48)
2002		Increase in amount of protective equipment worn by batters shown to be detrimental to performance due to heat stress (49).	Indicates difficulties of maintaining balance between protection from direct trauma and indirect systemic injury.
2003	Rise of 20/20 cricket in England with first international match later the same year (50)		
2005	Bowling workload recommendations for community level and elite junior fast bowlers revised (51).		Aimed at reducing the injury risk to younger fast bowlers whom were at risk of exceeding elite guidelines (51).
2010	Limitations on the distances fielders can be from the wicket without protective helmets and minimum distances for junior cricketers. Also junior wicket keepers to wear helmets when keeping up to stumps (45)		Aimed to reduce likelihood of traumatic injury due to reduced reaction time.
2012		Study on effectiveness of cricket helmets showed deficiencies in performance leading to traumatic head and facial injuries at the elite level (41).	Recommendations lead to revisions of the British Standard 2378 in testing and design with manufacture of more effective helmets.
2015		Stem guards introduced by some helmet manufacturers to rear of helmets to protect upper cervical region from traumatic injury.	Aimed at reducing impact trauma to upper cervical region. Unclear on effectiveness at this point in time (52).
2017	CA introduces new concussion policy for community cricket (53).		Provides for timely removal and assessment of players suspected of traumatic brain injury.
2017	International Cricket Council (ICC) introduces rule to limit bat thickness to 40 mm (54)		Aimed, in part, to limit power of bats and velocity of ball off the bat to protect fielders, bowlers and umpires from traumatic injury.
2017	ICC introduces policy for all elite level players to be wearing protective helmets of the latest standard (55)		
2019	CA and ECB mandate policy to require all (not just junior) community level players to wear helmets while batting and keeping up to stumps (56, 57).		Aimed to reduce all head injuries across all grades and ages.

To address injury prevention effectiveness gaps identified in Table 1, knowledge of injury is needed. Injury surveillance is an important steppingstone toward injury prevention. The vast majority of organised cricket is played in community competitions and schools. Community sport provides impetus for social and physical public health benefits (58, 59). Understanding the injury profile of the large community cohort could help maximise the safe participation, a goal promoted by the sport's governing body and a goal typical of community sports organisations (60).

1.5.2 What is community cricket?

There is no official definition of community cricket provided by the International Cricket Council (ICC) or Cricket Australia. For the purposes of this research, the definition adopted was formed through examination of the cricket pathway (Table 2) provided by Cricket Australia, expert opinion from a supervisor and Cricket Australia employee[1], and consideration of the insurance claims collection process to be evaluated in later sections of this thesis.

***Table 2**. Pathways for participants in cricket amongst four major cricket playing nations: Australia, England, New Zealand and South Africa*

Pathway Level	Australia	England	New Zealand	South Africa
Junior development	Junior Blasters. ages 5-7 Master Blasters ages 7-10	All Stars cricket: ages 5-8	Superstar cricket: ages 5-12 Super cricket: ages 13-18	Mini-cricket: ages up to 13
Club & School	Junior club: ages 9-17 School cricket Senior club: ages 17 +	Junior club: ages 9-17 School cricket Open age club cricket	Junior club: ages 11-17 School cricket Senior club: 17+	School cricket: ages up to U19 Club cricket: age restricted competitions and open age competitions
Premier [1]	Premier Cricket	Premier Cricket	Premier Cricket	Premier League Cricket
Next level	State level cricket	County level cricket	Provincial level cricket	Provincial level cricket

[1] Highest level of community level cricket, typically based out of major cities in each country.

In Australia, Cricket Australia is the custodian of all cricket related matters and does so by association through its State affiliates: Cricket Victoria, Cricket New South Wales, South Australian Cricket Association, Western Australian Cricket Association, Cricket Tasmania, Queensland Cricket, Cricket ACT (Australian Capital Territory), and Northern Territory Cricket.

Cricket Australia has a well promoted pathway for cricketers at all levels. Programs exist for children as young as five years old. The Junior Blasters program runs annually for children aged five to seven years and is focused on teaching the fundamentals of the game. The next level, Master Blasters, is designed for seven to ten-year olds, which allows children to adapt their skills to a game scenario. The emphasis for both Junior and Master Blasters programs, is that participants can have a go at all parts of the game – fielding, batting and bowling. Above this is junior club cricket, which typically begins organised competitive games from under 12s and upward. Much of this level of cricket is distinctly community based, with local cricket clubs and schools forming the backbone of this level of junior cricket.

Cricket is also a common sport played at primary schools and secondary schools. Both usually have some form of semi-organised and competitive level cricket, particularly at secondary school level. In terms of higher level school cricket, Cricket Australia has a relationship with the School Sports Association (SSA). The SSA was formed in 1981 as the parent body for school sports in Australia through its State and Territory affiliates is responsible for organising national competitions in many sports which allows talented youngsters to play a higher level of competition (61). The SSA, in conjunction with Cricket Australia, runs a national 12-and-under and 15-and-under competition between state representative sides for both boys and girls. This is an important talent identification competition for Cricket Australia, and many current State and National players have come through this system.

[1] Personal communication with Alex Kountouris, manager of the Sports Science and Sports Medicine area of Cricket Australia.

As players progress through the junior ranks they may also play regional representative cricket and eventually senior level cricket with their local club. Players wishing to progress their sporting careers will eventually seek out a Premier level club where they can work through the ranks and into the Premier first XI - the pool of which largely supplies the State level squads.

Cricket is mostly played outdoors (as described above) but also has an indoor variant played socially and competitively. With this in mind, the definition of community cricket adopted for this project is as follows:

- Encompassing all organised cricket in both indoor and outdoor formats;
- From junior development and club cricket up to and including premier level cricket;
- Includes organised school cricket, including 12 years and under and 15 years and under National championships;
- Regional and metro representative matches not under direct control and organisation of CA or state affiliates.

Community cricket excludes high performance settings, where otherwise community level players may be temporarily training under the organisation and management of Cricket Australia or state affiliates.

1.5.3 Injury surveillance in cricket

Elite levels

In terms of peer reviewed, prospectively collected injury data, the first study was with the South African national cricket team on tour at the 1992 World Cup, and the following tour of the West Indies (62). In 1998, Australia began prospectively recording injuries in their contracted players, both state and national teams, and first reported on this, retrospectively, in 2002 (47). England reportedly began a similar regular survey of its contracted players around the same time, but only recently has some of that information been reported in the published literature (63). Leary et al (64) published the earliest collected data on English County players from 1985 to 1995. However, they only did so in retrospect in the year 2000. South Africa showed it had the capability to provide and produce longitudinal injury surveillance at a national level also from 1998, in a 2003 publication (65). Mansingh et al (66) produced injury research on West Indian cricketers over an 18 month period in 2003/04 and New Zealand (NZ) began its foray into national injury surveillance from 2002, although only published in 2012 (67). Cricket Australia is the only nation to have regularly published internal (not peer reviewed) outcomes from the national injury surveillance of their elite contracted players since 2003, with the last being in 2016/17 (68). More recently, the first descriptive analysis of elite female cricket injuries in Australia (69) and the first longitudinal, prospectively collected injury data on elite English and Wales domestic players were published (63).

Table 3 shows a summary of the proportions of injuries reported by playing position and broad body region for elite level studies. This excludes studies in tournaments environments as they were of shorter durations (70, 71). The majority of studies were longitudinal in nature with only two studies not reporting at least two years of data (62, 66). Most studies reported bowling as the most common activity of injury onset, except for Perera et al (69), who reported on elite Australian female cricketers, and Mansingh et al (66) who reported on West Indian cricket injuries, both of which reported fielding as the activity of highest injury proportion. The latter noted that although fielding was the major cause of injury onset, players whose skill was predominantly bowling, were the most likely injured (66). The lower limb was almost universally reported as the highest proportion of broad body region of injury.

Table 3. *Injury proportions by playing position and broad body region for elite level cricket reported in prospective studies (not including purely tournament based surveillance) since 1992.*

					Injury proportion (%) by position			Injury proportion (%) by broad body region[1]			
First author, year, ref.	Years	age mean, (SD) /range	Participants	Injuries (n)	Bowling	Batting	Fielding	Head/neck & face	Upper limb	Trunk/back	Lower limb
Goggins 2020[2] (63)	2010-18	NR	505	1,287	42.6	22.8	30.4[3]	3.7	26.1	21.2	49.0
Perera 2019[9] (69)	2014-16	24.2 (± 4.5)	121	600	15.1	21.8	45.5[4]	5.4	35.3	5.7	43.3
Frost 2012 (67)	2002-08	NR	248	415	48.7	14.5	20	2.7	17.8	25.4	46.3
Orchard 2006 (48)	1998-05	NR	NR	426[5]	45.2[6]	20.8[6]	24.6[6, 7]	2.9[8]	18.9[8]	20.4[8]	51.2[8]
Mansingh 2006 (66)	2003-04	18-37	195	79	28.0	20.6	44.0	12.0	28.0	28.0	28.0
Stretch 2003 (65)	1998-01	12-29+	436	812	41.3	17.3	28.6	4.1	23.3	22.8	49.8
Leary 2000 (64)	1985-95	26.6 (±0.5)	54	990	NR	NR	NR	5.7	29.4	20.0	44.9
Smith 1992 (62)	1992	NR	14	15	26.7	20.0	33.3	13.3	26.7	26.7	33.0

[1] Not all values add to 100% due to unspecified/supressed data
[2] Injury proportions based on proportion of mean item injury rate / average total injury rate. Participants are the average number per year (range 494-512). Injury number estimated from average injury rate x (average number of days played / 1000) x 9 seasons.
[3] Includes 3% for wicket keeping.
[4] includes 3.4% for wicket keeping.
[5] Total proportions not adding to 100% are made up of other (e.g. illness)/not reported regions.
[6] Match injuries only (all positional % for match injuries only – there were 886 injuries in total).
[7] Includes 1.7% for wicket keeping.
[8] Body region % based on ratios of seasonal incidence of body region over total seasonal incidence.
[9] Female elite level players.
NR = Not reported.

Injury surveillance guidance

Injury surveillance is largely the purview of elite level sports (72). In 2005, cricket became the first international sport to produce a consensus statement on injury surveillance in the elite level of the game (13). This was intended to standardise injury data recording and reporting to help countries produce comparable research that could build an international profile of cricket injuries. Mansingh et al (66) were the first to produce a publication using the consensus methods on West Indian cricket injury in 2006, with Orchard et al (48) following soon after on Australian national and state cricket injuries and then following up four years later with updated data, looking at the effects of the introduction of T20 matches on injury profiles (73). Frost et al (67) used the consensus statement in their study of New Zealand (NZ) first class cricket injuries from 2002 to 2008, albeit retrospectively modifying data from the time frame prior to the publication of the consensus. The first reporting of injury profiles from the Asian cricketing nations was not until 2013 with Ranson et al's (70) study on five teams in the 2011 World Cup tournament, which included teams from Sri Lanka, Bangladesh and Pakistan. Another study used the original consensus statement to report on the Asian ICC associate countries competing in the 2013 Asian Cricket Council, under 19, Elite Cup (74). The Ranson et al (70) study also highlighted some short comings of the consensus around non-time-loss injuries and the rise of the shorter twenty overs a side (20/20) matches. The consensus was updated in 2016 to allow for research that had been conducted on injury definitions and the increased exposure of players to the newer, shorter, game formats such as the 20/20 (14). Since the update, two studies in elite level players have been published (63, 69).

Within the updated consensus, the preferred injury definition moved from being a 'significant injury' to a 'match time-loss injury' (14). An injury definition deemed relevant for community level cricket was also added; 'player reported injuries', where the assumption was that medical resourcing would be minimal (14). Player reported injuries could cover a broad spectrum of injuries. As far back as 1997, it was known that 50-60% of sports injuries do not lead to substantial time loss (75). There are typically three broad categories of injury definition: 1. all complaints, 2. medical attention injuries, and 3. time loss injuries, and Clarsen et al point out that there is no 'one size fits all' approach (76). Figure 2 illustrates the overlap between injury definitions, with the cricket consensus 'match time-loss' injuries added. For the community cricket researcher, 'player reported' injuries would need to be further defined to fit within this spectrum.

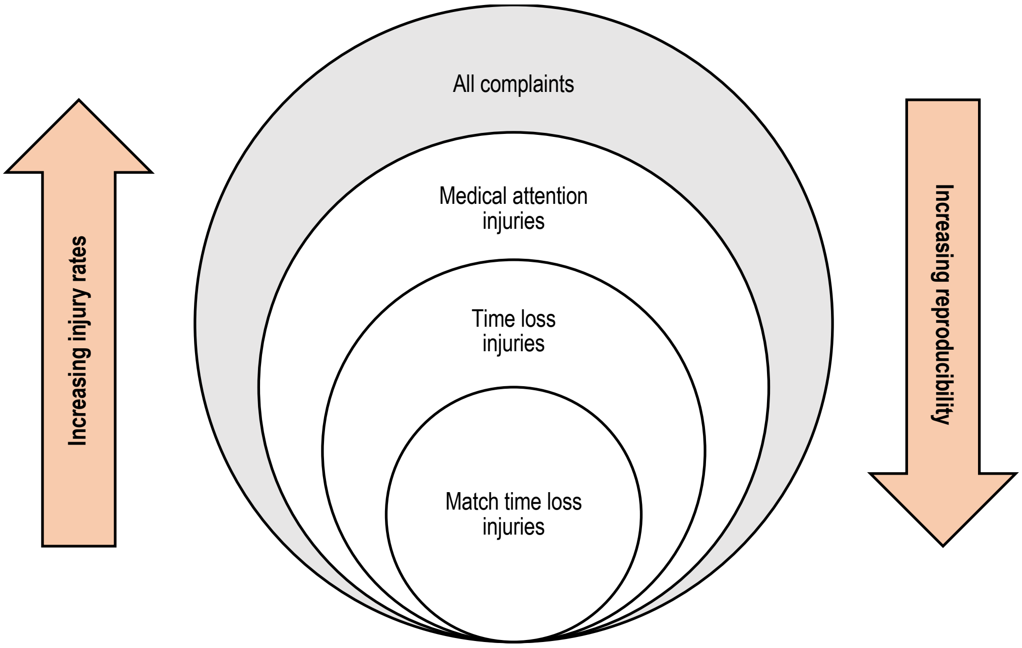

Figure 2*. Interactions between definitions of injury and illness and the likelihood of level of injury rates and reproducibility (adapted from Clarsen and Bahr (76) and Orchard et al (14))*

The authors of the original cricket injury consensus statement, whilst acknowledging the limitations of their injury definition, reasoned that it would create the most reliable method for injury surveillance, particularly as not all countries had an equal platform when it came to resources, even at the elite level (14). Clarsen and Bahr (76) also noted that addressing all complaints can be difficult and subject to systematic bias and suspect reliability. Medical attention injury reporting systems are more likely to capture a greater number of injuries than time loss injuries alone and also present a more complete picture of injury burden. However, the definition becomes more difficult to apply at community levels. Time loss injuries, as Clarsen et al (76) noted, requires no specific medical knowledge and therefore were considered to be more applicable at community levels.

The injury data items recommended for collection by the initial cricket consensus include (13):

1. Player name
2. Player details (e.g. date of birth, bowling type)
3. Injury diagnosis (including code and body region)
4. Injury side (left/right/bilateral/not applicable)
5. New injury/recurrence
6. Time of onset (match/training/other/gradual) including match details
7. Activity of onset (batting/bowling/fielding/gradual) including fielding position
8. Date of onset
9. Mechanism description
10. Qualification as a significant injury
11. Details of surgery required or any other major treatment (if relevant).

The 2016 consensus update added recommendations around the recording of the mode of injury onset. This included sudden onset non-contact injury, impact/trauma injury, gradual onset, insidious onset (i.e. no identifiable mode) and medical illness. It also recommended the mechanism of injury be described to assist in injury classification (14). A noticeable item missing from the cricket consensus, however, is the lack of severity or burden definitions or guidence, such as included in other sports injury consensus statements (77, 78). The cricket consensus statement only refers to ‘significant injury’ which is defined as an injury that prevents a player from being available for selection or prevents a player from being able to bat, bowl or wicket-keep according to the rules or requirement of the team captain.

Injury burden

The measure of the injury burden in sport can be dependent on the definition of injury used and point of view of the various stakeholders. For example, at elite levels, the player will be concerned about an injury that prevents them playing to any extent, but especially if it threatens their career and therefore livelihood. The club will be concerned the team may suffer in performance without their key player and possible financial losses associated (79, 80). From a community level perspective, because the sport may be more about social and physical fitness reasons, the burden of injury may be more pertinent to the external work life of the participant (81). In fact, the threat to income may be a significant impediment to return to sport participation post injury (7). From a public health perspective, the cost of treatment and rehabilitation can be a measure of injury burden, and long term effects of injuries can create additional loads on the public health system, as well as the individual (82).

The duration and nature of treatment sought is also a measure of severity that can help inform the overall burden of injury (9). Figure 3 shows the sports injury pyramid which is a theoretical hierarchy of sporting injuries and places of treatment (83). The injuries that are seen toward the apex of the pyramid are the least common but most severe in occurrence and injuries seen at the base of the pyramid are the most common and less severe. Various sources of data can provide information along the pyramid, from hospital data, insurance data and data collected prospectively, in the field.

It is through these three particular sources of data that this thesis has endeavoured to answer the research questions and aims posed. Serious injuries can be captured by hospital data, however it is recognised that only a small proportion of sports injuries require hospital treatment with studies of self-reported data indicating that around 9% of medical attention injuries are treated in hospitals but a further 50% are seen by physiotherapists, GPs or allied health practitioners (84). The more minor injuries can be important in the long term, particularly if they are accumulated, and lead to future health burden conditions such as osteoarthritis (82, 85). Therefore, the use of insurance claims data might be able to expand upon the understanding of injuries in community level cricketers.

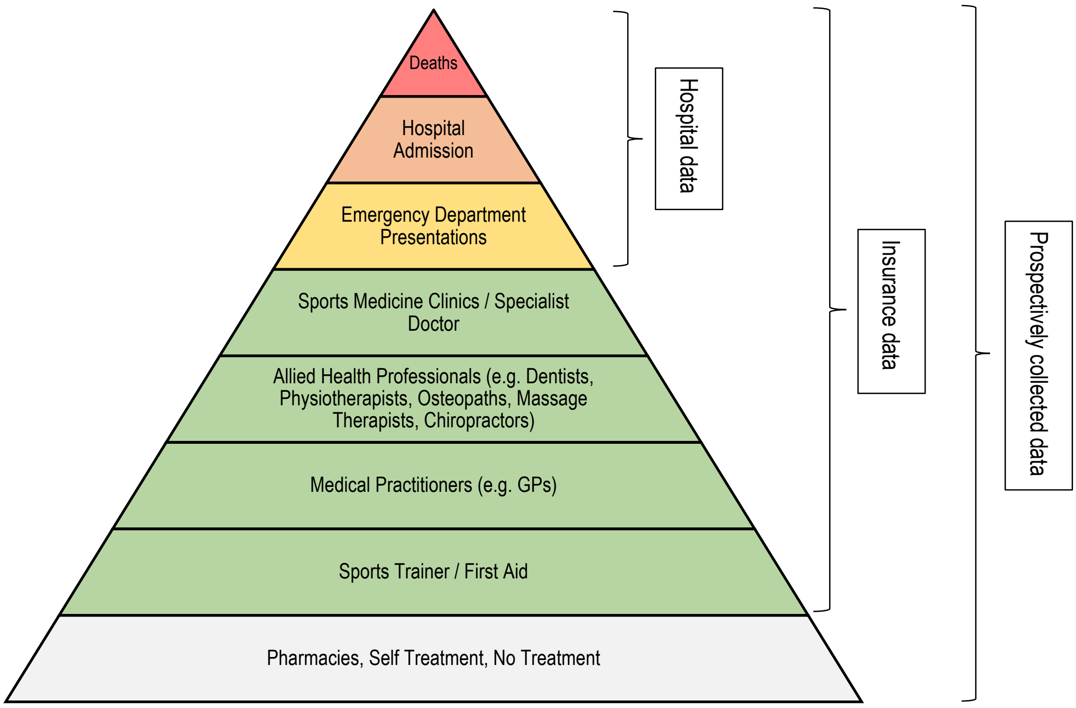

Figure 3. *Sports injury pyramid, with sub-categories for medical attention injuries outside of hospital settings (green) and likely sources of data. Adapted from Finch et al (83).*

1.6 Layout of thesis

Figure 4 outlines the overall layout and the rationale for the order of this thesis as described below.

Chapter 1 has introduced the industry driven problem, framework, aims and research questions. The chapter, in line with aim 1 and research question 1, outlines a brief history of cricket in the context of injury and injury prevention and defines community cricket. The chapter also briefly outlines the current extent of injury knowledge in the elite form of the game and how injury surveillance is defined within the sport.

Chapters 2 and 3 look deeper into the peer reviewed published literature to investigate the reporting of sports injury from insurance claims and injuries to community level cricketers. In line with aim 2 and research question 2, **Chapter 2** presents a scoping review of studies reporting sports injury data through insurance claims systems. The review seeks to compare the data reported with that required by the core data items of the ASIDD and identify common themes of limitations within the insurance claims systems in general.

Chapter 3 presents a systematic review of injuries in community level cricket from the published literature, in line with aim 1 and research question 1. The review breaks down the published evidence into categories of information associated with the sports injury pyramid:

- Acute medically treated, such as those reported from hospital or insurance data.
- Injuries reported by in-the-field prospectively collected data, likely to be more representative of all injuries along the pyramid.
- Other forms of data collection, such as retrospective survey or questionnaire, which while also likely to provide injury information along a greater range of the injury pyramid, are less reliable sources of data.

Chapters 4 and 5 utilise existing public administrative datasets to further describe injuries in community level cricketers. Beginning at the higher regions of the sports injury pyramid, **Chapter 4** analyses two hospital datasets from Victoria, Australia: the Victorian Admitted Episode Dataset (VAED), looking at hospital admissions from July 1, 2002 to June 30, 2017 and the Victorian Emergency Minimum Dataset (VEMD), looking at Emergency Department (ED) presentations from July 1, 2002 to June 30, 2017. Victorian hospital data were utilised because of the relative ease of access to the data and the highly representative nature of the dataset for Victoria, covering 100% of public hospitals since 2002. A detailed descriptive analysis is provided for male admissions and ED presentations only as female cohorts from these datasets have been a focus of a previous study (86). The chapter provides injury trends over time by injury type, nature and age groups, in line with aim 1 and research question 1.

Chapter 5 utilises the Accident Compensation Corporation (ACC) dataset, a national insurance scheme in New Zealand (NZ), to investigate cricket-related injury at the community level in NZ from July 1, 2008, to June 30, 2018. The ACC dataset was used because it was highlighted in **Chapter 2** as a potentially useful data source for sports injury reporting, with only limited information from it previously published on cricket-related injury. An in-depth descriptive analysis is provided for male and female claims in line with aim 1 and research question 1.

Chapter 6 summarises the general limitations, validity and data completeness of several injury data sources compared to the ASIDD and cricket injury consensus statement. Specifically, the prospective in-the-field collected injury data studies, hospital data from **Chapter 4** and ACC claims data from **Chapter 5** are examined for their data reporting completeness compared to the core data items of the ASIDD and cricket injury consensus statement, but within the limitations of the datasets provided.

Having explored the knowledge of published and public administrative data, the advantages, limitations and completeness of the data, the thesis turns its attention to an Australian private insurance dataset held by Cricket Australia and JLT/Marsh under the NCRPP.

In line with aim 2 and research question 2, **Chapter 7** begins the investigation of the NCRPP with an analysis of the data collection forms used by JLT/Marsh from the inception of the programme (2002) compared to the requirements of the ASIDD and the cricket injury consensus statement. The analysis shows there was a good alignment with the ASIDD and consensus statement, with small variations in data collection items over the years investigated. This chapter is presented in more of a technical report style, suitable for presentation to industry stakeholders.

In line with aim 2 and research question 2, **Chapter 8** then analyses the claims data collected by the NCRPP for validity and completeness against the ASIDD and cricket injury consensus statement. The fidelity of the data from collection to system availability is also assessed. The analysis highlights the lack of complete data on injury mechanism that would assist in identifying injury prevention strategies.

Chapter 9, in line with both aims and research questions, provides a comprehensive descriptive analysis of the injury data for community cricketers in Australia using the claims data from the NCRPP from 2008 to 2018.

Chapters 2 to 9 provide the methods, results and key findings only. **Chapter 10** completes the thesis by providing an overall summary and discussion of the results addressing the aims and research questions identified in **Chapter 1**. In relation to aim 1 and research question 1, a summary discussion is provided on the injury outcomes provided from existing literature and three existing databases analysed in **Chapters 3, 4, 5 and 9**. In relation to aim 2 and research question 2, a summary discussion is provided on the outcomes of the analysis into the usability of the NCRPP claims system for injury surveillance in community level cricket. Recommendations are made specifically for the improvement of future data collection within the NCRPP, in line with stakeholder expectations, and in general for the other existing databases assessed for future injury surveillance purposes in community cricket.

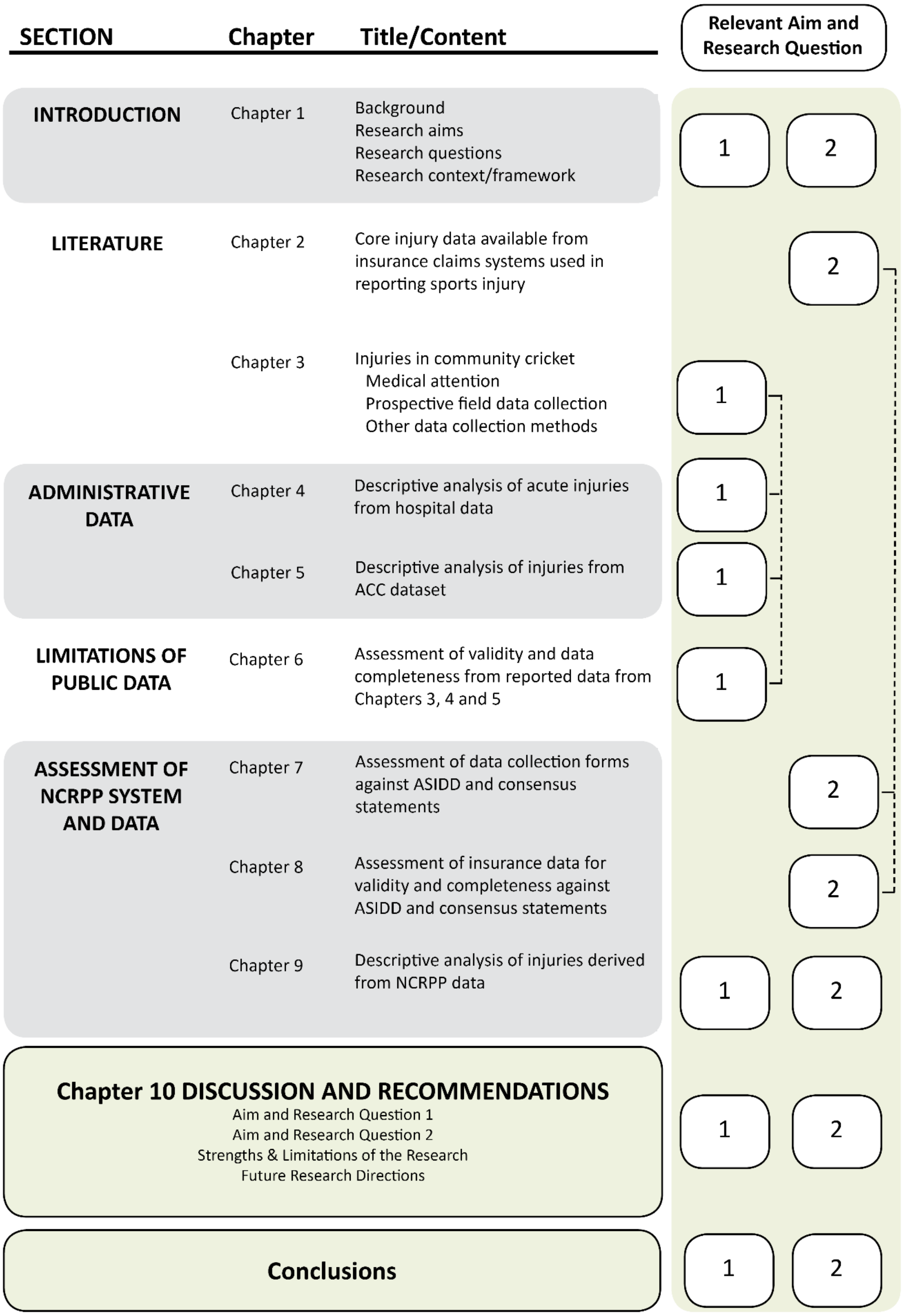

Figure 4. *Thesis layout. Note: Chapters 2-9 present rationale, methods, results and summary of key findings only. Chapter 10 provides a collective discussion of the preceding Chapters.*

Chapter 2. Insurance claims systems used in sports injury reporting: A scoping review to identify limitations and comparison to the ASIDD

2.1 Chapter rationale

As mentioned in Chapter 1, insurance claims could potentially be one source for wide ranging injury information to community level sports, including cricket. Aim 2 and research question 2 of this thesis is to examine an existing insurance system for suitability to be used as an injury surveillance system for community cricket in Australia. In order to gain an appreciation of the scope of coverage, limitations, advantages and disadvantages of insurance systems used in identifying sports-related injury, a review of the existing literature was performed.

2.2 Aim

The two primary aims of this Chapter are:

1. To identify peer reviewed studies that have used insurance claims data as a primary source of sports injury data.
2. To provide a thematic analysis of the limitations, advantages and disadvantages of insurance systems and the data provided, based on comparison with the core items of the Australian Sports Injury Data Dictionary (ASIDD).

2.3 Methods

A systematic search was conducted across eight online databases: CINAHL, MEDLINE, SPORTDiscuss (all through EBSCOHost), ScienceDirect, SCOPUS, Web of Science, PubMed, and Google Scholar. The search terms were “sport*” AND “injur*” AND “insurance” being present in the title, abstract or keywords of a paper. Variations to the search strings were used depending on the database. Examples of search terms used are shown in Table 4. The initial search was conducted by the author of the thesis and included papers from inception of database to 2 September 2019.

Table 4. Search terms used in online systematic search for the various databases searched.

Database	Search terms and limiters	Articles found (less duplicates)
EBSCOHost (MEDLINE, CINAHL, SportsDiscuss)	TI (sport* AND injur*) AND AB (sport* AND injur*) AND AB (insurance) Human subjects and English language only, CINAHL excluded MEDLINE records.	23
ScienceDirect	Title, abstract, keywords: (sports OR sport) (injuries OR injury) insurance	20
SCOPUS	(TITLE-ABS-KEY (sport* AND injur*) AND TITLE-ABS-KEY (insurance)) English language only; excluded subject areas: Biochemical & genetics, agricultural, arts & humanities, mathematics, business, computers, physics, veterinary, chemistry, immunology; excluded source type: books, book series, conference proceedings.	308
WebofScience	(TI=(sport* AND injur*) AND ALL=insurance) AND LANGUAGE: (English) AND DOCUMENT TYPES: (Article OR Book OR Review)	16
PubMed	(((sport[Title/Abstract] OR sports[Title/Abstract])) AND (injury[Title/Abstract] OR injuries[Title/Abstract])) AND insurance	127
Google Scholar	"sports injuries" OR "sport injury" AND "insurance claims"	319

2.3.1 Inclusion criteria

Included studies were required to:

- Be peer reviewed with original data collection, published or In Press by 2nd September 2019 in the English language;
- Have been published from 1998;
- Have used insurance claims as one of the primary sources of injury data.

Editorials, reports, letters, books, reviews, and conference proceedings were excluded.

2.3.2 Data extraction

After the search was completed, duplicates were removed and the titles and abstracts screened for relevance. Where it was unclear, the article was retained to the next stage. The full text of the remaining articles was examined for inclusion.

Data were extracted on a custom form, which included: study design, country, setting and context, aims, year and timeframe, ethics, number and type of sports covered, overall claim numbers, claims for sport in focus, age range, gender, levels of play, data source, claim type, data collection methods, type of data collected, injury definition, injury severity measure/definition, completeness of data, nature/type, body part, mechanisms, severity, time loss, costs, duration of window for claim, medical diagnosis associated with claim, internal auditing, date of injury available, comparability to the core items of the ASIDD (described below) and limitations of the claims system.

A qualitative synthesis is presented by descriptive and tabular summary of countries, sports analysed and how each study reviewed compared to six of the seven core item requirements of the ASIDD:

1. Age
2. Gender
3. Activity when injured (broad areas: organised, unorganised sport or leisure)
4. Mechanism of injury
5. Body region injured
6. Nature of injury

The core item of 'date of injury' was assumed as mandatory for insurance systems to collect and assumed unlikely to be reported in a study. Additional items, not specifically in the ASIDD, of phase of activity when injured and injury severity/burden measures are also recorded.

A thematic analysis of the reported limitations of the insurance systems/data were also undertaken and is presented in tabular and figure formats for data item completeness and information bias.

2.4 Results

A total of 42 articles were retrieved for detailed review (Figure 5). The majority of studies utilised insurance claims databases from New Zealand, USA, Sweden and Australia (Table 5). The majority of studies (n = 23, 55%) were published from the year 2010.

Table 5. *Countries most represented in studies using insurance claims to assess sports-related injury (n = 42).*

Country	Number of studies[1]
New Zealand	10
USA	8
Sweden	5
Australia	5
Germany, Belgium, Canada, Great Britain[2] & Ireland (each)	2
France, Finland, Switzerland, & Japan (each)	1

[1] Number of studies per country listed.
[2] One study excluded Northern Ireland.

The majority of studies included both male and female claimants (n = 26, 63%), with four studies specifically focusing on male (n = 2) or female (n = 2) populations and 11 studies not reporting the sex of participants/claimants. Twenty-nine (71%) of the articles contained a majority of non-elite level participants.

Two of the studies specifically analysed the completeness and usefulness of the insurance scheme data in sports injury surveillance through comparison with the ASIDD (87, 88). One study assessed the accuracy of the identification/categorisation of the sport rugby union within the insurance data (89). Four studies used insurance data to assess injury prevention measures (90-93) and 11 studies reported just one of injury type, injured body location or outcome (90, 94-103).

There were 82 different sport categories listed across the 42 studies. Table 6 shows the sports represented in at least three studies. Football (soccer) and rugby union were the most commonly represented sports. Cricket was referenced in three studies (99, 102, 104).

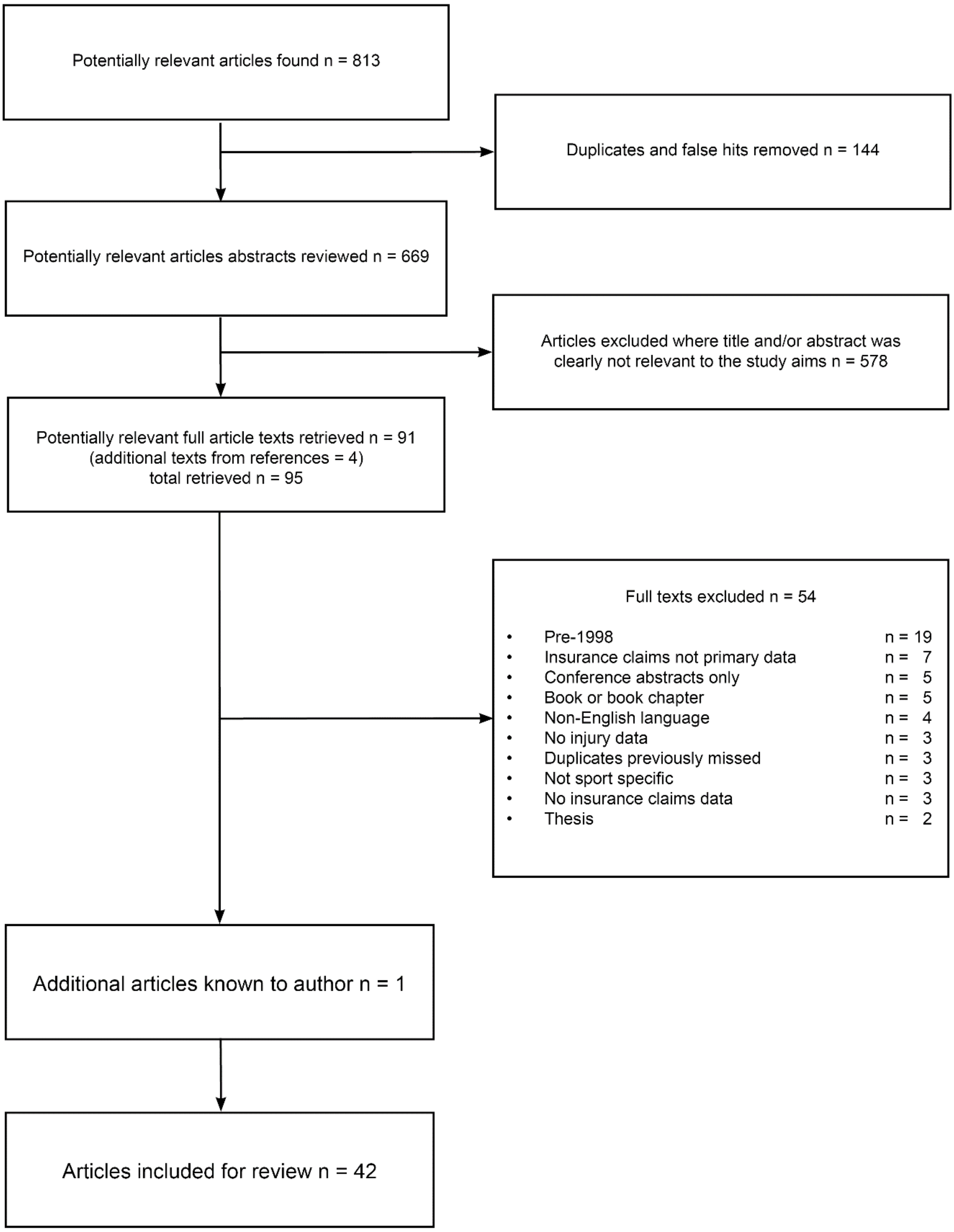

Figure 5. *Search flow chart for studies reporting sports-related injury derived from insurance claims.*

__Table 6.__ Sports most commonly represented in studies using insurance claims to assess sports-related injury (n = 42 studies, n = 82 sports).

Sport	Number of studies that included the sport
Football (soccer)	15
Rugby union	8
Basketball & Ice hockey	7
Handball, Baseball, & Netball	6
Rugby league	5
Hockey (field)	4
Cricket, Tennis, Horse racing, Floorball, Swimming & Softball	3

(Note: numbers add to more than total study numbers included due to studies reporting on multiple sports).

Table 7 shows the distribution of six of the ASIDD core items represented in the studies. The ASIDD items of age, gender, injury nature, and injured body location items were relatively well represented, ranging from 69% to 76% in availability. The broad area of activity when injured was available in 31 (74%) studies, with all of those being related to organised sport. Eight of the studies with a partial coverage of the broad area of activity, at the time of injury, were related to the ACC in NZ, where the level of formality (i.e. organised/informal) is not recorded. Injury mechanism was represented fully in 7 (19.1%) of studies and partially in four others. The majority of studies (seven of eight) that did report mechanism of injury utilised sport specific insurance systems, or insurance companies that were more specific to sports coverage (87, 103, 105-109).

__Table 7.__ Available information derived from the reviewed studies relating to six of the core items in the ASIDD. Values in parentheses represent column (%).

Information available	Age	Gender	Activity (Broad)	Injury nature	Body location	Injury mechanism	Total
Yes	31 (73.8)	29 (69.0)	31 (73.8)	30 (71.4)	32 (76.2)	8 (19.1)	161 (63.9)
Partial	6 (14.3)	2 (4.8)	10 (23.8)	1 (2.4)	3 (7.1)	4 (9.5)	26 (10.3)
Not reported / Unclear	5 (11.9)	11 (26.2)	1 (2.4)	11 (26.2)	7 (16.7)	30 (73.4)	65 (25.8)

For other (non-core) items, activity at onset and/or phase of activity when injured was represented in 17 (40%) of the studies and injury severity/burden measures were represented in 20 (48%) of the studies. Of the studies indicating some measure of severity or injury burden, five reported time loss data (107, 110-113), with one reporting time loss from work (112). Three studies reported permanent medical impairment percentages (114-116), five reported cost based data (113, 117-120) and six studies reported fatalities (96, 103, 108, 113, 115, 116). Table 8 summarises the studies reviewed.

Table 8. *Summary of sport-related injury studies using insurance claims data by year of publication (n = 42 studies).*

Study First author & year (ref)	Study design /aim	Location	Time frame	Data Source	Sport and level of play	Number of claims (and/or injuries where stated)	Completeness of data	Age	Sex	Activity when injured (Broad areas)[1]	Injury Nature	Body location	Mechanism	Activity/ phase within sport	Severity/ burden measure(s)
Quarrie (2019) (121)	Retrospective cohort study • quantify injury and injury risk	New Zealand	2005 to 2017	Accident Compensation Corporation (ACC)	Rugby union Non-elite	635,657	NR	Yes	Yes	Partial (mixed, mostly organised)	Yes	Yes	NR	NR	NR
Aman (2019) (114)	Observational cohort study • most common body part injured • most severe injuries leading to permanent medical impairment (PMI)	Sweden	2006 to 2015	Swedish Insurance Company - Folksam	Mixed Non-elite	Floorball= 11,081 Handball= 7,930 Ice Hockey= 20,204 Football= 50,758	Reported in earlier study (Aman 2014)	Yes	Yes	Yes (organised)	Partial	Yes	NR	NR	PMI 1% - 99%
Joseph (2019) (122)	Descriptive epidemiological study • type and body location of injuries	Australia	1 Jan 2016 to 21 Dec 2016	The Netball Australia National Risk Protection Accident Insurance Program	Netball Non-elite	1,215	No records excluded based on incomplete data	Yes	NR	Yes (organised)	Yes	Yes	NR	Yes	NR
Klein (2019) (110)	Descriptive epidemiological study of the two highest divisions in the Bundesliga using the national statutory accident insurance scheme to analyse unique injury data.	Germany	2014/15 to 2016/17 seasons	National statutory accident insurance scheme, Verwaltungs-Berufsgenossenschaft (VBG)	Football (Soccer) Elite	1,275		Partial (mean only)	Yes	Yes (organised)	NR	Yes	NR	Yes	Time loss (days) as per consensus
Takahashi (2019) (94)	Descriptive epidemiological study • anterior cruciate ligament (ACL) • analyse the mechanism and trend across sexes • identify modifiable risks	Japan	Jan 2016 - unknown	Injury and Accident Mutual Aid Benefit System	Mixed Non-elite	200 each in: Soccer Basketball Volleyball Handball Judo	40 unknown ACL injuries were excluded	Partial (mean only)	Yes	Partial (mostly organised)	Yes	Yes	Yes	NR	NR
King (2018) (104)	Descriptive analysis • moderate to serious and serious injuries.	New Zealand	2012 to 2016	Accident Compensation Corporation (ACC)	mixed Non-elite	Rugby union = 25,680 Football (soccer) = 14,435 Netball = 11,757 Rugby league = 6,621 Cricket = 3,087	NR	Yes	Yes	Partial (mixed, mostly organised)	Yes	Yes	NR	NR	2 levels defined: moderate to serious and serious claims

Table 8 (cont).

Study First author & year (ref)	Study design /aim	Location	Time frame	Data Source	Sport and level of play	Number of claims (and/or injuries where stated)	Completeness of data	Age	Sex	Activity when injured (Broad areas)[1]	Injury Nature	Body location	Mechanism	Activity/ phase within sport	Severity/ burden measure(s)
Aman (2018) (90)	• assess effectiveness of a Knee Control Program (KCP) • incidence of acute knee injuries	Sweden	2006 to 2015	Swedish Insurance Company - Folksam	Soccer Non-elite	9,318 ACL claims	NR	Yes	Yes	Yes (organised)	Yes	Yes	NR	NR	NR
Luig (2018) (111)	Descriptive epidemiological study • evaluate injury patterns pre- and post- changes in league structure	Germany	1 Jun 2010 to 30 Jun 2013	German Statutory Accident Insurance VBG	Handball elite	930 players 5,456 injuries	Missing data were completed for each season via print and online media	Partial (means only)	Yes	Yes (organised)	Yes	Yes	NR	Yes	Time loss (days)
Aman (2017) (115)	• identify most common and most severe injuries • identify injury prevention priorities at a national level.	Sweden	2006 to 2013	Swedish Insurance Company – Folksam	Mixed	84,754	Unknown injury body locations ranged between at 0.1% - 2.6% for all sports	Yes	Yes	Yes (organised)	Yes	Yes	NR	NR	PMI and deaths
Amoo-Achampong (2017) (95)	Retrospective analysis • describe trends in concussion	USA	Jan 2010 to Dec 2014	PearlDiver Technologies	Mixed Non-elite	All n = 1,758 Top five: American football= 667 soccer= 332, basketball = 294 baseball = 221 lacrosse & field hockey= 85	NR	Yes	Yes	Partial (mixed)	Yes	Yes	NR	NR	NR
Aman (2016) (116)	Retrospective analysis • identify high-risk sports • injury incidence and severity	Sweden	2008 to 2011	Swedish Insurance Company - Folksam	Mixed Non elite	n = 47,470 injuries Top 5 sports annual injury means: Football= 5,012 Ice hockey=2,955 Floorball=1,126 Handball=1,043 Motorcycle/ snowmobile=730	NR	Yes	Yes	Yes (organised)	NR	NR	NR	NR	PMI and deaths
Fortington (2016) (123)	Retrospective analysis • describe the number, type and body location of injuries	Australia	2004 to 2013	JLT Sport	Australian Football Non-elite	522	100% of insurance claims used	Yes	Yes	Yes (organised)	Yes	Yes	NR	NR	NR
Fortington (2016) (96)	Descriptive analysis • number and cause of deaths	Australia	2004 to 2013	Australian Football National Risk Protection Program (AFNRPP) - JLT Sport	Australian Football Non-elite	31	NR	Yes	Yes	Yes (organised)	Yes	NR	Partial	Yes	Deaths

Table 8 *(cont).*

Study First author & year (ref)	Study design /aim	Location	Time frame	Data Source	Sport and level of play	Number of claims (and/or injuries where stated)	Completeness of data	Age	Sex	Activity when injured (Broad areas)[1]	Injury Nature	Body location	Mechanism	Activity/ phase within sport	Severity/ burden measure(s)
Roe (2016) (117)	Descriptive ecological study • identify frequencies and costs from	Ireland	2007 to 2014	Gaelic Athletic Association Injury Scheme	Hurling, Gaelic football Elite / Non-elite	58,038 lower limb=34,811	Poor reporting of injury claims sites limited specific analysis – e.g. ACL injury only reported from 2010-2012.	Yes	Yes	Yes (organised)	NR	Yes	NR	NR	Overall costs
Bohu (2015) (97)	Descriptive epidemiological study • shoulder dislocations/subluxations • identify the rate, type and mechanism of injury • describe the characteristics of injured players.	France	2008 to 2013	The insurance company of the Fédération Française de Rugby (FRF) - Centre de Gestion Administratif Rugby	Rugby union Non-elite	1,345	NR	Yes	Yes	Yes (organised)	Yes	Yes	NR	Yes	NR
Reeves (2015) (118)	Retrospective analysis • lower limb injury • assess the type, cause, cost and mechanisms.	New Zealand	2006 to 2011	ACC	Badminton Non-elite	1,909	Incomplete injury mechanism information.	Partial (means only)	Yes	Partial (mixed)	Yes	Yes	Partial (causes reported)	NR	Overall cost
Aman (2014) (87)	Analysis of an insurance system • measure the reliability of injury data collected	Sweden	2006-2010	A Swedish Insurance Company	Mixed Non-elite	27,947	93% of ASIDD items present in some form, with agreement score 24 out of 30. 100% of core items, 87% of strongly recommended items, 50% of recommended items. When compared to cricket consensus statement, data were at least partially available in 9 of 11 items.	Yes	Yes	Yes (organised)	Yes	Yes	Yes	Yes	-

Table 8 (cont).

Study First author & year (ref)	Study design /aim	Location	Time frame	Data Source	Sport and level of play	Number of claims (and/or injuries where stated)	Completeness of data	Age	Sex	Activity when injured (Broad areas)[1]	Injury Nature	Body location	Mechanism	Activity/ phase within sport	Severity/ burden measure(s)
Bollars (2014) (124)	Descriptive epidemiological study • compare incidence, type and severity of injuries.	Belgium	1999/00 and 2009/10 seasons	Royal Belgium Football Association nationwide insurance system	Soccer Non-elite	56,364	1999/00: 4,180 (13%) and 2009/10: 2,222 (9%) of claims incomplete where type of injury and player characteristics were not available.	Yes	Yes	Yes (organised)	Yes	NR	NR	NR	Partial (fractures, dislocations, concussion, ligament injuries considered serious).
King (2014) (98)	Retrospective analysis • concussion • compare incidence and costs	New Zealand	2001/02 to 2010/11	ACC	Mixed Non-elite	Rugby union= 802 soccer = 183 rugby league= 179 netball = 74 hockey = 35, touch rugby= 34, softball/ baseball= 23	NR	Yes	Yes	Partial (mixed)	Yes	Yes	NR	NR	Moderate to serious claims and costs
Crowley (2011) (125)	Descriptive epidemiological • assess injury incidence • compare female injury patterns with male injury patterns.	County Cork, Ireland	2008	Gaelic Athletic Association Injury Scheme	Gaelic football Non-elite	245	NR	NR	Yes	Yes (organised)	Yes	Yes	NR	Yes	NR
Carter (2010) (105)	Descriptive analysis • determine the most common injury scenarios.	USA	2002 to 2006	Bollinger Inc. through US Lacrosse	Lacrosse Non-elite	1,083	359 (33%) of cases had missing data	NR	Yes	Yes (organised)	NR	Partial (only top 3)	Yes	Yes	NR
Wattie (2010) (126)	Descriptive epidemiological study • assess change in age banding	Canada	Sep 1995 to Aug 2002	Hockey Canada Insurance Database (HCID)	Ice hockey Non-elite	4,959	NR	Yes	NR	Yes (organised)	NR	NR	NR	NR	NR
Welch (2010) (99)	Descriptive epidemiological study • trends in sports-related dental injury	New Zealand	1999 to 2008	ACC	Mixed Non-elite	claims n = 4,959 Top 6 sports (average % claims per year) rugby 27.3% water sports 16.2% cycling 7.2% soccer 6.9% basketball 4.8% cricket 4.6%	NR	Yes	Yes	Partial (mixed)	Yes	Yes	NR	NR	NR

Table 8 (cont).

Study First author & year (ref)	Study design /aim	Location	Time frame	Data Source	Sport and level of play	Number of claims (and/or injuries where stated)	Completeness of data	Age	Sex	Activity when injured (Broad areas)[1]	Injury Nature	Body location	Mechanism	Activity/ phase within sport	Severity/ burden measure(s)
King (2009) (127)	Retrospective analysis • describe injuries and associated costs	New Zealand	1999 to 2007	ACC	Rugby league Non-elite	42,754	NR	Yes	Yes	Partial (mixed)	Yes	Yes	NR	NR	Minor & moderate to serious claims and costs
Balendra (2008) (119)	Descriptive analysis • career-ending injuries	Great Britain	1991-2005	Professional Riders Insurance Scheme	Horse racing Elite	45	NR	Yes	Yes	Yes (organised)	Yes	Yes	NR	Partial	Cost benefits paid
Cumps (2008) (112)	Epidemiological cohort study • determine injury rate and medical costs	Flanders, Belgium	2003	Each sports federation has insurance – specifics not provided	Mixed Non-elite	14 sports=13,359 Top 5: Basketball = 3,326 Volleyball= 2,104, Outdoor football = 1,754 Gymnastics= 1,452 Tennis= 1,298	Category A sports n = 4, provided comprehensive injury data and costs, category B sports n = 10, provided comprehensive injury data but not medical costs and Category C sports n = 58, only provided member and claims numbers.	NR	NR	Yes (organised)	NR	Yes	NR	NR	Work time loss (absentee-ism) and medical costs
Gianotti (2008) (91)	Retrospective analysis • evaluate new rugby scrum laws.	New Zealand	2002 to 2007	ACC	Ruby union Non-elite	153	NR	Yes	NR	Yes (organised)	NR	Yes	NR	Yes	Moderate to serious claim (at least 7 days missed work time)
Turner (2008) (113)	A cohort study • to determine cost of injuries	England, Wales and Scotland	1996 to 2006	Professional Riders Insurance Scheme	Horse racing elite	1,328	NR	NR	NR	Yes (organised)	Yes	Partial	NR	Yes	Time loss and costs. Deaths also reported.
Gianotti (2007) (92)	Retrospective analysis • assess two concussion programs	New Zealand	Jul 2003 to Jun 2005.	ACC	Rugby union Non-elite	10,068	NR	NR	NR	Partial (mixed – mostly organised)	Yes	Yes	NR	NR	Moderate to serious claims

Table 8 (cont).

Study First author & year (ref)	Study design /aim	Location	Time frame	Data Source	Sport and level of play	Number of claims (and/or injuries where stated)	Completeness of data	Age	Sex	Activity when injured (Broad areas)[1]	Injury Nature	Body location	Mechanism	Activity/ phase within sport	Severity/ burden measure(s)
Otago (2007) (120)	Retrospective analysis • injury frequency • cost related to age.	Victoria, Australia	1999	Insurance company associated with Netball Victoria	Netball Non-elite	829	NR	Yes	NR	Yes (organised)	Yes	Yes	NR	NR	Costs
Wattie (2007) (106)	Descriptive analysis injury prevalence by age	Canada	1998 and 2003.	The Hockey Canada National Insurance Program with the Hockey Canada Insurance Database (HCID)	Ice Hockey Non-elite	6,864	NR	Yes	NR	Yes (organised)	NR	NR	Yes	NR	NR
Shae (2004) (100)	Descriptive epidemiological study • assess incidence of anterior cruciate ligament (ACL) injury	USA	1995 - 1999	Bene-marc Inc.	Soccer Non-elite	knee injuries= 8,215 ACL = 1,793	NR	Yes	Yes	Yes (organised)	Yes	Yes	NR	NR	NR
Finch (2003) (88)	Analysis of an insurance system • assess the usefulness of insurance claims data	Australia	Jan 1993 to Feb 1999	Two insurance companies (not specified)	Squash Non-elite	586	92% of ASIDD items present in some form with an agreement score of 20 out of 26. 100% of core items, 85% strongly recommended items, 100% of recommended items.	Yes	Yes	Unclear	Yes	Yes	Partial	Yes	-
Marshall (2003) (93)	Ecological study • evaluate the use of faceguards and safety balls	USA	1997 to 1999	Little League's compensation claims database	Baseball and T-ball Non-elite	4,233	Missing data identified but not quantified.	Yes	Yes	Yes (organised)	NR	NR	Partial	Yes	NR
Molsa (2003) (107)	Descriptive epidemiological study • upper limb injuries • investigate mechanisms, types and severity of injuries	Finland	1996	Pohjola Insurance Company, Ltd	Ice hockey Non-elite	760	NR	Yes	Yes	Yes (organised)	Yes	Yes	Yes	Yes	Time loss

Table 8 (cont).

Study First author & year (ref)	Study design /aim	Location	Time frame	Data Source	Sport and level of play	Number of claims (and/or injuries where stated)	Completeness of data	Age	Sex	Activity when injured (Broad areas)[1]	Injury Nature	Body location	Mechanism	Activity/ phase within sport	Severity/ burden measure(s)
Mueller (2001) (108)	Descriptive epidemiological study	USA	1987 to 1996.	Little League Baseball Inc.	Baseball Non-elite	29,038	NR	Yes	Partial (includes both M & F)	Yes (organised)	Yes	Yes	Yes	Yes	Deaths reported
de Loes (2000) (101)	Descriptive epidemiological study • knee injuries • estimate risk and incidence rates	Switzerland	1987 to 1993	Swiss Military Insurance	Mixed Non-elite	3,864 Top 5 (M/F): Soccer= 1,916/46 Skiing= 164/304 Ice hockey= 389/4 handball= 230/115 basketball= 68/78	NR	Yes	Yes	Yes (organised)	Yes	Yes	NR	NR	NR
Waller (2000) (109)	Descriptive epidemiological study • to identify injury profiles.	USA	1 Jan 1993 to 31 Dec 1996	Insurance broker	Horse racing Elite	6,545	NR	Partial (means only)	NR	Yes (organised)	NR	Yes	Yes	Yes	NR
Richardson (1999) (128)	Descriptive analysis	USA	1997	United States Swimming	Swimming Non-elite	886	NR	Yes	NR	Yes (organised)	Yes	Yes	NR	Yes	NR
Simpson (1999) (89)	A pilot ecological study • determine feasibility of claims data for injury surveillance	New Zealand	2007 to 2014	ACC	Rugby union Non-elite	265	Of the 456 ACC claimants, 303 (66%) were interviewed and 265 (88%) had injuries from rugby union – the remainder were misclassified.	NR	NR	Yes (organised)	NR	NR	NR	NR	NR
Love (1998) (102)	Retrospective analysis • dental injury • to identify public health prevention campaigns	New Zealand	1993 to 1996	ACC	Mixed Non elite	Mean annual claim numbers for top 10 sports (excludes union): Swimming=669 Rugby league=418 Basketball=364 Cricket=438 Hockey= 295 Soccer=313 Netball=260 Squash= 141 Softball/baseball=122 Tennis= 123	An 'other' category was used for sports that could not be coded due to incomplete forms – but no proportion stated.	Yes	Partial	Partial (mixed)	Yes	Yes	NR	NR	NR

Table 8 (cont).

Study First author & year (ref)	Study design /aim	Location	Time frame	Data Source	Sport and level of play	Number of claims (and/or injuries where stated)	Completeness of data	Age	Sex	Activity when injured (Broad areas)[1]	Injury Nature	Body location	Mechanism	Activity/ phase within sport	Severity/ burden measure(s)
Maron (1998) (103)	Descriptive prevalence study • quantify sudden cardiac death • inform pre-participation screening	Minnesota	1985/86 to 1996/97	Mandatory insurance plan covering catastrophic injury or death	Mixed High School	3	NR	Yes	Yes	Yes (organised)	Yes	Yes	Yes	Yes	Death

[1] Broad areas assessed were whether sport was organised or unorganised.

NR = Not reported.

Thematic analysis of insurance claims systems used for sports injury reporting

Table 9 lists the limitations of insurance claims systems used for sports injury reporting identified within the studies by the original study authors.

Table 9. *Thematic analysis of specific themes identified from studies using insurance claims data to report sports related injury (n = 42 studies).*

Limitation	Frequency	Studies stating this limitation (First author, year, reference)
Biased toward relatively severe injuries	14	Bollars (2014) (124); Cumps (2008) (112); de Loes (2000) (101); Gianotti (2008) (91); Joseph (2019) (122); King (2009) (127); King (2018) (104); Klein (2019) (110); Luig (2018) (111); Molsa (2003) (107); Otago (2007) (120); Roe (2016) (117); Turner (2008) (113)
Not all potential claims are submitted	8	Aman (2019) (114); Joseph (2019) (122); Marshall (2003) (93); Mueller (2001) (108); Richardson (1999) (128); Shae (2004) (100); Welch (2010) (99)
Doesn't differentiate injury severity or time loss	6	Bohu (2015) (97); Luig (2018) (111); Reeves (2015) (118); Roe (2016) (117); Waller (2000) (129); Wattie (2007) (106)
Missing information - activity	6	de Loes (2000) (101); Finch (2003) (88); King (2009) (130); Simpson (1999) (89); Takahashi (2019) (94); Welch (2010) (99)
Administrative changes	5	Gianotti (2007) (92); King (2018) (104); Love (1998) (102); Roe (2016) (117); Welch (2010) (99)
Relies on accuracy of health care diagnosis	5	Amoo-Achampong (2017) (95); Bollars (2014) (124); Luig (2018) (111); Quarrie (2019) (121); Takahashi (2019) (94)
Timing of claims cut off dates	5	Aman (2017) (115); Aman (2018) (90); Aman (2019) (114); Carter (2010) (105); Fortington (2016) (96)
Missing information – cause or mechanism of injury	4	Fortington (2016) (96); Otago (2007) (120); Quarrie (2019) (121); Reeves (2015) (118)
Missing information – injury detail	4	Finch (2003) (88); King (2009) (127); King (2018) (104); Takahashi (2019) (94)
Not inclusive of all injuries - acute injuries captured more than chronic injuries	4	Gianotti (2008) (91); Luig (2018) (111); Richardson (1999) (128); Waller (2000) (109)
Not everyone is entitled to claim	3	Fortington (2016) (96); Marshall (2003) (93); Roe (2016) (117)
Does not account for more than one injury per person	2	Bollars (2014) (124); Waller (2000) (109)
No auditing of the system for quality/accuracy	2	Gianotti (2007) (92); Wattie (2010) (126)
Missing information - claimant details	1	Waller (2000) (109)
Missing information – diagnostic changes	1	Quarrie (2019) (121)
Missing information - general	1	Molsa (2003) (107)

2.5 Summary of key findings

This review identified 42 studies, since 1998, that utilised insurance claims data to report on sports-related injury and/or which investigated the usefulness of insurance claims data to do so. Over the 21 years from which studies were selected there has been an increase in epidemiological studies that have used insurance claims, with more than half of the studies being published in the last 10 years. The studies have represented a wide variety of sports overall, but the majority of sports tend to be reflective of those most popular in the country of origin.

Key findings include:

- The majority of the studies looked at non-elite levels of sports participant injuries, indicating the usefulness of insurance claims data at community level sport, particularly in organised forms.
- Several insurance schemes have been shown to have a high validity, particularly in relation to the core items of the ASIDD (11) and a relatively high level of completeness in the data they collect.
- The level of data validity could be improved, particularly in relation to the ASIDD core item of injury mechanism, and some of the ASIDD strongly recommended items such as those regarding level of organisation of the sport and phase of activity when injured.
- There has been limited studies on cricket-related injury through insurance claims over the last 21 years (n = 3), and none using a sport or cricket specific insurance scheme. This highlights an avenue for further exploration, as is presented in Chapters 6 through 9 of this thesis.

Chapter 3. Injuries in community cricket: A systematic review of the literature.

3.1 Chapter rationale

The potential for insurance claims to be utilised in the surveillance of sports injury was presented in Chapter 2. The scarcity of applied studies in community cricket injury was noted. Therefore, in line with aim 1 and research question 1, Chapter 3 investigates the existing published knowledge on community cricket injury, using other data sources, through a systematic review of the literature.

3.2 Aim

The primary aim of this review was to summarise what is known about the location, nature, mechanism and severity of injuries in community level cricket from existing, peer reviewed, literature. The second aim was to assess the reporting quality and likelihood of bias within these studies.

3.3 Methods

3.3.1 Registration

This systematic review was registered online through PROSPERO, the international prospective register of systematic reviews (https://www.crd.york.ac.uk/prospero/), record CRD42017079047 (updated 3 July, 2020), and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines.

3.3.2 Eligibility criteria

All original published research of full text, peer reviewed studies in the English language that investigated the epidemiology of injuries in community level cricketers of all ages were eligible for inclusion.

Community level cricket is defined in Chapter 1. For this systematic review, community cricket excludes high performance centres, or equivalents, where otherwise community level players may be training or playing temporarily under the auspices of higher cricketing bodies.

Case reports, editorials, reports, letters, books, reviews, conference proceedings were excluded. Studies where the proportion of community level players was fewer than 50% were excluded on the basis that injuries and mechanisms may differ between elite and community level and therefore not be comparable.

3.3.2 Information sources and search process

Nine databases were searched: CINAHL, MEDLINE and SPORTDiscuss (all through EBSCOHost), ScienceDirect, SCOPUS, Web of Science, PubMed, Informit and Google Scholar. Reference lists of included articles were checked for additional studies of relevance and experts were consulted for knowledge of any additional studies not already captured.

The search terms were “cricket*” AND “injur*” (and synonyms/derivatives) being present in the title, abstract or keywords of a paper. Variations to the search strings were used depending on the database. An example of a search description is shown in Table 10. The search periods were as follows:

- The initial search included papers from inception of database to the 30th September 2017;
- Additional papers were included from an updated search to the 2nd April, 2018;
- A second update was conducted to 2nd November 2018;
- A final update was conducted to December 2019.

3.3.3 Study selection and data collection

After the search was completed, duplicates and false hits were removed, myself and a colleague (SOC), independently screened the titles and abstracts for eligibility. Publications were excluded only where both reviewers agreed that the title/abstract was not relevant to the study aims. The full text of the remaining articles was examined independently for eligibility. Any disagreements regarding inclusion were resolved through discussion with one of my supervisors (LF).

A colleague (SOC) and the author of this thesis, independently extracted data from the eligible articles on a custom data extraction form, which included: study design, country, setting and context, aims, year and timeframe, ethics, overall participant numbers, age range, gender, levels of play, facets of play (e.g. batting, bowling and or fielding), participant recruitment, data collection methods, injury definition, injury severity measure/definition, number of injuries, exposure measures, incidence, prevalence, nature (type), locations (body parts), mechanisms, severity, losses/drop outs, and number of injuries not defined. Any disagreement regarding study type, participant characteristics, measurement methods or main results was clarified by discussion with one of my supervisors (LF).

__Table 10.__ Search example, EBSCOHost (CINAHL, MEDLINE & SPORTDiscuss databases)

Search	Terms	Limiters	Results
S1	Ti: cricket*	CINAHL: English language, exclude MEDLINE records, human; MEDLINE: English language, human	3604
S2	Ti: injur*	CINAHL: English language, exclude MEDLINE records, human; MEDLINE: English language, human	175, 213
S3	S1 AND S2		172[1]
S4	(S1 AND S2) AND Ab: cricket* AND Ab: injur*		113[1]
S5	S3 NOT S4		59[1]
S6	S3 OR Ab: (cricket* AND injur*)		571
S7	Ab: cricket*	CINAHL: English language, exclude MEDLINE records, human; MEDLINE: English language, human	8,653
S8	Ab: injur*	CINAHL: English language, exclude MEDLINE records, human; MEDLINE: English language, human	766,399
S9	S7 AND S8		512
S10	S3 AND S9		113
		Overall results retrieved	**172[1]**

[1] = Searches S3, S4 and S5 were compared to ensure the same titles were present and results retrieved = 172 (59 + 113).

3.3.4 Risk of bias in individual studies

It was expected that there would be multiple study designs to consider for assessment, from descriptive cross sectional studies to database summaries and prospective cohort designs. Therefore, to provide an assessment tool of relevance across the review, a nine question critical appraisal tool was designed using elements of the Downs and Black (131) and STROBE (132) tools. Specific questions regarding injury definition and injury severity were included as being pertinent to this review's aim on reporting around the current and past cricket consensus statements. Refer to Appendix C for details on the critical appraisal tool.

Risk of bias assessment was based on three of the questions (questions 2, 3 and 4) relating to selection, information and attrition biases (133, 134). If each of these questions was answered 'yes' then the study was considered to have a low likelihood of bias. Where a 'partial' was assigned, this was because of insufficient clarity in any of these three questions that could result in the study being considered to have an unclear likelihood of bias. Any 'no' response to these questions would likely result in the study being considered as having a high likelihood of bias.

Studies were reviewed independently by myself and a colleague (SOC) and where agreement could not be reached then one of my supervisors (LF) was consulted.

3.3.5 Data synthesis

To address the primary aim of this review and identify the number, nature, mechanism, and severity of injuries in community cricket, a qualitative synthesis was undertaken. An overall descriptive and tabular summary is presented separated into studies where injuries were acute and medically treated, such as those reported from hospital or insurance data; injuries reported by in-the-field prospectively collected data, and other forms of data collection, such as retrospective survey or questionnaires. Further detail is presented within each of the abovementioned categories, where appropriate, for the relevant summary outcomes:

- Injury rates,
- Prevalence/proportions,
- Nature,
- Body location,
- Mechanism/setting, and severity.

Due to the degree of heterogeneity in the study types and data collected, meta-analysis was not appropriate. In addressing the secondary aim of this review, looking at the reporting quality, descriptive quantitative findings of individual items in the critical appraisal tool and the likelihood of bias are presented.

3.4 Results

A total of 1,327 articles were identified. Once duplicates and false hits were removed there were 614 articles assessed via title and abstract with 506 being excluded based on eligibility, leaving 108 full texts to be retrieved. Sixty-four articles were subsequently excluded leaving 44 articles for inclusion. Reference lists of included articles were checked for additional studies of relevance (n = 30 added) and two supervisors (AK and CF) were consulted for knowledge of any additional studies not already captured (n = 5 added). Thus an additional 35 articles were considered, with 14 subsequently excluded. A total of 65 articles were included for analysis (Figure 6).

There were 39 studies that used acute medical attention data to report injuries in community cricket, 14 studies that used in-the-field prospective data collection methods and 11 studies that used other retrospective data collection methods. Thirty-one of the studies were specific to cricket, whilst 33 studies included cricket amongst other sports.

The earliest publication included was from 1975 (135). Since then, there has been an increase in studies reporting cricket injury data in the last decade with 29 (45%) studies occurring since 2010. Figure 7 shows the distribution of the date, by decade, of publication of studies reviewed by reported data type.

Table 11 shows the number of studies by country of data population sourced. Overall, Australia had the most studies with community cricket injury data (n = 23). South Africa had the most cricket only injury data studies (n =12), followed by Australia (n = 10).

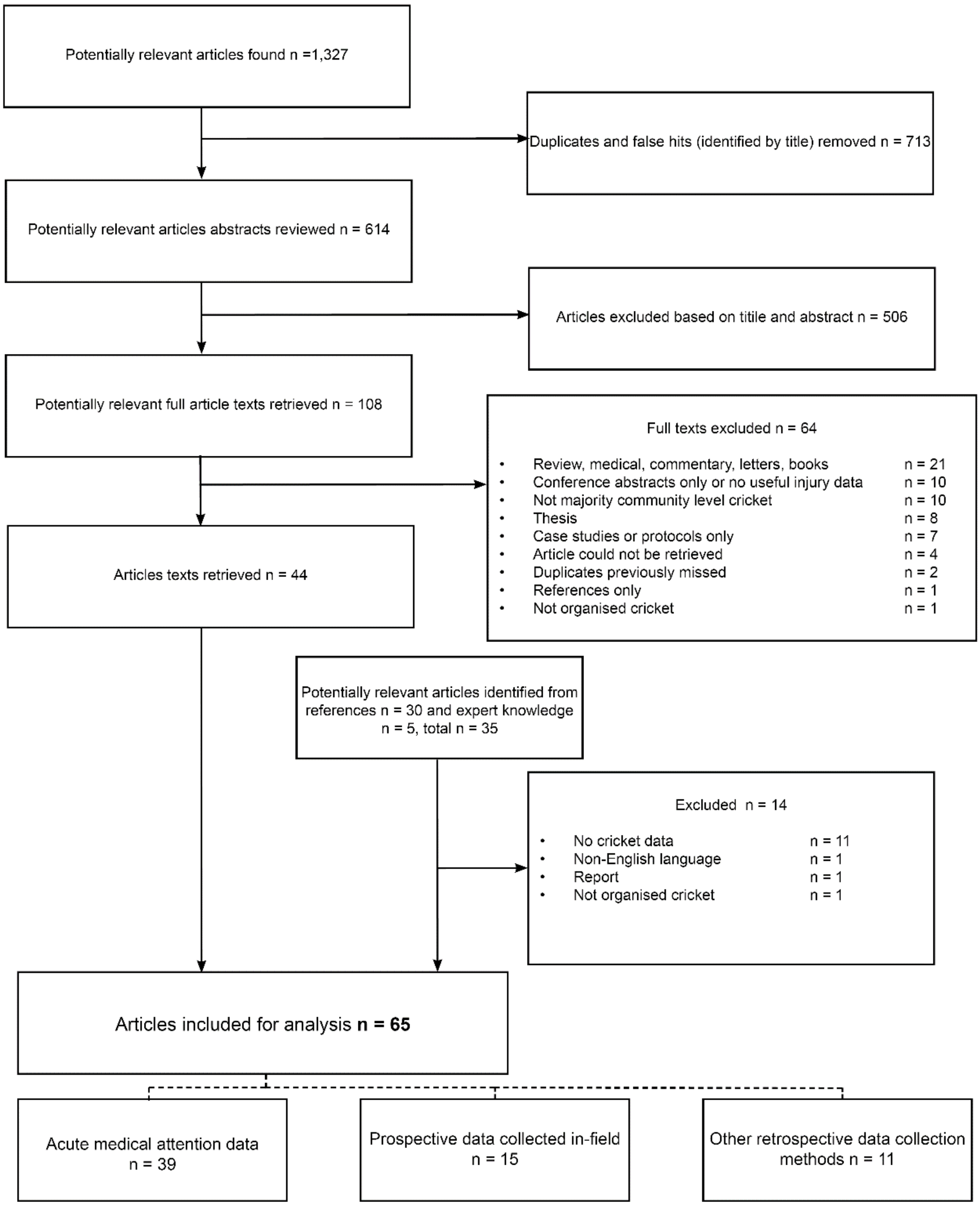

Figure 6. *Search flow for studies reporting injury outcomes in community cricketers.*

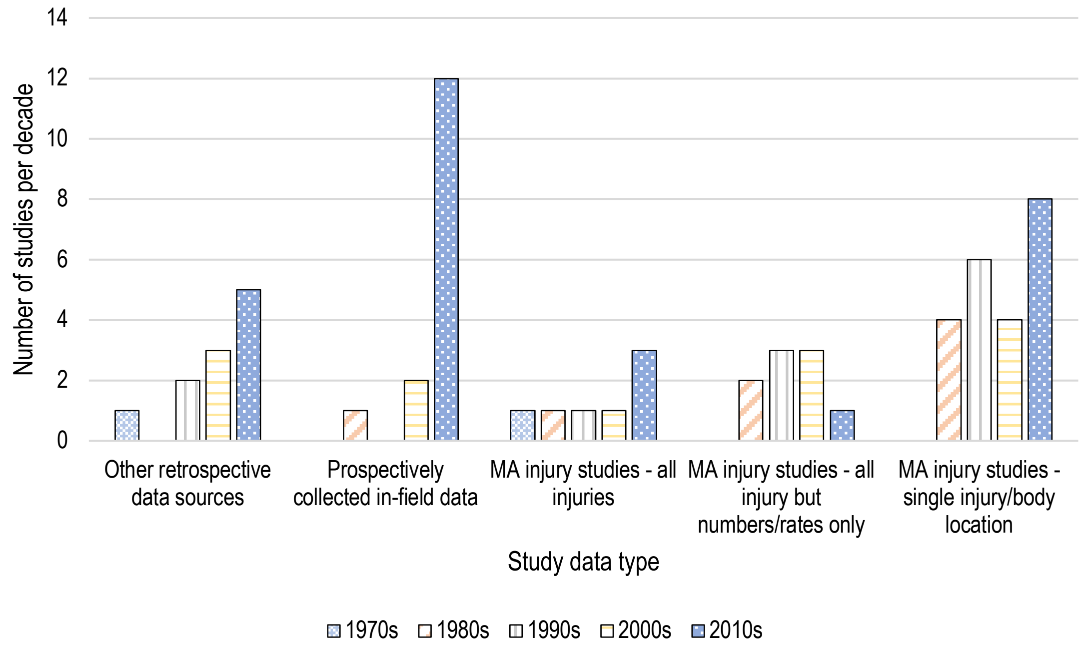

Figure 7. *Number of studies by study data collection type and decade published. (MA = medical attention), (n = 65)*

Table 11. *Number of studies by country of origin, data collection type and whether the study was specific to cricket or included cricket as a sport (n = 65).*

	Study Type	Total	Aus	Ban	China	France	India	NZ	Nigeria	United Kingdom			Sing	SL	SAF
										England	Scotland	Wales			
Cricket Specific	MA all injury (nature/ body loc./ mech)	4	2	-		-	-	2	-	-	-	-	-	-	-
	MA all injury (No./rates)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MA single injury nature/body region	5	1	-	-	-	-	3	-	1	-	-	-	-	-
	Prospective in-field data collection	14	7	-	-	-	-	-	-	-	-	-	-	1	6
	Other retrospective data collections	8	-	-	-	-	-	-	1	1	-	-	-	-	6
	Sub-Total	**31**	**10**	**-**		**-**		**5**	**1**	**2**	**-**	**-**	**-**	**1**	**12**
Cricket Included	MA all injury (nature/ body loc./ mech)	3	1	-	-	-	-	1	-	1	-	-	-	-	-
	MA all injury (No./rates)	10	6	-	-	-	-	1	-	2	1	-	-	-	-
	MA single injury nature/body region	17	6	-	1	1	1	3	-	2	1	1	1	-	-
	Prospective in-field data collection	1	-	-	-	-	-	-	1	-	-	-	-	-	-
	Other retrospective data collections	3	1	1	-	-	-	-	-	1	-	-	-	-	-
	Sub-Total	**34**	**14**	**1**	**1**	**1**	**1**	**5**	**1**	**6**	**2**	**1**	**1**	**-**	**-**
	Overall	**65**	**24**	**1**	**1**	**1**	**1**	**10**	**2**	**8**	**2**	**1**	**1**	**1**	**12**

Aus = Australia, Ban = Bangladesh, NZ = New Zealand, Sing = Singapore, SL = Sri Lanka, SAF = South Africa, MA = medical attention

3.4.1 Medical attention injury studies

There were 39 studies that reported community cricket injury based on medical attention data.

3.4.1.1 Study characteristics

There were three broad types of medical attention (MA) injury data studies: MA injury reporting all injuries with at least one of injury nature, body location or mechanism reported, n = 8 (Table 12), MA injury reporting all injury but reporting only numbers and/or rates, n = 9 (Table 13), MA injury reporting only one injury nature or body location, n =22 (Table 14).

The majority of the studies used hospital based data (n = 31, 77%) and of those, 10 reported on ED presentations (86, 136-144), 10 reported on specialist clinics/departments (145-154) and 13 reported on admissions data (86, 129, 137, 155-164). There were five studies that used insurance claims data, all of which were sourced using the Accident Compensation Corporation (ACC) data in NZ (99, 102, 104, 151, 162). Two studies utilised general practice (GP) data (137, 165), two used survey data (166, 167) and one study used newspaper and coronial data sources (3).

Most studies analysed a wide range of ages, with the majority of hospital and insurance data studies reporting on ages typically five years and older. Three hospital based studies reported on specific paediatric age groups, one of five to 15 year olds (156), one of nine to 13 year olds (138) and another six to 18 year olds (155).

The majority of studies (n = 38) included both male and female cases. One study was specific to females (86).

Table 12. *Study characteristics of acute medical attention injuries in community level cricket looking at all injuries with at least one of injury nature, body region or mechanism reported (n = 8)*

First author, Year [reference]	Setting / Context & Aims	Overall Participants (n), Age, Sex	Injury Data Collection Methods	Injury Definition, Severity Measure (SM)	Number of Injured people (n_p) or Injuries (n_i)	Exposure Measure (EM), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Mechanism of Injuries	Severity of Injuries	Other Information
Perera 2019 (86)	A comprehensive profile of hospital treated cricket injuries sustained by female cricketers in Victoria, Australia from 2002/03 to 2013/14.	n = 668 cases overall with 547 ED presentations and 121 HA All female aged 5 years or more. Top 3 age groups for HA: 20-24 19.0% 10-14 16.5% 30-34 10.7% Top 3 age groups for ED: 10-14 19.9% 15-19 15.7% 20-25 13.3%	Data sourced from Victorian Injury Surveillance Unit (VISU) which holds ED data under the Victorian Emergency Minimum Dataset (VEMD) and HA data under the Victorian Admitted Episode Dataset (VAED)	ED presentation or HA. For HA, SM: < 2 days bed stay or ≥ 2 days bed stay.	ED n_p = 547 HA n_p = 121	Per 1,000 participants Overall = 1.9 (95% CI 0.8 – 4.5)	HA: Fractures = 57 (47.1%) Dislocation, sprain & strain = 22 (18.2%) Injury to muscle and tendon = 8 (6.6%) Superficial injury = 6 (5.0%) Other unspecified = 28 (23.1%) ED: Dislocation sprain & strains = 199 (36.4%), fractures = 92 (17.2%) Superficial injury = 80 (14.6%) Open wound = 46 (8.4%) Injury to muscle and tendon = 38 (6.9%) Eye injury – excluding foreign body = 16 (2.9%) Intracranial injury = 9 (1.6%) Other unspecified = 67 (11.9%)	HA: Head = 34 (28.1%) Shoulder = 6 (5%) Elbow = 14 (12%) Wrist/hand = 21 (17.4%) Abdominal/lower back/spine/pelvis = 0 Knee/lower leg = 27 (22%) Ankle/foot = 7 (5%) Unspecified = 12 (10%) ED: Head = 152 (27.8%) Shoulder = 22 (4%) Elbow = 33 (6%) Wrist/hand = 158 (29%) Abdominal/lower back/spine/pelvis = 6 (1%) Knee/lower leg = 66 (12%) Ankle/foot = 77 (14%) Unspecified = 6 (1%) Suppressed[1] = 27 (5%)	HA: Hit/struck/crushed by ball or bat = 54 (44.6%) Fall = 33 (27.3%) Overexertion and/or strenuous movements = 15 (12.4%) Other unspecified = 15 (12.4%) Not reported = 4 (3.3%) ED: Hit/struck/crushed by ball or bat = 349 (63.8%) Fall = 104, (19.0%) Other unspecified = 94 (17.1%)	HA: Bed stay < 2 days = 95 (78.5%) Bed stay ≥ 2 = 26 (21.5%)	-

Table 12 *(cont).*

First author, Year [reference]	Setting / Context & Aims	Overall Participants (n), Age, Sex	Injury Data Collection Methods	Injury Definition, Severity Measure (SM)	Number of Injured people (n_p) or Injuries (n_i)	Exposure Measure (EM), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Mechanism of Injuries	Severity of Injuries	Other Information
Schneuer 2018 (156)	Investigate sports-related hospitalisations in children aged 5 to 15 years in New South Wales (NSW), Australia, from 2005 to 2013.	n = 20,034 sport-related cases. Cricket related = 463 Ages: 5-8 years n = 58 9-12 years n = 128 13-15 years n = 277 M = 81% overall, F = 19% overall. Cricket proportion > 81% for males but could not extract exact value.	Data sourced from the NSW Admitted Patient Data Collection (APDC)	Either hospitalised for 3+ days, had major surgery, required intensive care unit admission, mechanical ventilation, or blood transfusion	Cases = 463 Injuries = 500	Cricket related injury represented 2.5% of all sports-related hospitalisation	Fracture = 54.2% TBI = 11.8% Open wound = 18% Dislocation = 7.7% Muscle or joints = 2% Ocular = 4.6% Dental = 1.4% Spinal cord/nerves < 0.1% Internal organs = 1% Blood vessel < 0.1% Foreign body < 0.1%	Head = 31.8% Hand = 24.2% Forearm = 15.8% Lower leg = 5.2% Abdomen = 4.2% Eye = 3.6% Knee = 3.4% Shoulder = 2.6% Hip/thigh = 2.0% Ankle/foot = 2.0% Neck = 1.8% Thorax < 0.1%	NR	All cases (n = 463) counted as severe.	2.9% of cases were subsequent hospitalisations distinct from the initial case.
King 2018 (104)	Provide retrospective analysis of moderate to serious injury and serious injury claims and related costs for five sporting codes using national insurance claims (ACC) in New Zealand from 2012 to 2016.	n = 853, 324 claims from which 60,803 moderate to serious claims (3072 cricket related), 597 serious claims (15[a] cricket related). Age 0 – 85+ years Sex: M = 2864 F: 208 for moderate to serious claims M = 12 F = 3 for serious claims[2]	Retrospective analysis of data from ACC for 5 years from 2012 to 2016	Any injury which qualified for a moderate to serious injury or serious injury claim. SM = moderate to serious injury and serious injury as defined by the ACC based on level of benefits and care provided.	n_p cricket related: moderate to serious injury claims = 3072, serious injury claims = 15	EM = NR 0.4% of all claims cricket related. 5.0% of sporting claims (of the 5 included) cricket related	Moderate to serious claims: Soft tissue = 1980 (64.4%) Fracture/dislocation = 948 (30.9%) Laceration/wound = 59 (1.9%) Concussion/brain injury = 44 (1.4%) Deafness = 15 (0.49%) Gradual onset = 14 (0.46%) Dental injuries = 6 (0.20%) Hernia = 6 (0.20%) Serious claims: Concussion/brain injury = 9 (60%) Fracture/dislocation = 6 (40%)	Moderate to serious claims: Head/neck = 212 (6.9%) Upper limb = 1086 (35.4%) Lower limb = 1394 (45.4%) Chest/back/shoulder = 72 (2.3%) Serious claims[a]: Head/neck = 15 (56%) Lower limb = 12 (44%)	NR	3072 moderate to serious claims 15 serious claims	Cricket ranked 5th for total moderate to serious injury claims but 3rd for mean cost per claim. Cricket ranked equal 3rd for serious injury claims but 5th for mean costs per claim. Moderate to serious claims for fracture/ dislocations increased significantly over 2012-2016.

Table 12 (cont).

First author, Year [reference]	Setting / Context & Aims	Overall Participants (n), Age, Sex	Injury Data Collection Methods	Injury Definition, Severity Measure (SM)	Number of Injured people (n_p) or Injuries (n_i)	Exposure Measure (EM), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Mechanism of Injuries	Severity of Injuries	Other Information
Walker 2010 (129)	Hospitalisation of cricket players in NZ from 2000-2005 inclusive. Identify the epidemiology of injury resulting in hospitalisation, agents and mechanisms (products and activities) associated with injury and evidence of assistance to those developing activity specific PPE.	n = 498 cases Age range = 2-80 years 0-9: 8% 10-19: 28% 20-29: 23% 30-39: 21% 40-49: 12% 50-59: 4% 60+: 3% Sex: M > F but no numbers	Retrospective analysis of NZ's National Minimum Dataset of public and private hospitals	ICD-10-AM codes for case hospitalised for at least one night, including bystanders injured as a direct result of cricket activity. SM = Serious non-fatal cases based on ICISS score of <= 0.941	$n_p = n_i = 498$	EM = 100,000 people/year & 100,000 participants / year. Population IIR = 2.3 Participant IIR = 39 Almost 1% of all cases were cricket related	Fracture: 218 (44%) Sprain/strain/soft tissue: 76 (15%) Dislocation: 31 (6%) Contusion: 27 (5%) Rupture/tear: 18 (4%) Concussion: 14 (3%) Open wound: 12 (2%) Seizure: 11 (2%) Other: 90 (18%)	Head & neck: 114 (23%) – 28 fractures, 11 open wounds, 10 concussions Upper limb: 178 (36%) – 111 phalanges, 32 lower arm, upper arm & shoulder 33 Lower limb: 156 (31%) – Achilles 44, tibia/fibula 27, ankle 25, knee 21 Trunk & back: 14 (3%) Not specified: 36 (7%)	Exposure to inanimate mechanical forces: 240 (48%) – of these 144 (60%) were hit by ball, 33 (14%) hit by bat. Falls: 108 (22%) Overexertion or repetitive movements: 102 (21%) Exposure to animate objects (e.g. player collisions): 34 (7%) Unspecified: 3%	20 (4%) cases were classified as serious non-fatal, 11 due to being struck by bat or ball, 6 due to collisions with other players, 2 from falls and 1 from overexertion.	For children under 10 years that were injured under exposure to inanimate mechanical forces, 25 (72%) were struck by the bat.
Upadhyay 2000 (138)	Emergency presentations to Starship Children's Hospital Auckland, NZ. Describe the nature of injuries sustained by children playing cricket from 1993 to April 1998.	n = 60 cases Age range = 9 – 13 years Sex NR	Retrospective review of existing data	Injury secondary to playing cricket under ICD[3] code E-8897 SM = NR	$n_p = n_i = 60$	EM = NR	Fracture: 26 (43.3%) Closed head injury: 8 (13.3%) Blunt trauma: 8 (13.3%) Other: 18 (30%) – noted as soft tissue contusions, ligamentous injuries, minor lacerations and abrasions.	Head/face & neck: 16 (26.7%) Thorax/abdomen: 8 (13.3%) Upper limb: 18 (30%) Other unspecified: 18 (30%)	Hit by ball: 31 (51.6%) Hit by bat: 12 (20%) Fall: 12 (20%) Collision with player: 3 (5%) Fall on bat handle: 1 (1.7%) Fall on stumps: 1 (1.7%)	2 injuries were severe, both blunt abdominal trauma 19 cases (31.6%) required operative procedures Median range of days of stay in hospital: 1-2.5 days 18 cases did not require admission to hospital (all other)	-
Finch 1998 (139)	Emergency department (ED) presentations of sports injuries in selected parts of Australia for the period 1989-1993. Describe sports injury cases presented to selected hospital emergency departments and redress the lack of community based information on sports injury in Australia	n = 516,221 98,140 attendees to NISU EDs. 51,203 < 15 years old (children) 46,837 ≥ 15 years old (adults) not specific to cricket Gender NR	Data collected from 74 public hospitals and medical centres on standardised collection forms throughout Australia	NR SM = NR	$n_{p(children)}$ = 1,945 $n_{i(children)}$ = 2,345 $n_{p(adults)}$ = 3,408 $n_{i(adults)}$ = 3,846	EM = NR 3.7% of all children presenting with sports injury and 7.3% of all adults presenting with sports injury related to cricket	Children / Adult: Haematoma/bruising: 30.2% / 19.6% Fracture: 17.8% / 20.7% Laceration: 17.8% / 11.8% Sprain/strain: 12.4% / 26.0% Inflammation/swelling/pain: 7.5% / 10.6% Superficial abrasion: 2.9% / 1.2% Other: 11.4% / 11.5%	Children/Adults: Head: 44.2% / 16.6% Upper extremity: 33.9% / 32.6% Lower extremity: 15.5% / 22.8% Trunk: 3.2% / 4.2% Other: 11.4% / 11.5%	Head and facial injuries generally associated with hits with the ball or bat	8.2% of emergency department presentations for children were admitted to hospital. 5.4% of emergency department presentations for adults were admitted to hospital.	-

Table 12 (cont).

First author, Year [reference]	Setting / Context & Aims	Overall Participants (n), Age, Sex	Injury Data Collection Methods	Injury Definition, Severity Measure (SM)	Number of Injured people (n_p) or Injuries (n_i)	Exposure Measure (EM), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Mechanism of Injuries	Severity of Injuries	Other Information
Forward 1988 (141)	Review indoor cricket injuries presenting to ED of Royal Perth Hospital, Australia over a 6 month period. (Published in 1988 – no reference to dates investigated).	n = 64 cases 19-34 years Sex: M = 50 (78%) F = 14 (22%)	Recording of all indoor cricket injuries presenting in ED	NR (all indoor cricket related injuries) SM = work time loss	n_p = 64 n_i = 65	EM = NR	Fractures: 19-22 (includes 3 bruised or fractured ribs) Grade I/II ligament strains: 10 Eye specific damage: 6 Dislocations: 5 Bruising: 2-5 (includes 3 bruised or fractured ribs) Friction burns (infected): 4 Lacerations: 4 Avulsions: 2 Concussion: 1 Other: 7	Head & neck: 14 – eye injuries 6 (43%), supraorbital ridge 4 (29%), nasal bone 3 (21%) Upper limb: 30 – proximal phalanx 11 (37%) Lower limb: 18 – ankle 5 (28%), knee 5 (28%) Thorax: 3 – ribs 3 (100%)	Batters most often struck on fingers by ball Wicket-keepers: 5 of 7 injuries d/t being struck in eye by ball One player was struck by the bat in an argument.	No time off work: 19% < 1 week off: 19% 1 week – 1 month: 19% > 1 month: 11% Not known: 32%	Activity at onset: Fielding: 72% Batting: 17%
Crompton 1977 (144)	Sports injuries treated at the Birmingham Accident Centre, England, UK. Determine the incidence and type of sports injuries treated at the Birmingham Accident Hospital in 1975.	n = 40,169 new cases, 2,806 being sports injuries. Age range: 0-50+ years not specific to cricket M: 80% F: 20% not specific to cricket	Retrospective analysis of existing hospital data	ID = Injuries classified according to aetiology, intrinsic injuries classified as self SM = NR	n_p = n_i = 171	ER = NR 6% of identified sporting injuries cases due to cricket	NR	NR	153 (89%) extrinsic[4] implemental 15 (9%) extrinsic environmental 2 (1%) intrinsic[4] 1 (1%) secondary	6.9% of all serious extrinsic injuries. 137 (82%) of extrinsic injuries considered minor (cuts, bruises, minor injuries), 31 (18%) relatively serious.	-

ED = Emergency Department, HA = Hospital Admissions, M = Male, F = Female, NISU = National Injury Surveillance Unit, NR = Not Reported, ACC = Accident Compensation Corporation, ICD-10-AM = International Classification of Diseases, 10th Ed. Australian Modification, ICISS = International Classification Injury Severity Score, PPE = personal protective equipment, NZ = New Zealand, IIR = Injury Incidence Rate, SM = Severity Measure, ID = Injury Definition

[1] Suppressed data due to small numbers.

[2] There is some disparity in the reported figures of the number of serious for cricket-related injury (reported in different tables as n=15 and n=27).

[3] ICD version not stated in study.

[4] Extrinsic injuries were those caused by external factors (implemental (from article) = ball, bat). Intrinsic injuries were classified as self-inflicted injuries.

Table 13. *Study characteristics of acute medical attention injuries in community level cricket looking at all injuries with only number of injuries and/or injury rates reported.*

First author, Year [reference]	Setting / Context & Aims	Overall Participants (n), Age, Sex	Injury Data Collection Methods	Injury Definition, Severity Measure (SM)	Number of Injured people (n_p) or Injuries (n_i)	Exposure Measure (EM), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Mechanism of Injuries	Severity of Injuries	Other Information
Fernando 2018 (136)	Report the incidence of presentations to emergency departments (EDs) in Victoria, Australia for sport and active recreational related injuries and establish the sports with the highest injury rates per participation from 2012/13 to 2014/15.	n = 1,037,978 Overall 171,541 sports related cases. Cricket related: Male = 94%, Female = 6% Ages ≥ 5 years	Cases identified from VISU data using VEMD of public hospital emergency departments in Victoria, Australia	ID = All sports and active recreational related injuries presenting to ED. SM = NR	$n_{p\geq15}$ = 3527 presentations ≥ 15 years old n_p = 4535 presentations O/A	EM = Annual injury rate, per 100,000 population and Injury rate, per 100,000 participants. Both for ≥ 15 years old. 24.9 per 100,000 population (≥ 15 yrs) 1,237 per 100,000 participants (≥ 15 yrs) Age proportions: 5-14 = 22%, 15-24 = 27%, 25-44 = 40%, ≥ 45 = 11%	NR	NR	NR	NR	Cricket ranked 14th of 20 sports for injury per 100,000 participants. Cricket ranked 9th for mean annual expenditure and 14th for mean cost per incident.
Cassell 2003 (137)	Medically treated sport and active recreational injuries across six postcodes in the La Trobe Valley, Victoria via hospital (VAED, VISS) data and GP presentations (ELVIS) over 12 months 7 Nov 1994 to 6 Nov 1995. Quantify and describe injuries from sport and active recreation that were treated medically in a defined region of the La Trobe Valley over a 12 month period and report rates of injury per 10,000 residents and construct a pyramid of medically treated sports injuries.	n = 2294 Overall 112 hospital admission 1179 ED presentations 1003 GP presentations Ages 5+ years not specific to cricket 70% hospital admissions male 73% ED presentations male ~67% GP presentations male Not specific to cricket	Hospital admission via VAED data with E-codes under ICD-9-CM, Ed presentations via VISS standardised voluntary completed for by patient and doctor, GP presentations via ELVIS – standardised collection forms completed by GP and patient	ID = -codes on ICD-9-CM, ISIS context activity codes 102, 103, 301-303, otherwise doctor diagnosis were recorded under ICD-9 E codes SM = Length of stay, level of treatment/follow up/referral	n_p = 75 ED presentations, 55 GP presentations n_i = unknown	EM = per 10,000 persons For cricket: 6.4% of all ED presentations (95% CI 5.0-7.8) 5.5% of all GP presentations (95% CI 4.1-6.9)	NR	NR	NR	NR	-

Table 13 *(cont).*

First author, Year [reference]	Setting / Context & Aims	Overall Participants (n), Age, Sex	Injury Data Collection Methods	Injury Definition, Severity Measure (SM)	Number of Injured people (n_p) or Injuries (n_i)	Exposure Measure (EM), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Mechanism of Injuries	Severity of Injuries	Other Information
Finch 2002 (168)	Five sports medicine clinics in Melbourne, Victoria, Australia from August 1996 to August 1998. Describe and compare two injury surveillance systems within sports medicine clinics to determine if a simplified approach provides similar information to a more comprehensive approach.	N = 8161 cases Mean age: year 1 = 24.6 years, year 2 = 24.7 years. M: 69.9% F: 30.1%	Data collection forms – one part completed by the patient the other by a practitioner	ID = any new sports injury presenting to the clinic for the first time. SM = NR	NR for cricket	EM = NR Year 1: Cricket related presentations = 3.8% of all presentations (95%CI 3.3-4.3) Year 2: Cricket related presentations = 3.4% of all presentations (95%CI 2.5-4.3)	NR	NR	NR	NR	-
Mummery 2002 (166)	Telephone survey of the adult population of QLD, Australia from 25th August to 1st September 2000, aiming to examine medically attended injuries that occurred during sport and recreational activities.	n = 1337 Age range = 18 – 94 years Mean age = 45.03 years M: 682 F: 655	Stratified sampling of 3 QLD regions with random selection of adult within dwelling > 18 years who were living in QLD and could be contacted by land-line telephone	ID = MA SM = TL from work, school and/or activity.	n_p = 191 n_i = 222 $n_{cricket}$ = 4	EM = participation rate per 10,000 persons, injury rate per 1,000 persons. For cricket 137.9 injuries per 1,000 persons (95% CI 120.6 – 155.2)	NR	NR	NR	NR	-
Jago 1998 (165)	Survey of sport and recreational injuries in a single general practice (GP) clinic in Melbourne, Victoria, Australia, over a single year, aiming to gain better knowledge of the range of these type of injuries commonly seen in general practice.	n = 78 sporting injuries (estimated 9% of all presentations). Mean age = 25 years (not specific to cricket) M: 79.5%, F:20.5% (not specific to cricket)	Questionnaires partially filled out each by GP and patient at 4 x 2 weekly periods at 3 monthly intervals	ID = sport or recreational activity injury presenting to GP. SM = NR	n_p = unknown n_i = 4	EM = NR 5.1% of injury presentations were cricket related.	NR	NR	NR	NR	-

Table 13 (cont).

First author, Year [reference]	Setting / Context & Aims	Overall Participants (n), Age, Sex	Injury Data Collection Methods	Injury Definition, Severity Measure (SM)	Number of Injured people (n_p) or Injuries (n_i)	Exposure Measure (EM), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Mechanism of Injuries	Severity of Injuries	Other Information
Nicholl 1995 (167)	Postal questionnaire of sporting and recreational fitness activity in the previous 28 days sent out to ~ 29,000 persons aged 16-45 years in England and Wales aiming to provide reliable estimates of the annual incidence and patterns of exercise related morbidity (ERM), to describe the nature and severity of injuries, compare risks for different activities and examine what factors may affect risk and also to provide estimates of the costs.	28,857 mailed survey, 68% of 26,449 adults responded = 17,985, 1705 sport related. 360 (2.0%) reported participating in cricket Age range 16-45 years not specific to cricket. 75% injuries sustained by males not cricket specific	A previously piloted questionnaire with a 28 day reference period. 4 years 1987 – 1990 Pilot study 1987-88 and this survey 1989-90	ID = Any injury or illness however minor through taking part in any of the activities participants listed in the last 28 days SM = Trivial injuries. Substantive injuries were defined as those which restricted the participant from taking part in usual activities for at least one day and for those that treatment had been sought. Recurrent injuries also defined as ERMs originally sustained outside 28 days	Estimated 1.1 million ERM per annum related to cricket	EM = Risk of ERM per 1,000 occasions of participation. Cricket related: 48.7 per 1,000 participants for all incidents 13.7 per 1,000 participations for new substantive injuries 11.9 excluding incidents that result in time off sport	NR	NR	NR in full	New substantive injuries: 29%[1] New non-substantive injuries: 43%[1] Recurrent injuries: 29%[1]	Cricket accounted for 1/3 of all injuries resulting from being struck by ball or equipment. Struck by ball: 15
Hume 1994 (162)	Describe the nature, extent and severity of sports injuries in New Zealand using existing data from Health information Service (HIS) national mortality data and public hospital mortality data, Dunedin Hospital ED data (A&E), ACC claims data and Dunedin Sports Injury Clinic data (DSIC).	n = 118,417 O/A. 18,885 deaths (70 sport related) Hospital: 47,941 (4,374 sport related) A&E: 24,333 (3,680 sport related) ACC: 26,638 claims DSIC: 620 Age NR M:F ratios: Deaths 79:21 Hospitalisations 75:25 A&E 73:27 ACC claims 75:25 DSIC 70:30 All not specific to cricket	Hospital and HIS data reviewed for the purposes of case ascertainment and coding the type of sport, ACC and DSIC coded data extracted HIS national mortality data 1978-1987 HIS public hospital morbidity 1988 A&E May 1989-April 1990 ACC financial year 1989/90 DSIC 1988	ID = NR SM = NR	n_p cricket related: Deaths: 0, Hospital: 233 A&E : 197 ACC: 1102 DSIC: 0	EM: per 100,000 persons per year. Cricket related: 4.1-5.0% injury incidence across all databases Hospitalised: 99.36 per 100,000 persons per year 5.1% of Hospitalised cases 4.1% of all ACC claims	NR	Only reported body part Finger/ thumb: 32	NR	ACC data: Disabling[2] injuries: 115 (10.4%) Hospital data: Severe injuries (AIS-4): 2 (4.3%)	-

Table 13 (cont).

First author, Year [reference]	Setting / Context & Aims	Overall Participants (n), Age, Sex	Injury Data Collection Methods	Injury Definition, Severity Measure (SM)	Number of Injured people (n_p) or Injuries (n_i)	Exposure Measure (EM), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Mechanism of Injuries	Severity of Injuries	Other Information
Rowell 1988 (142)	A&E department of the Royal Sussex County Hospital, Brighton (RSCH) and University of Sussex Sports Injury Clinic (SIC). To compare the sports injuries treated during overlapping time periods at an A&E department and SIC situated in the same geographical area over 12 months from October 1986.	n = 2802 overall, 2,478 at RSCH, 324 at SIC Mean age 23.4 years (SD 9.9) at RSCH, mean age 29.7 years (SD 10.6) at SIC. Cricket mean age 27.3 years (SD 10.5) at RSCH and 45.7 years (SD 11.3) at SIC Gender: RSCH 83% M, 17% F SIC 78% M, 22% F not cricket specific	Data extracted from hospital computer system that were classified with 'sports injuries' and data from SIC	ID = Sports injuries as classified in hospital system and SIC SM = NR	n_p RSCH cricket related = 92 n_p SIC cricket related = 4	EM =NR 3.5% of hospital presentations (ASR +2.3) 1.2% of clinical presentations (ASR -2.3) ($p < 0.005$)	NR	NR	NR	NR	-
Watters 1984 (143)	A&E department of Royal Infirmary Edinburgh. Assess the proportion of referrals to the accident and emergency department due to injuries incurred whilst participating in sport and note which sports and which injuries occurred from 1 April to 31 March 1981.	n = 58,539 cases with 2,770 sports injury related. Overall mean age Male: 22.16 years (SD 6.59) Female: 20.9 years (SD 7.5) Cricket mean age 28.6 years (SD 9.5) 89% M 11% F, not cricket specific	Prospectively collected data on standard form	ID = Sports injuries in organised sport. SM = NR	n_p cricket related = 33	EM = NR Cricket represented 1% of all sporting injuries	NR	NR	NR	NR	-

ED = Emergency Department, HA = Hospital Admissions, M = Male, F = Female, NISU = National Injury Surveillance Unit, NR = Not Reported, ACC = Accident Compensation Corporation, ICD-10-AM = International Classification of Diseases, 10th Ed. Australian Modification, ICISS = International Classification Injury Severity Score, PPE = personal protective equipment, NZ = New Zealand, IIR = Injury Incidence Rate, A&E = Accident & Emergency.

[1] Indicative only as values derived, in part, from scaling off article figure.

[2] Permanent loss or impairment of bodily function.

Table 14. *Study characteristics of acute medical attention injuries in community level cricket where only a single injury nature or injured body region/part is reported.*

First author, Year [reference]	Setting / Context & Aims	Overall Participants (n), Age, Sex	Injury Data Collection Methods	Injury Definition (ID), Severity Measure (SM)	Number of Injured people (n_p) or Injuries (n_i)	Exposure Measure (EM), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Mechanism of Injuries	Severity of Injuries	Other Information
Wang 2019 (155)	Sports related fractures in children and adolescents aged 6 to 18 years old from two university affiliated hospitals in Chongqing, China, from 2001 to 2010.	n = 410 age mean 13.5 ± 3.1 years M = 335, F = 75 Cricket related: n = 16 Age mean 10.3 ± 2.9 years M = 13, F = 3	Retrospective analysis of X-rays, CT and MRI scans of admitted patients	ID = sports-related fractures admitted to hospital SM = NR	n_p = n_i =16	Cricket represented 3.9% of all sports related fractures	100% fractures	Upper extremity n = 12 (75%) Of which n = 6 were to humerus/radius. Lower extremity n = 2 (12.5%) Craniofacial n = 1 (6.3%) Spinal n = 1 (6.3%)	NR	NR	2 injuries had nerve injury associated.
Brukner 2018 (3)	Australian cricketing deaths over the last 158 years. A historical review of direct trauma related deaths in organised and informal cricket in Australia via print media, coronial and insurance data.	n = 174 cases, Age range = infant to 78 years M = 173, F = 1	Media searches via online repositories, direct outlet contacts and national coronial and cricket insurance databases	ID = only fatalities directly related to participation in a match or training as a player, official or spectator. SM = death	n_p = n_i = 174 83 cases organised cricket, 91 cases informal cricket. (1 case known elite level cricket)	EM = NR	Related to organised cricket: Head, neck or face trauma = 37 Chest trauma (likely commotio cordis) = 13, Peritonitis due to abdominal trauma = 3 VAD/SAH = 2 (+4) Tetanus due to arm fracture = 1	Related to organised cricket: Head, face, neck = 39 (47%) Trunk = 16 (19%) Upper limb = 1 (1%)	Related to organised cricket: Batting = 45 Struck by ball = 44, complications from fractured arm = 1. Fielding = 11 Struck by ball = 6, collisions with other players or boundary fences = 5. Wicket keeping = 6 Struck by ball from bowler = 4, struck by ball from fielder = 1, struck by bat = 1 Bowling = 1 struck by ball. Umpiring = 3 and Preparing pitch = 2, all struck by ball	All fatalities	Only 5 fatalities in last 30 years: 3 commotio cordis and 2 VAD/SAH
Andrabi 2017 (145)	Patients presenting to the department of neurosurgery, Sheri-Kashmir Institute of Medical Sciences, Kashmir (SKIMS), India with craniotomy defect and had cranioplasty. Aimed to evaluate the indication, materials, complications and outcomes of cranioplasty over the period August 2010 –September 2015.	n = 236 cases Age range = 1 – 70 years Mean age = 33.44 years (not cricket specific). M: 81.8% F: 18.2% (not cricket specific)	Retrospective data collected from medical files from Aug 2010 – Jul 2013 and prospective data collected from Aug 2013 – Sept 2015	ID = all patients who presented to SKIMS, 3 with craniotomy defect and had cranioplasty performed. SM = NR	n_p = n_i = 4	EM = NR Cricket represented 1.7% of all presentations	Head trauma	Head 100%	Hit by ball 100%	100% required surgical bone flap removal/repair	-

Table 14 *(cont).*

First author, Year [reference]	Setting / Context & Aims	Overall Participants (n), Age, Sex	Injury Data Collection Methods	Injury Definition (ID), Severity Measure (SM)	Number of Injured people (n_p) or Injuries (n_i)	Exposure Measure (EM), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Mechanism of Injuries	Severity of Injuries	Other Information
Lock 2017 (157)	Review of CT scans on the face and orbits at the National University Hospital, Singapore to evaluate the epidemiology and demographic characteristics of sports-related population to other causes over 24 months from 2013 to 2014.	n = 1421 scans O/A, 438 orbital fractures with 65 sports related. Mean age of sport related fractures = 36.9 years (SD 17.9 years). M = 58, F = 7 not cricket specific	Retrospective analysis of CT scans and clinical data from hospital	ID = orbital fractures related to sports injury. SM = non-specific surgical or conservative treatment	n_p cricket related = 3	EM = NR 4.62% of sports-related orbital fractures were due to cricket.	Orbital fractures 100%	Head/face 100%	NR	NR	Of the 65 sports related orbital fractures, 38 treated conservatively and 27 with surgery.
Russell 2014 (146)	Hand injuries presenting to specialist plastic surgery unit, England, UK, in the summer months from June 1st 2010 to August 31st 2010. Analyse the pattern of hand injuries occurring at the amateur level of cricket.	n = 27 cases Age range = 13-63 years Mean = 33 years Gender NR	Prospective injury data from presenting patients	ID = hand injuries due to cricket SM = NR	n_p = 27 n_i = 28	EM = NR	Bony injuries = 28 Fractures = 20, dislocations = 8 Associated soft tissue injuries = 25	Right hand: 61% Left hand: 39% Ring finger: 29% Little finger: 29% Thumb: 18% Index finger: 14% Middle finger: 11% Distal phalanx & DIPJ most likely to be injured: 11 (39%) & 5 (17.9%)	Direct blow: 53.5% Axial load: 28.5% Hyperextension: 14.2% Crush: 3.5% Fielding: 78.6% Batting: 7% Wicket-keeping: 10.7%	16 cases (57%) caused the player to stop playing, 12 cases had first aid administered at scene, 3 cases (10.7%) required surgery	-
Finch 2013 (158)	Hospital admissions in Victoria, Australia over nine financial years from 2002-03 to 2010-11. Enumerate trends in sport related concussion presentation to hospitals.	n = 28,718 O/A, 4,745 sport related. Age range: all ≥15 years Gender NR	VISU data using Victorian Admitted Episodes Dataset (VAED)	ID = ICD-10AM principle diagnosis of injury S00-T98, concussion injury recorded S06.00-S06.05, unintentional external cause V00-X59 and activity code U50-U71.	n_p = n_i = 51	EM = per 100,000 participants Cricket mean rate over 9 years = 3.0 concussions per 100,000 participants	Concussion 100%	Head 100%	NR	NR	Estimated -31.8% change in rate over 9 years (p = 0.53). Cricket was the only sport with a decrease in the rate of hospitalisations for sport related concussions.
Lee 2012 (147)	Oral and maxillofacial unit at Christchurch Hospital, Canterbury region, New Zealand. Presentation of cricket related facial fractures to a tertiary hospital from 1996 – 2006.	n = 561 sports-related facial fractures, n_c = 40 cricket related. Age range = 12-52 years Mean = 29 years < 16: 7.5% 16-30: 45% 31-45: 32.5% > 46: 7.5% M = 39, F = 1	Retrospective data review of patient records	ID = facial fractures from cricket SM = NR	n_p = 40 n_i = 47 fractures	EM = NR 7% of sports-related facial fractures presenting to hospital	100% Facial fractures	Frontal: 0% Midface: 70% Mandible: 30%	Impact by ball: 55% Collision with player: 5% Hit with instrument: 2.5% Unknown: 37.5%	37.5% required hospitalisation 37.5% required surgery	-

Table 14 *(cont).*

First author, Year [reference]	Setting / Context & Aims	Overall Participants (n), Age, Sex	Injury Data Collection Methods	Injury Definition (ID), Severity Measure (SM)	Number of Injured people (n_p) or Injuries (n_i)	Exposure Measure (EM), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Mechanism of Injuries	Severity of Injuries	Other Information
Welch 2010 (99)	All orofacial claims received in a 10 year period to the NZ accident rehabilitation and compensation insurance corporation (ACC). Describe and analyse trends in new sports related dental injuries that have been reported to ACC in the 10 years from 1999-2008	275,130 new claims, ~ 62,179 sports related. 0-61+ Not cricket specific 61.4% M 38.6% F Not cricket specific	Retrospective analysis of ACC claims data	ID = New dental injury claims SM = NR	n_p cricket related claims = 28,600*	EM = NR Mean 4.6% of all sports related dental claims per year over the 10 year period. Range 3.6 – 5.6%	Dental injury	100% dental	NR	NR	Cricket ranked 6th out of 19 sports analysed
Antoun 2008 (148)	Retrospective sample data from the oral and maxillofacial unit of Christchurch Hospital, Christchurch, New Zealand, over 11 years 1996 – 2006 aiming to investigate the prevalence, anatomical sites and management of sports related maxillofacial fractures in New Zealand	n = 2582 cases with fractures 561 sports related & 40 cricket related Ages: < 16: 8.1% 16-30: 48.6% 31-45: 35.1% 46-60: 8.1% > 60: 0% Median ~ 30* years M: 39, F: 1	Existing hospital data from oral and maxillofacial unit	ID = Fracture only -soft tissue excluded. SM = Treatment approach: Active, conservative and other	n_p = 40 n_i = 49	EM = NR 7.1% of all sports related fractures were due to cricket*	100% fractures	Upper third (skull & frontal bones): 0 Middle third: 32 Lower third: 17	NR	16 patients required active treatment (surgery), 21 patients treated conservatively, 1 other	-
Driscoll 2008 (159)	Heat related hospitalisations in Australia in all sporting activity aiming to summarise the extent and characteristics of cases of illness due to environmental heat significant enough to result in hospitalisations arising during sporting activity over 2002-03 and 2003-04 period.	n = 1315 heat related O/A 148 sport related. Age range: 0-75+ years not specific to cricket (nearly all cricket cases aged less than 54) 68% M 32% F not specific to cricket	Cases identified from hospital separations databases complied by AIHW	ID = ICD-10-AM codes with external cause codes X30 (environmental sources of heat) and or X92 (man-made source of heat) and diagnosis code T67 (effects of heat and light). SM = NR	n_p = n_i = 16	EM = Per 1,000,000 per year (excluding < 15 years old) based on population survey data. 10 cricket cases per 1,000,000 / yr (95% CI 5.5=16.9) 10.8% of sport related cases due to cricket.	Heat related	Systemic	NR	NR	Overall mechanisms: (not specific to cricket) Heatstroke & sunstroke: 36% Heat syncope, 15% Heat exhaustion – anhydrotic: 7% Heat exhaustion – not specified: 43%

Table 14 *(cont).*

First author, Year [reference]	Setting / Context & Aims	Overall Participants (n), Age, Sex	Injury Data Collection Methods	Injury Definition (ID), Severity Measure (SM)	Number of Injured people (n_p) or Injuries (n_i)	Exposure Measure (EM), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Mechanism of Injuries	Severity of Injuries	Other Information
Finch 2008 (160)	Hospitalisations due to heat related illness in NSW from January 2001 and December 2004 inclusive. Provide new epidemiological data on sports/leisure heat illness hospitalisations in NSW over a four year period	n = 905 O/A, 109 sport / leisure related, 8 cricket related Age range: 0-45+ years not cricket specific M = 75, F = 34 not cricket specific	In patient separations/discharges from NSW acute hospitals were collected from the In-Patient Statistics Collection (ISC)	ID = ICD-10-AM codes for 'exposure to excessive natural heat X30 and or 'effects of heat and light' T67. Sport and leisure cases identified by activity codes Y93.0-Y93.1 prior to July and U50 – U72 after June 2002 SM = NR	$n_p = n_i = 8$	EM = NR 7% of all heat related cases were related to cricket	Heat related	Systemic	NR	NR	Overall – not specific to cricket: Heat exhaustion: 40% Heatstroke & sunstroke: 32%
Maladiere 2001 (161)	A prospective collection of patients admitted to department of oral and maxillofacial surgery at the Pite-Salpetiere University Hospital, France over the period of March 1998 to March 2000 to analyse the demographics, site and causes of facial fractures due to sport.	n = 140 cases O/A with 154 fractures. Age range = 15-57 years, mean age = 28.5 years. Cricket related = 28 years M: 123, F: 7 O/A, cricket related = M: 1	Prospective collection of patient data from medical records	ID = facial fracture related to sports injury. SM = NR	n_p cricket related = 1	EM = NR 0.7% of all sports related facial fractures due to cricket.	Fracture 100%	100% face	100% equipment (non-specific)	NR	-
Love 1998 (102)	New Zealand formal and informal sporting community – excluding rugby union that have claimed through the Accident Rehabilitation & Compensation Insurance Corporation (ACC) over the financial years 1993-1996. To identify the sports at risk for dental injuries other than rugby union to be able to target public health campaigns	n = 19,445 claims O/A. Age range = 0-75+ years not cricket specific M:F ratio 2:1 not cricket specific	Accident Rehabilitation & compensation Insurance Corporation (ACC) data	ID = Claims made to ACC for dental injuries that occurred during sport. A new claim was defined as claims that were registered during any given year for which the entitlement was paid. SM = NR	n_p cricket related = 1,752 claims, based on an average of 438 claims / year	EM = NR Odds ratio claims per year: 1993: 1.00, 1994: 1.29, 1995: 1.14, 1996: 1.00 ($p = 0.389$)	Dental injuries	Dental injuries	NR	NR	-
Hill 1998 (140)	Oral and maxillofacial injuries from sport at A&E department of Cardiff Royal Infirmary, Wales, UK. Asses the aetiology and oral and maxillofacial service demand over a 12 month period of 1994.	n = 790 O/A Age range: 11-68 years Mean age = 21 years not specific to cricket M 695, F 85 not specific to cricket	Data collected from patients on standardised forms who had seen resident oral and maxillofacial surgical staff	ID = Maxillofacial injuries of both hard and soft tissue SM = NR	$n_p = n_i = 37$	EM = NR 4.7% of all sporting injuries*	NR	100% maxillofacial injuries	NR	NR	-

Table 14 *(cont).*

First author, Year [reference]	Setting / Context & Aims	Overall Participants (n), Age, Sex	Injury Data Collection Methods	Injury Definition, Severity Measure (SM)	Number of Injured people (n_p) or Injuries (n_i)	Exposure Measure (EM), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Mechanism of Injuries	Severity of Injuries	Other Information
Fong 1994 (149)	Eye injury patients presenting at Royal Victorian Eye and Ear Hospital over 2 years November 1989 to October 1991. Determine the magnitude and describe the spectrum of sports-related eye injuries and compare sporting profile variations within Australia and overseas. Provide recommendations to help decrease the frequency and severity of eye injuries	n = 700 O/A Age range 0-65+ years. Mean age = 26 years (SD 12 years) not specific to cricket M 84% F 16% not cricket specific	Patients completed a standardised questionnaire and clinical information documented by doctors	ID = eye injury patients SM = NR	$n_p = n_i = 100$ ~52 outdoor cricket ~48 indoor cricket	EM = Per 100,000 participants (over 15 yrs) Outdoor cricket: 44 per 100,000 participants (7.3% of all sports related eye injuries) Indoor cricket: 48 per 100,000 participants (6.7% of all sports related eye injuries)	Outdoor/Indoor Lid/conjunctival laceration: 20% / 12% Corneal abrasion: 8% / 7% Hyphaema: 60% / 71% Penetrating injury: 2% / 3% Retinal tear/detachment: 1% / 0% Orbital fracture: 4% / 2%	100% eye and periocular	NR	Outdoor / Indoor Injuries requiring surgery: 5 / 3	-
Lim 1993 (163)	Patients within the department of plastic and reconstructive surgery at the Royal Adelaide Hospital, South Australia, Australia. Review the extent of the problem, analyse the spectrum of facial fractures sustained in sports in South Australia from June 1989 to June 1992	n = 839 O/A, 137 sport related. Age range = 15-65 years 89.1% below 35 years not cricket specific 93.5% M 6.5% F not cricket specific	Standardised form was completed by patients on discharge and reviewed alongside any radiological studies	ID = Facial fracture SM = NR	n_p cricket related = 20	EM = NR 14.6% of all sports related facial fractures were cricket related*	Facial fractures	Mandible: 4 Zygoma: 12 Orbit: 3 Nose: 1	Hit by ball: 19 (95%)	NR	89.1% of all patients required surgery with average length of stay in hospital 4.7 days – not specific to cricket
Aburn 1990 (150)	Eye injuries treated at Wellington Hospital eye department. Review the frequency and type of ocular and periocular injuries due to indoor cricket related incidents from January 1987 to June 1989	n = 29 indoor cricket cases (Also noted 1 outdoor cricket presentation) 16-38 years Mean age 26.8 years M = 22, F = 7	Outpatient registers at the Wellington Hospital eye clinic	ID = Sports-related ocular and periocular injuries. SM = NR	$n_p = 29$ $n_i = 78$ (also 1 outdoor cricket injury)	EM = NR	Traumatic iritis: 19 Traumatic mydriasis: 12, Commotio retinae: 10, Blowout fracture: 8, Periorbital bruising: 8 Hyphaema: 6 Corneal abrasion: 4 Vitrous haemorrhage: 3, Subconjunctival haemorrhage: 3 Choroidal tear: 2 Others: 4	100% ocular or periocular	100% due to impact with cricket ball	2 cases suffered permanent loss of vision with best corrected vision in affected eye 6/9, but not considered severe	-

Table 14 (cont).

First author, Year [reference]	Setting / Context & Aims	Overall Participants (n), Age, Sex	Injury Data Collection Methods	Injury Definition (ID), Severity Measure (SM)	Number of Injured people (n_p) or Injuries (n_i)	Exposure Measure (EM), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Mechanism of Injuries	Severity of Injuries	Other Information
Sadlier 1990 (151)	Report the incidence of finger and thumb injuries in the fracture unit at Wellington Hospital, New Zealand and examine ACC claims for indoor cricket injuries in New Zealand between 1st April to 31st October 1987. Report the incidence of finger and thumb injuries in New Zealand and to examine the mechanism of the injuries and their consequences.	n = 33 cases from fracture clinic n = 520 cases from ACC Mean age 28.4 years Fracture clinic: M: 25 F: 8 No gender data on ACC	26 of 33 patients contacted about the mechanics of their injury. Outpatients were clinically assessed for ROM and alignment. 31 of 33 radiographs were analysed. ACC data were collected between April and October to minimise outdoor cricket injury overlap	ID = Finger or thumb fractures. (also collected data on sprain & strain from ACC data) SM = NR	ACC Data: n_p = 79 hand and thumb injuries n_i = 63 fractures or dislocations Fracture Clinic: n_p = n_i = 33	EM = NR	ACC Data: Fractures & dislocations: 63 of 79 finger & thumb injuries. Fracture Clinic: DIPJ: 19 – 9 anterior capsule avulsions, 4 mallet fingers, 3 posterior dislocations, 3 misc. fractures PIPJ: 6 – 4 anterior capsule avulsions, 2 misc. injuries MCPJ: 2 – 1 subluxation, 1 not specified Proximal & distal phalanx: 5 – all fractures	ACC Data: Face: 89 (17%) Fingers & thumb: 79 (15%) Knees: 106 (20%) Fracture Clinic: Little finger: 9 Thumb: 8 Index finger: 7 Ring finger: 6 Middle finger: 4 DIPJ: 19 PIPJ: 6 MCPJ: 2	Wicket-keeping: 12 (36.4%) Batting: 3 (9.1%) Fielding behind stumps (back-stumps): 3 (9.1%) Fielding (general): 8 (24.2%)	Fracture Clinic Data: 19 had no time off work, 10 claimed on ACC and averaged 3.4 weeks off work. 23 had an average time of 28 days off sport	Other injuries from ACC data: Sprain & strain: 88 of 106 knee injuries Facial injuries: 89
MacEwen 1987 (152)	Eye injuries occurring in sport that presented to the Glasgow Eye Infirmary and Western Infirmary Eye Casualty departments. Determine the incidence, mechanism and outcome of eye injuries associated with various sports in the West of Scotland over 18 months from 1 Jan 1985 to 30 Jun 1986	n = 246 O/A relating to sport. Age range = 6-66 years, mean 24.8 years not cricket specific 86.6% M 13.4% F not cricket specific	Retrospective analysis of casualty records for eye injuries occurring in sport	ID = Eye injuries associated with sport SM = non-specific, final corrected acuity	n_p cricket related = 6	EM = NR 2.4% of all sport related eye injuries were due to cricket.	Periorbital injuries: 5 Corneal abrasion: 1	100% eyes	Impact from ball: 5 Impact from bat: 1	NR	-
Gregory 1986 (153)	Sports related eye injuries presenting at Sussex eye hospital, England, UK, over 18 months from October 1982 to March 1984.	n = 92 O/A cases. Age range = 9 – 72 years, mean age = 28.5 years O/A (cricket 23 years) M: 69 O/A (4) F: 23 (1)	Data derived from hospital notes	ID = eye injuries presenting to Sussex Hospital SM = loss of acuity	n_p = n_i = 5	EM = NR Cricket related eye injuries represented 5.4% of all sports related presentations	NR	100% eye	100% struck by ball	Initial loss of acuity 1.20. None of the cricket related cases were admitted to hospital	-

Table 14 *(cont).*

First author, Year [reference]	Setting / Context & Aims	Overall Participants (n), Age, Sex	Injury Data Collection Methods	Injury Definition (ID), Severity Measure (SM)	Number of Injured people (n_p) or Injuries (n_i)	Exposure Measure (EM), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Mechanism of Injuries	Severity of Injuries	Other Information
Hill 1985 (154)	Patients seen in the department of oral and maxillofacial surgery at St. Luke's Hospital, Bradford, England, UK. Dental and facial injuries following sports accidents over five years – no dates stated.	n = 130 cases Age ranges: 0-9: 0 10-19: 8 20-29: 4 30-39: 6 40-45: 9 Gender NR	Patient's details, cause, nature and treatment recorded on specifically designed record cards	ID = dental and facial injuries - only injuries to hard tissue (bone and teeth) SM = NR	$n_p = n_i = 27$	EM = NR 20% of all sports-related cases*	100% facial fractures	Dental/alveoli: 5 Mandible: 7 Malar: 14 Maxilla: 1	Struck by the ball: 70% Struck by the bat: 15% Other including head clashes, falls and other unspecified: 15%	NR	-
Littlewood 1982 (164)	Consecutive hyphaemas admitted to Royal Perth Hospital, Perth, Australia. Retrospectively examine ocular hyphaemas admitted to Royal Perth Hospital and examine the cost effectiveness of current management from January 1979 to June 1981	n = 138 O/A, 65 sport related Age range = 13-92 years not cricket specific 86% M 14% F not cricket specific	Retrospective analysis of hospital data	ID = Hyphaema SM = Major ocular injury defined as any significant structural damage likely to result in short or long term vision loss	n_p cricket related = 9	EM = NR 7% of hyphaemas presenting due to cricket	Hyphaema 100% eye	NR	NR		-

ED = Emergency Department, HA = Hospital Admissions, M = Male, F = Female, NISU = National Injury Surveillance Unit, NR = Not Reported, ACC = Accident Compensation Corporation, ICD-10-AM = International Classification of Diseases, 10th Ed. Australian Modification, ICISS = International Classification Injury Severity Score, PPE = personal protective equipment, NZ = New Zealand, IIR = Injury Incidence Rate, CT = Computer Tomography, MRI = Magnetic Resonance Imaging.

3.4.1.2 Critical assessment and risk of bias

Overall, for MA injury studies, 51% (n = 20) were of a low likelihood of bias. Two studies had a high likelihood of bias (141, 151). The remaining 17 studies (44%) were unclear in their likelihood of bias. Overall, MA studies covered 63% of the critical appraisal items fully.

Tables 15 to 17 show the summary of critical assessment and likelihood of bias considerations for studies grouped as per medical attention injury in community cricket reporting:

Group 1: All injuries with at least one of injury nature, location and/or mechanism. Three (38%) of the studies in Group 1 had a low likelihood of bias. Studies in Group 1, had 64% of items fully addressed (Table 15).

Group 2: All injuries with numbers and rates only. Five (56%) of the studies in Group 2 had a low likelihood of bias. Studies in Group 2 were the best in terms of addressing the critical appraisal items, with 74% of items fully addressed overall (Table 16).

Group 3: Single injury type or body location respectively. Eleven (50%) of the studies within Group 3 had a low likelihood of bias. Studies in Group 3, that reported single injury nature and/or body location, were the least comprehensive, addressing only 51% of critical appraisal items fully (Table 17).

The major reasons why studies were given an unclear likelihood of bias was a lack of clarity around how the data were obtained, recorded or assessed (critical appraisal item 3) and a lack of reporting on any missing data and how this was addressed (critical appraisal item 4). Critical appraisal item 4 was the least comprehensively addressed item, averaging 18% fully addressed across all MA studies. Item 9, addressing ethical and funding aspects, was also found to have an overall low proportion of fully addressed responses (36%).

Table 15. *Critical assessment and likelihood of bias for studies of acute medical attention injuries in community level cricket reporting all injuries with at least one of injury nature, body region or mechanism reported (Group 1, n = 8).*

Study (First author & year)	Likelihood of bias[a]	**1.** Were the study aims and design described adequately & are they compatible?	**2.** Was the study setting, subjects, source, target population and size described adequately?	**3.** Was the method of data collection described adequately and did it seek to minimise information bias?	**4.** Has there been appropriate reporting of attrition of subjects or missing data?	**5.** Was there an injury definition and or injury severity measure/definition provided and were they suitable for the study design?	**6.** Were the injury outcomes and exposure measures reported in a standardised, justified and reasonable manner?	**7.** Were limitations to the study discussed adequately?	**8.** Is there a summary of key results, their potential generalisability and whether they and any conclusions match the aims and/or reflect the limitations of the study?	**9.** Does the study explain any ethics requirements, author conflicts of interest and or funding arrangements?
Perera 2019 (86)	Low	Yes	Yes	Yes	Yes	Yes	Partial	Yes	Yes	Yes
Finch 1998 (139)	Low	Yes	Yes	Yes	Partial	Partial	Yes	Yes	Yes	Partial
Walker 2010 (129)	Low	Yes	Yes	Yes	Partial	Yes	Yes	Yes	Yes	Yes
Schneuer 2018 (156)	Unclear[1]	Yes	Yes	Partial	Partial	Yes	Yes	Yes	Yes	Yes
King 2018 (104)	Unclear[2]	Yes	Yes	Partial	Partial	Yes	Yes	Yes	Yes	Yes
Upadhyay 2000 (138)	Unclear[3]	Yes	Partial	Yes	Partial	Yes	Yes	No	Yes	No
Forward 1988 (141)	High[4]	Partial	Partial	Partial	Partial	Partial	Yes	No	Partial	No
Crompton 1977 (144)	Unclear[5]	Yes	Yes	Partial	Partial	Partial	Yes	No	Yes	No
Proportion of yes answers		88%	75%	50%	13%	63%	88%	63%	88%	50%

Questions 2, 3 and 4 (shaded) represent items used to determine likelihood of bias.

Notes on Likelihood of bias:

[1] Unclear whether they were trying to remove all non-organised cases.

[2] Overall number of cricket-related cases not reported. There was no clear information on how missing information (if any) was dealt with.

[3] Unclear on how subjects were recruited. Unclear how the data were collected, i.e. how often. There was no clear information on how missing information (if any) was dealt with.

[4] Unclear when the six month timeframe took place. Unclear how indoor cricket data were identified within hospital data. There was no clear information on how missing information (if any) was dealt with.

[5] Unclear how data were identified from records.

__Table 16.__ Critical assessment and likelihood of bias for studies of acute medical attention injuries in community level cricket reporting all injuries with only number of injuries and/or injury rates reported (Group 2, n = 9).

Study (First author & year)	Likelihood of bias[a]	**1.** Were the study aims and design described adequately & are they compatible?	**2.** Was the study setting, subjects, source, target population and size described adequately?	**3.** Was the method of data collection described adequately and did it seek to minimise information bias?	**4.** Has there been appropriate reporting of attrition of subjects or missing data?	**5.** Was there an injury definition and or injury severity measure/definition provided and were they suitable for the study design?	**6.** Were the injury outcomes and exposure measures reported in a standardised, justified and reasonable manner?	**7.** Were limitations to the study discussed adequately?	**8.** Is there a summary of key results, their potential generalisability and whether they and any conclusions match the aims and/or reflect the limitations of the study?	**9.** Does the study explain any ethics requirements, author conflicts of interest and or funding arrangements?
Fernando 2018 (136)	Low	Yes	Yes	Yes	Partial	Yes	Yes	Yes	Yes	Yes
Cassell 2003 (137)	Low	Yes	Yes	Yes	Partial	Yes	Partial	Yes	Yes	Partial
Finch 2002 (168)	Low	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mummery 2002 (166)	Unclear[1]	Yes	Yes	Partial	Yes	Yes	Yes	Yes	Yes	Yes
Jago 1998 (165)	Unclear[2]	Yes	Partial	Partial	Yes	Partial	Yes	Yes	Yes	Yes
Nicholl 1995 (167)	Low	Yes	Yes	Partial	Yes	Yes	Yes	Yes	Yes	Partial
Hume 1994 (162)	Low	Yes	Yes	Yes	Partial	Yes	Yes	Yes	Yes	Partial
Rowell 1988 (142)	Unclear[3]	Yes	Yes	Partial	Partial	Partial	Yes	Partial	Yes	Partial
Watters 1984 (143)	Unclear[4]	Yes	Yes	Partial	Partial	Partial	Yes	Yes	Yes	No
Proportion of yes answers		100%	89%	44%	44%	67%	89%	89%	100%	44%

Questions 2, 3 and 4 (shaded) represent items used to determine likelihood of bias.

Notes on Likelihood of bias:

[1] Questionnaire piloted but not validated and 12 month recall required by interviewees.

[2] Unclear how eligibility was determined (i.e. who determined it). Questionnaire not validated and query on GP training in sports medicine diagnosis.

[3] Unclear on method of data collection from sports injury clinic.

[4] Unclear how injury forms were collected. No reporting on missing information (if any).

Table 17. Critical assessment and likelihood of bias in studies of acute medical attention injuries in community level cricket where only a single injury nature or injured body region/part is reported (Group 3, n = 22).

Study (First author & year)	Likelihood of bias[a]	**1.** Were the study aims and design described adequately & are they compatible?	**2.** Was the study setting, subjects, source, target population and size described adequately?	**3.** Was the method of data collection described adequately and did it seek to minimise information bias?	**4.** Has there been appropriate reporting of attrition of subjects or missing data?	**5.** Was there an injury definition and or injury severity measure/definition provided and were they suitable for the study design?	**6.** Were the injury outcomes and exposure measures reported in a standardised, justified and reasonable manner?	**7.** Were limitations to the study discussed adequately?	**8.** Is there a summary of key results, their potential generalisability and whether they and any conclusions match the aims and/or reflect the limitations of the study?	**9.** Does the study explain any ethics requirements, author conflicts of interest and or funding arrangements?
Wang 2019 (155)	Unclear[1]	Yes	Partial	Partial	Partial	Yes	Yes	Partial	Yes	Partial
Brukner 2018 (3)	Low	Yes	Yes	Partial	Partial	Yes	Yes	Yes	Yes	Yes
Andrabi 2017 (145)	Unclear[2]	Partial	Partial	Partial	Partial	Partial	Yes	No	Partial	No
Lock 2017 (157)	Low	Yes	Yes	Partial	Partial	Partial	Yes	Partial	Yes	Yes
Russell 2014 (146)	Unclear[3]	Yes	Partial	Partial	Partial	Partial	Yes	No	Yes	Yes
Finch 2013 (169)	Low	Yes	Yes	Yes	Partial	Yes	Yes	Yes	Yes	Yes
Lee 2012 (147)	Low	Yes	Yes	Yes	Partial	Yes	Yes	No	Yes	No
Welch 2010 (99)	Low	Yes	Yes	Yes	Partial	Partial	Yes	Yes	Yes	No
Antoun 2008 (148)	Low	Yes	Yes	Yes	Partial	Partial	Yes	Partial	Yes	No
Driscoll 2008 (159)	Low	Yes	Yes	Yes	Partial	Partial	Yes	Yes	Yes	No
Finch 2008 (160)	Low	Yes	Yes	Yes	Partial	Yes	Yes	Yes	Yes	Partial
Maladiere 2001 (161)	Unclear[4]	Yes	Yes	Partial	Partial	Partial	Yes	No	Yes	No
Love 1998 (102)	Unclear[5]	Yes	Yes	Yes	Partial	Partial	Partial	Yes	Partial	No
Hill 1998 (140)	Low	Yes	Yes	Yes	Partial	Yes	Yes	No	Yes	No
Fong 1994 (149)	Low	Yes	Yes	Yes	Partial	Yes	Partial	No	Yes	Partial
Lim 1993 (163)	Low	Yes	Yes	Yes	Partial	Partial	Yes	No	Yes	No

Study (First author & year)	Likelihood of bias[a]	**1.** Were the study aims and design described adequately & are they compatible?	**2.** Was the study setting, subjects, source, target population and size described adequately?	**3.** Was the method of data collection described adequately and did it seek to minimise information bias?	**4.** Has there been appropriate reporting of attrition of subjects or missing data?	**5.** Was there an injury definition and or injury severity measure/definition provided and were they suitable for the study design?	**6.** Were the injury outcomes and exposure measures reported in a standardised, justified and reasonable manner?	**7.** Were limitations to the study discussed adequately?	**8.** Is there a summary of key results, their potential generalisability and whether they and any conclusions match the aims and/or reflect the limitations of the study?	**9.** Does the study explain any ethics requirements, author conflicts of interest and or funding arrangements?
Aburn 1990 (150)	Unclear[6]	Yes	Partial	Partial	Partial	Partial	Yes	Partial	No	No
Sadlier 1990 (151)	High[7]	Partial	Partial	Partial	Partial	Partial	Yes	No	Partial	No
MacEwen 1987 (152)	Unclear[8]	Yes	Partial	Partial	Partial	Partial	Yes	No	Yes	No
Gregory 1986 (153)	Unclear[9]	Yes	Partial	Partial	Partial	Partial	Yes	No	Partial	No
Hill 1985 (154)	Unclear[10]	Partial	Partial	Partial	Partial	Partial	Partial	Partial	Partial	No
Littlewood 1982 (164)	Unclear[11]	Partial	Partial	Partial	Partial	Partial	Yes	Partial	No	No
Proportion of yes answers		82%	59%	45%	0%	32%	86%	73%	68%	18%

Questions 2, 3 and 4 (shaded) represent items used to determine likelihood of bias.

Notes on Likelihood of bias:

[1] Overall number of sport-related cases not reported. Limited information on source of injury information. There was no clear information on how missing information (if any) was dealt with.

[2] Overall number of cases not reported. Unclear how the prospective data were collected. There was no clear information on how missing information (if any) was dealt with.

[3] Overall sport-related cases not reported, or all cricket-related injuries. Limited detail on how data were extracted. There was no clear information on how missing information (if any) was dealt with.

[4] Unclear how data were identified from records. There was no clear information on how missing information (if any) was dealt with.

[5] Indoor and outdoor cricket not coded separately in early years so combined for whole study. There was no clear information on how missing information (if any) was dealt with.

[6] Overall number of sport-related cases not reported. Limited information on source of injury information. There was no clear information on how missing information (if any) was dealt with.

[7] Data limitations ignored and attempted to isolate indoor cricket cases by selecting off-season months. Numbers of follow up included but there was no clear information on how missing information (if any) was dealt with.

[8] Overall number of presentations not reported. Unclear how data were collected/extracted. There was no clear information on how missing information (if any) was dealt with.

[9] Overall number of presentations not reported. Unclear how data were collected/extracted. There was no clear information on how missing information (if any) was dealt with.

[10] Setting not clearly outlined and unclear recruitment procedures. Unclear on data collection procedure. There was no clear information on how missing information (if any) was dealt with.

[11] Overall number or cases not reported. Unclear how data were collected/extracted. Large number (> 20%) lost to follow up.

3.4.1.3 Injury rates

Seven (19%) of the MA injury studies presented information on injury incidence rates (IIR) (Table 18). All the studies used hospital data when calculating the IIR. Five of the studies were from Australia (86, 136, 149, 159, 169) and two from NZ (129, 162). Four of the studies looked at all injuries (86, 129, 136, 162) and three looked at a single injury type (149, 159, 169).

Table 18. *Injury incidence rates reported by studies looking at MA injury.*

Study	n participants	n injuries	Study Design	Injury Case Definition	Exposure	Injury Incidence Rate for Cricket-Related Cases
Perera 2019 (86)	668 cases overall	121 admissions, 547 ED presentations	Retrospective analysis of hospital data	ED presentation or HA with activity code U51.1 cricket.	Per 1,000 female participants	Overall 1.9 per 1,000 participants 1.5 per 1,000 participants for ED presentations 0.3 per 1,000 participants for hospital admissions
Fernando 2018 (136)	171, 542 sports and active recreation cases	4535	Retrospective analysis of hospital data	Sports and active recreation-related injuries	Annual injury rate, per 100,000 population (≥ 15 years) Injury rate per 100,000 participants (≥ 15 years)	24.9 injuries per 100,000 population 1,237 injuries per 100,000 participants
Finch 2013 (158)	4,745 sports-related cases	51	Retrospective analysis of hospital data	ICD-10AM principle diagnosis of injury S00-T98, concussion S06.00 – S06.05, unintentional external cause V00 – X59 & activity code U50-U71	Per 100,000 participants	Mean rate over 9 years = 3.0 concussions per 100,000 participants
Walker 2010 [a] (129)	498 cases	498	Retrospective analysis of hospital data	ICD-10AM-3 codes for hospitalised cases for at least one night including bystanders.	Per 100,000 people per year Per 100,000 participants per year	2.3 hospitalisations per 100,000 people per year 39 hospitalisations per 100,000 participants per year
Driscoll 2008 l(159)	148 sports-related cases	16	Heat related hospitalisations	ICD-10AM codes with external cause codes X30 or X92 and diagnosis codes T67	Per 1,000,000 per year excluding < 15 years old using population survey data	10 per 1,000,000 / year (95% CI 5.5 – 16.9) for ≥ 15 years of age
Fong 1994[a] (149)	700 sports-related cases	100 (52 outdoor, 48 indoor cricket)	Eye injuries reporting to eye & ear hospital	Eye injuries due to sport	Per 100,000 participants over 15 years old using population data	Outdoor cricket: 44 per 100,000 participants, Indoor cricket: 48 per 100,000 participants
Hume 1994 (162)	Sport-related: mortality = 70 Hospital = 4,374 A&E = 3,680 ACC = 26,638 DSIC = 620	Mortality = 0, Hospital =233, A&E = 197, ACC = 1102, DSIC = 0	Mortality data, hospitalisations, Accident Emergency, insurance claims data and Sports medicine clinic presentations	NR	Hospitalised injuries per 100,000 participants per year	99.36 hospitalisations per 100,000 participants per year

HA = Hospital Admissions, ED = Emergency Department presentations, ICD-10AM = International Classification of Diseases version 10 Australian Modification, A&E = Accident and Emergency, ACC = Accident Compensation Corporation, DSIC = Dunedin Sports Injury Clinic

3.4.1.4 Injury prevalence

Cricket, as a proportion of sports-related injury cases within MA injury studies, varied from 1.2% to 6.4%, with the minimum and maximum values occurring in ED presentation data studies (Table 19). Insurance claims (5.0% to 5.3%) and general practitioner (GP) (5.1% to 5.5%) data studies had similar proportions of cricket-related claims/cases and the proportion of cricket-related injury presenting to sports medicine clinics varied from 1.2% to 3.8%. One study reported cricket-related hospitalisations (admissions), nationally for NZ, at 5.1% of sports-related cases (162).

Table 19. *Cricket-related injury proportion of all sports-related injury.*

Study	Overall Cases	Sports-Related Cases	Cricket Related Cases	Cricket as a proportion of overall cases / claims	Cricket as proportion of sports-related cases / claims
Hospital Admission Data					
Schneuer 2018[1] (156)	NR	20,034	463	-	2.3%
Hospital ED[2] Data					
Fernando 2018 (136)	1,036,978	171,541	4,535	0.4%	2.6%
Cassell 2003 (137)	NR	1,179	75	-	6.4%
Finch 1998 (139)	516,221	98,140	5,133	1.0%	5.2%
Hume 1994 (162)	24,533	3,680	197	0.8%	5.1%
Watters 1984 (143)	58,539	2,770	33	0.1%	1.2%
Crompton 1975 (144)	40,169	2,806	171	0.4%	6.1%
Insurance Claims Data					
King 2018[3] (104)	853,324	61,400	3,087	0.4%	5.0%
Hume 1994 (162)	156,694	26,638	1,102	0.7%	4.1%
GP[4] Data					
Cassell 2003 (137)	NR	1003	55	-	5.5%
Jago 1998 (170)	867	78	4	9.0%	5.1%
Sports Medicine Clinics					
Finch 2002 (168)	8,161	8,161	NR	3.4 – 3.8%[5]	3.4 – 3.8%[5]
Hume 1994 (162)	620	620	0	-	-
Rowell 1988 (142)	324	324	4	1.2%	1.2%

NR = Not Reported, [1] Children aged 5 to 15 years only, [2] = Emergency Department presentation only (not hospitalisation), [3] = data for 5 sports only (rugby union, rugby league, football, netball and cricket), [4] = General Practitioner, [5] = varied over two years (year 1: 3.8% of n = 6464, year 2: 3.4% of n = 1242)

Three studies reporting on MA injury presented age group proportions (Table 20). The proportions of injuries in females presenting to ED was similar to that of both male and female combined for the majority of age groups, with proportions slightly higher in the 5 to 14 years old age group (25.2% vs 22%) and lower in the 45 + years age group (6.9% vs 11%) for females. The proportion of 5 to 14 year olds (3.4%) claiming insurance in NZ for cricket-related injury was lower than for the ED presentations (22%) in Victoria, Australia, and much higher for the 25 to 44 years old (56.3% vs 40%) and 45+ years age (16.7% vs 11%) groups.

Table 20. *Age group proportions for MA injury studies.*

	All players			By Age Group (years)								
Study	**n sports related cases/ claims**	**n_c cricket related**	**n_c / n**	**5-9**	**10-14**	**15-19**	**20-24**	**25-29**	**30-34**	**35-39**	**40-44**	**≥ 45**
Perera 2019 (86)	HA: 121	121	100%	7.4%	16.5%	7.4%	19.0%	9.9%	10.7%	6.6%	5.8%	8.3%
	ED: 547	547	100%	5.3%	19.9%	15.7%	10.1%	13.3%	9.5%	8.2%	9.0%	6.9%
Schneuer 2018 (156)	HA 20,034	463	2.3%	463[1]								
Fernando 2018 (136)	ED: 171,541	4,535	2.6%	22%[2]		27%[3]		40%[4]				11%
King 2018 (104)	61,400[5]	3,087	5.0%	0.71%	2.7%	7.8%	16.5%	18.6%	15.4%	11.4%	10.9%	16.7%

n_c = number of cricket-related cases/claims, HA = Hospital Admissions, ED = Emergency Department presentations, [1] 5 to 8 years = 58, 9 to 12 years = 128, 13 to 15 years = 277, [2] = for ages 5 – 14 years, [3] = for ages 15 – 24 years, [4] = for ages 25 – 44 years, [5] = insurance claims from 5 sports

3.4.1.5 Injury nature

Table 21 shows the injury natures reported for MA cricket-related injury. Fractures, dislocation, strain and sprain and bruising were the most commonly associated injury types where studies looked at all injuries. Fractures were typically more common in hospital admissions than ED presentations, except in one NZ study that looked at a narrow age band of children (9 to 13 years old) which reported 43% fractures in ED (138). Sprain and strain and/or dislocations were more common in ED presentations than fractures, except in under 15 year olds in an Australian national ED presentation study (139).

Insurance claims data reported soft tissue injuries as being proportionally more than twice as common as fractures and dislocations (104). The majority of reported hand injuries were fractures, followed by avulsions/dislocations and sprains (146). Fractures were more common, proportionally, in outdoor cricket-related eye injury cases than those associated with indoor cricket (149).

Table 22 shows the proportions of specific cricket-related injury types/natures where cricket was only one of the sports reported on. For eye injuries the proportion of cricket-related injuries varied from 2.4% to 14.3% of all sports-related eye injuries. Facial fractures varied from 0.7% to 20.8% and dental injury varied from 4.6% to 9.0%.

One study reported on head and orofacial injury to schoolboy cricketers in England and Australia and found that the majority of these injuries occurred to the head (48.7%) and face (44.6%) and 6.7% to the dental region (170).

Table 21. *Injury nature for medically attended injury studies.*

Study	n injuries / cases or claims	Age range	Concussion / closed head, intracranial injury or seizure	Superficial injury	Eye injury	Fracture	Avulsion / dislocation	Injury to muscle & tendon or rupture / tear	Internal organ injury	Open wound / laceration	Sprain	Strain	Bruising	Overuse	Inflammation [1, 2]	Abrasion, friction burn	Other [3] / NR
Perera 2019 (86)	HA: 121	5 - 45+ years	-	5.0%	-	47.1%	[11]	6.6%	-	-	18.2% [11]		-	-	-	-	23.1%
	ED: 547	5 - 45+ years	1.6%	14.6%	2.9%	17.2%	[11]	6.9%	-	8.4%	36.4% [11]		-	-	-	-	11.9%
Schneuer 2018 (156)	HA: 463	5 – 15 years	11.8%	8.4%	4.6%	54.2%	7.7%	2.0%	1.0%	18.0%	-	-	-	-	-	-	1.4% [15]
King 2018 (104)	3087 [4]	0 - 85 years	1.7%	-	-	30.9% [14]	-	-	-	1.9%	64.1% [12]		-	0.5%	-	-	0.9%
Russell 2014 (146)	28 [5, 6]	-	-	-	-	71.4%	28.6%	-	-	-	-	-	-	-	-	-	-
Finch 2013 (169)	HA: 51 [6]	-	100%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lee 2012 (147)	40 [6]	-	-	-	-	100%	-	-	-	-	-	-	-	-	-	-	-
Walker 2010 (129)	HA: 498	2 - 80 years	5.0% [j]	-	-	43.8%	6.2%	3.6%	-	2.4%	-	15.2%	5.4%	-	-	-	18.1%
Upahdyay 2000 (138)	ED: 60	9 – 13 years	13.3%	-	-	43.3%	-	-	13.3%	-	-	-	-	-	-	-	30.1%
Finch 1998 (139)	ED: 2,345	< 15 years	-	-	-	17.8%	-	-	-	17.8%	12.0% [13]		30.2%	-	7.5%	2.9%	11.4%
	ED: 3,846	≥ 15 years	-	-	-	20.7%	-	-	-	11.8%	26.0% [13]		19.6%	-	10.6%	1.2%	11.5%
Fong 1994 (149)	52 [6, 7]	-	-	-	96.2%	3.8%	-	-	-	-	-	-	-	-	-	-	-
	48 [6, 8]	-	-	-	97.9%	2.1%	-	-	-	-	-	-	-	-	-	-	-
Aburn 1990 (150)	78 [6, 8]	-	-	-	79.5%	10.3%	-	-	-	-	-	-	10.3%	-	-	-	-
Forward 1988 (141)	ED: 65 [8]	19 – 34 years	1.5%	-	9.2%	33.8% [7]	10.8%	-	-	6.2%	15.4%	-	6.2%	-	-	6.2%	10.7%

HA = Hospital Admissions, ED = Emergency Department presentations, [1] = includes pain, swelling and apophysitis, [2] = includes non-specific musculoskeletal pain, trigger points, lower back or other joint pain, [3] = all other injury either not specified or unknown, [4] = insurance claims data, , [5] = hand injuries only, [6] = hospital clinic/surgery cases, [7] = outdoor cricket , [8] = indoor cricket, [9] = includes 3 ribs (4.6%) labelled bruised or fractured, [10] = 2.2% seizures, [11] = dislocation, sprain and strain were combined, [12] = category 'soft tissue injury', [13] = sprain or strain, [14] = fracture and dislocation combined, [15] = dental 1.4%

Table 22. Studies reporting specific injury nature for medical attention injuries

Study	Overall cases / participants	Sports-related cases	Cricket related cases	Cricket as a proportion of overall cases / claims	Cricket as proportion of sports-related cases / claims
Head injury					
Jagger 2009 [5] (170)	411	269	131	31.9%	48.7%
Eye Injury					
Lock 2017 (157)	438	65	3	0.7%	4.6%
Fong 1994 (149)	NR	700	100[1]	-	14.3%[1]
Aburn 1990 (150)	NR	29	29	-	-
MacEwen 1987 (152)	NR	246	6	-	2.4%
Gregory 1986 (153)	NR	92	5	-	5.4%
Littlewood 1982 (164)	138	65	9	6.5%	13.8%
Facial fractures					
Lee 2012 [3, 4] (147)	NR	561	40	-	7.1%
Antoun 2008 (148)	2582	561	40	1.5%	7.1%
Jagger 2009 [5] (170)	411	269	120	29.2%	44.6%
Maladiere 2001 (161)	NR	140	1	-	0.7%
Hill 1998 (140)	-	790	37	-	4.7%
Lim 1993 (163)	839	137	20	2.4%	14.6%
Hill 1985 (154)	-	130	27	-	20.8%
Dental injury					
Welch 2010 (99)	275,130 claims	62,179	2,860	1.0%	4.6%[2]
Jagger 2009 [5] (170)	411	269	18	4.4%	6.7%
Love 1998 (102)	19,445 claims	19,445	1,752	-	9.0%
Heat Illness					
Driscoll 2008 (159)	1315	148	16	1.2%	10.8%
Finch 2008 (160)	950	109	8	0.8%	7.3%

[1] = 52 outdoor cricket injuries (7.6%), 48 indoor cricket injuries (6.7%), [2] = yearly mean of 4.6% claims per year over 10 years, [3] = cricket specific study, [4] = study replicates cricket specific results from earlier study Antoun et al (148), [5] = cricket specific study looking at orofacial and head injuries, NR = Not Reported

3.4.1.6 Injured body part

Table 23 shows the studies reporting proportion of injuries by broad body locations for medical attention injuries. Where fatalities were concerned, nearly half (47%) were due to head/neck/face injuries (3). For injuries presenting to ED, the upper limb was typically the most common body region injured, with proportions ranging from 30% to 47%, followed by lower limb injuries, ranging from 16% to 28%. The exception to this was in one study looking at ED presentations in Australia for children aged under 15 years, where head/face/neck injuries were more common (139). Where insurance claims were used, the upper and lower limb injuries were proportionally equal and the head/neck/face injuries were much less common proportionally than in hospital cases (104). The one study that looked specifically at indoor cricket injuries, reported higher proportions of upper limb injuries than other studies where outdoor and indoor cricket were not differentiated (141).

Table 23. *Studies reporting proportions of injured body locations by broad regions for MA injuries (n = 8).*

Study	n injuries, cases or claims	Head/Face/Neck	Upper Limb	Trunk/Back	Lower Limb	Unspecified
Perera 2019 (86)						
	HA: 121	28%	34%	-	28%	10%
	ED: 547	28%	39%	1%	26%	6%
Schneuer 2018 (156)	HA: 463	37%	43%	4%	13%	3%
Brukner 2018 (3)	83 [1]	47%	1%	19%	-	33%
King 2018 (104)	3,087 [2]	7%	35%	2%	46%	10%
Walker 2010 (129)	HA: 498	23%	36%	3%	31%	7%
Upadhyay 2000 (138)	ED: 60	27%	30%	13%	-	30%
Finch 1998 (139)						
Ages < 15 years	ED: 2,345	44%	34%	3%	16%	11%
Ages ≥15 years	ED: 3,846	17%	33%	4%	23%	12%
Forward 1988 (141)	ED: 64 [3]	22%	46%	5%	28%	-

HA = Hospital Admissions, ED = Emergency Department presentations, [1] = fatalities in organised cricket, [2] = insurance claims data, [3] = indoor cricket injures,

3.4.1.7 Injury activity, setting and mechanism

Four studies presented information on the cricket activity when injured (Table 24), however, two of those were specific to hand and/or finger injuries only (146, 151). Two of the studies were also specific to indoor cricket (141, 151). Fielding was the most common activity when injured for indoor cricket and for hand/finger injuries. Where fatalities were the outcome, batting was reported as being the most common activity associated with the injury event, followed by fielding (3).

Table 24. *Studies reporting cricket activity at onset of MA injury (n = 4).*

Study	n injuries, cases or claims	Bowling	Batting	Fielding	Other / NR
Brukner 2018 (3)	83[1]	1.2%	54.2%	20.5% (7.2%)[5]	24.1%
Forward 1988 (141)	64[2]	-	17.0%	72.0% (10.1%)[5]	-
Russell 1988 (146)	28[3]	-	7.1%	89.3% (10.7%)[5]	3.6%
Sadlier 1990 (151)	33[4]	-	9.1%	69.7% (36.7%)[5]	21.2%

[1] = fatalities in organised cricket, [2] = indoor cricket injures, [3] = hand injuries only in outdoor cricket, [4] = indoor cricket finger and thumb fractures, [5] = values in parentheses are proportion of fielding injuries occurring to wicket-keepers

Table 25 shows the mechanism of injury reported in medical attention injury studies. The most common mechanism of injury was typically being struck by the ball. Where all injuries were reported, falls were typically the second most common injury mechanism, followed by non-specific overexertion.

Table 25. Studies reporting mechanism of MA injury.

Study	n injuries, cases or claims	Struck by Ball	Struck by Bat or Equipment	Non-specific Overexertion	Non-specific Overuse	Non-specific Falls	Player collision	Other / NR
Perera 2019 (86)	HA: 121	44.7% [1]		12.4%	-	27.3%	-	17.1%
	ED: 547	63.8% [1]		-	-	19.0%	-	12.4%
Brukner 2018 (3)	83 [2]	73.5%	1.2%	-	-	-	6.0%	19.3%
Russell 2014 (146)	28 [3, 4]	100%		-	-	-	-	-
Lee 2012 (147)	40 [3]	55.0%	2.5%	-	-	-	5.0%	42.5%
Walker 2010 (129)	HA: 498	31.4%	7.2%	-	22.3%	23.6%	7.4%	10.7%
Upahdyay 2000 (138)	ED: 60	51.7%	23.3%	-	-	20.0%	5.0%	-
Finch 1998 (139)	ED: 6,191	27.0% [1]		-	-	-	-	-
Aburn 1990 (150)	78 [3, 5]	100% [1]		-	-	-	-	-
Forward 1989 (141)	ED: 64 [5]	98.4%	1.6%	-	-	-	-	-
Hill 1985 (154)	27 [3]	70.4%	14.8%	-	-	14.8%	-	-

HA = Hospital Admissions, ED = Emergency Department presentations, NR = Not Reported, [1] = struck by ball, bat or equipment combined, [2] = fatalities, [3] = hospital clinic/surgery cases, [4] = hand injuries only, [5] = indoor cricket

3.4.1.8 Injury severity

Few studies reported specifically on injury severity for medical attention injuries and as such the information is presented within the text only. Brukner et al (3) reported 83 cricket-related fatalities over a 152 year timeframe in Australia, five of which were in the last 30 years.

Most recently, Perera et al (86) reported that for female cricket-related injuries that required hospitalisation, 78.5% required less than 2 days bed stay and 21.5% required two or more days bed stay. A study of sports-related injuries in NSW, Australia, reported all the cricket-related cases (n = 463) as severe (requiring either three or more bed days stay, admission to intensive care unit, mechanical ventilation or blood transfusion) (156). For ED presentations at a national level in Australia from 1989 to 1993, 8.2% of the under 15 year olds and 6.4% of the 15+ year olds were subsequently admitted to hospital (139). In Auckland, NZ, between 1993 and 1999, there were two injuries considered severe and 32% of 9 to 13 year olds required surgical procedures. The mean range of bed stays for the children was 1.0 to 2.5 days (138). Throughout NZ, from 2000 to 2005, 4% (n = 20) of hospitalisations due to cricket-related injury were classified as serious non-fatal according to the International Classification Injury Severity Score (ICISS), with over half of those (n = 11) due to being struck by the ball or bat (129).

Forward (141) reported that of the indoor cricket injuries presenting to Royal Perth Hospital, in Australia, 19% required no time off work, 19% each required less than one week off work or between one week and one month off work, 11% needed greater than one month off work and 32% of cases were unknown. Fong (149) reported that of the 22 (3.1%) sports-related eye injuries that required major surgery, cricket accounted for seven (32%) of those and five of those occurred in outdoor cricket.

King et al (104) reported that of the successful insurance claims, 92.8% resolved without further medical assistance beyond the initial session that generated the claim for all sports combined. Cricket had 0.4% of successful claims deemed to be serious, where serious claims are those requiring extended medical and income support.

3.4.2 Prospective injury studies

3.4.2.1 Study characteristics

Table 26 shows the study characteristics of the 15 studies reporting on injury, prospectively collected. Seven of the studies were from Australia (46, 51, 171-175), six from South Africa (176-181), and one each from Sri-Lanka (182) and Nigeria (183). Eight of the studies (53%) investigated only pace bowler cohorts (51, 173, 175, 177-181). Twelve (80%) of the studies reported on males only, two studies did not specify sex distributions (46, 172) and only one study noted female injury numbers (174).

Eight (53%) of the studies used self-reported questionnaires to collect injury data, four studies used primary data collectors, two used medical staff and one used a proxy with physiotherapist follow up. The majority of studies used medical attention and/or match time loss as their injury definition (n =12, 80%), two studies were specific to lower back injuries in bowling cohorts and one study reported any acute injury.

Table 26. *Study characteristics of studies that used prospective on-field injury data collection methods (n = 15).*

First Author, Year and Reference	Setting / Context & Aims	Overall Participants (n), Age & Sex	Injury Data Collection Methods	Injury Definition (ID) & Severity Measure (SM)	Number of Injured participants (n_p) & Injuries (n_i)	Injury Incidence Rate (IIR), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Specific cricket activity at Injury Onset	Mechanism of Injuries	Severity of Injuries	Other Information
Gamage 2019 (182)	To conduct a longitudinal prospective in-season injury data collection on Sri-Lankan U15 & U17 school-boy cricketers in the national division 1 tournament from May – September 2016	59 teams (34 U15, 25 U17) 573 participants overall: 347 U15 players 226 U17 players 100% male	Surveys were sent to teachers in charge of cricket teams. Consenting players completed injury survey after each match and returned surveys at seasons end.	Injury descriptions taken from a validated survey tool – Juniors Enjoying Cricket Survey. SM = MTL, Non-MTL	n_p = 404 n_i = 744	IIR = per 100 match days played (MDP) Overall IIR = 28 per 100 MDP (95% CI 26.0 - 30.2) 70.5% of participants received at least one injury.	Batting: bruises n = 60, (32.3%); not sure n = 21, (11.3%), strain n = 19, (10.2%); sprain n = 17, (9.1%), abrasion n = 16, (8.6%); Bowling: strain n = 44, (30.6%), sprain n = 25, (17.4%), joint injury n = 17, (11.8%), bruise n = 10, (6.9%), not sure n = 10, (6.9%); Fielding: abrasions n = 112, (34%), bruises n = 55, (16.7%), strain n = 34, (10.2%), joint injury n = 27, (8.2%), sprain n = 24, (7.3%); Wicket Keeping: abrasions n = 11, (21.6%), bruises n = 9, (17.6%), strain n = 8, (15.7%), ongoing injury n = 7, (13.7%), joint injury n = 5, (9.8%)	Batting: thigh n = 21, (11.4%), hand n = 18, (9.7%) knee n = 14, (9.7%), Lower back n = 13, 7%, head/scalp n = 11, (5.9%), neck n = 11, (5.9%); Bowling: Lower back n = 21, (14.4%), knee n = 17, (11.6%), thigh n = 17, (11.6%), shoulder n = 16, (11%), lower leg n = 16, (11%), ankle n =15, (10.3%); Fielding: knee n = 56, (16.8%), hand n = 48, (14.4%), elbow n = 42, (12.6%), lower leg n = 22, (6.6%), shoulder n = 19, (5.7%), thigh n = 17, (5.1%); Wicket Keeping: Lower back n = 10, (18.5%), hand n =9, (16.7%), knee n = 6, (11.1%), thigh n = 4, (7.4%), elbow n = 3, (5.6%), face n = 3, (5.6%)	Fielding n = 324, (46%) Batting n = 179, (25.4%) Bowling n = 143, (20.3%) Wicket Keeping n = 53, (8.3%)	Batting: struck by ball n = 93, (51.4%), overexertion n = 21, (11.6%), other n = 16, (8.8%), overuse n = 11, (6.1%); Bowling: overexertion n = 44, (31.4%), other n = 19, (13.6%), slip/trip n = 15, (10.7%), change of direction n = 15, (10.7%); Fielding: dive for catch n = 119, (36.1%), struck by ball n = 59, (17.9%), mishandling ball n = 47, (14.2%), slip/trip n = 24, (7.3%); Wicket Keeping: struck by ball n = 15, (28.3%), dive for catch n = 11, (20.8%), overexertion n = 10, (18.9%), mishandling ball n = 6, (11.3%)	MTL injuries: Batting n = 40, (26.1%), Bowling n = 42, (27.5%), Fielding n = 61, (39.9%), Wicket Keeping n = 9, (5.9%), Other n = 1, (0.6%); Non-MTL: Batting n = 139, (25.2%), Bowling n = 101, (18.3%), Fielding n = 263, (47.7%), Wicket Keeping n = 44, (8.0%), Other n = 4, (0.7%)	Top MTL injuries by specific location and diagnosis (most common activity associated, n): Hand and wrist bone injury (fractures) MTL = 92.9% (fielding n = 10) Facial organ injuries MTL n = 8, 61.1%, Head injury (concussion, nerve) MTL = 42.9%, (batting n =8) Ankle ligament sprain MTL = 42.1% (fielding n = 8) Thigh muscle/tendon strains MTL = 40.7%, (bowling n = 11) Lower leg muscle/tendon strain MTL = 31.3%, (bowling/fielding n = 7)
Pote 2019 (176)	To monitor workload of South African school boy cricketers within the school cricket context between October – November 2017.	n = 12 Aged between 16 and 19 years 100% male 5 batters, 3 bowlers, 4 all-rounders	Convenience sample from within a single school from first XI players. Data recorded by primary data collectors.	ID = MTL SM = NR	n_p = 2 n_i = 2	16.7% of players monitored were injured.	NR	Knee n = 2	Bowling n = 2	NR	Both injuries were MTL	-

Table 26 *(cont).*

First Author, Year and Reference	Setting / Context & Aims	Overall Participants (n), Age & Sex	Injury Data Collection Methods	Injury Definition (ID) & Severity Measure (SM)	Number of Injured participants (n_p) & Injuries (n_i)	Injury Incidence Rate (IIR), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Specific cricket activity at Injury Onset	Mechanism of Injuries	Severity of Injuries	Other Information
Soomro 2018 (171)	To conduct injury surveillance across all premier 1st grade teams playing in the Sydney Grade Cricket competition in NSW, Australia, over the 2015/16 season as a basis for reporting injury epidemiology of premier level cricketers.	n = 408 from 20 teams. Age range for all participants 18 – 53 years. Age range for injured participants 18 – 43 years. Mean age injured = 24.1 years, SD = 5.3 years. 100% male	Team selections were checked via MyCricket website and changes were followed up at club level by Cricket NSW physio to assess if changes were injury based.	ID = MTL SM = TL	n_p = 65 n_i = 86	IIR = per 10,000 exposure hours for match time. Overall IIR = 35.54 per 10,000 exposure hours Prevalence = 4.06%	NR	Lower back n = 17 (19.8%), Foot n = 12 (14%), hand/wrist n = 11 (12.8%), knee n = 9 (10.5%), abdomen n = 8 (9.3%), calf n= 6 (7%), hamstring n = 6 (7%), illness n = 5 (5.8%), elbow n = 3 (3.5%), groin n = 2 (2.3%), hip n = 2 (2.3%), shoulder n = 2 (2.3%), chest/pecs n = 1 (1.2%), unidentified n = 2 (2.3%)	NR	NR	Average severity in TL (weeks): Chest/pecs = 9 Lower back = 7.9 Knee = 6.7 Hand/wrist = 4.3 Calf = 3.8 Foot = 3.6 Elbow = 3.3 Hamstrings = 3.0 Abdomen = 2.9 Shoulder = 2.6 Hip = 1.5 Illness = 1.2 Groin = 1 .0 Unidentified = 1.0	Injuries by match type: 20/20 n = 11 (12.8%) 1-day n = 31 (36%) Long form n = 44 (51.1%)
Martin 2017 (177)	Schoolboy cricketers playing high school cricket in South Africa during pre-season and 3 months of the 2014 season. Investigate association of rested and activated thickness and side to side symmetry of the lateral abdominal muscles and prospective injury in adolescent pace bowlers	n = 28 Age range: 13-18 years. Mean age ~ 16.5 years. 100% male	Self-report questionnaire	ID = MA & TL Contact injuries defined as injuries sustained due to collision with player or object SM = NR	n_p = 11 n_i = 14	IIR = NR 39% of participants injured	Contact injuries = 5 Non-contact injuries = 6	Upper limb: 3 (21.4%) - 100% contact injuries Lower limb: 3 (21.4%) - 33% contact injuries Lower back: 6 (42.8%) - 33% contact injuries Other: 2 (14.3%) - 100% non-contact	Fielding: 38.5% Bowling: 30.8% Batting: 8% 22.7% could not be specifically identified	NR	NR	23 (82%) had suffered 44 previous injuries: Upper limb: 40.9% Lower limb: 27.3% Lower back: 22.7% Other: 14.3% Of the previously injured 60.9% did not sustain an in-season injury
Martin 2017 (178)	Functional Movement Screen (FMS) of schoolboy cricketers in one geographical region of South Africa to determine if FMS is a predictor of injuries in adolescent pace bowlers.	n = 27 Age range 13-18 yrs Mean age = 16.82 yrs (SD 1.70 yrs) 100% male	Self-report questionnaire	ID = TL and or MA Contact injuries defined as injuries sustained due to collision with player or object SM = NR	n_p = 10 n_i = 13	IIR = NR 37.1% of participants injured	5 players had 6 contact injuries, 5 players had 7 non-contact injuries	Upper limb: 3 (23.1%) – 100% contact injuries Lower limb: 3 (23.1%) – 33% contact injuries Lower back: 6 (46.2%) – 33% contact injuries Other: 1 (7.6%) – 100% non-contact injury	Fielding: 57.1% Bowling: 21.1% Batting: 7.1% 14.7% unknown		NR	No relationship between FMS and injury
Olivier 2016 (179)	Premier club cricketers in South Africa. Investigate side to side symmetry of lumbar multifidis cross-sectional area as a potential precursor of injury in fast bowlers	n = 26 18-26 years Mean 21.8 years SD 1.8 years 100% male	Self-report questionnaire	ID = MA & TL Only non-contact injuries SM = NR	n_p = 16 n_i = 34	IIR = NR 61.5% of participants injured	NR	Lower back: 11 Lower limb: 5	Bowling: 15 Others not reported	NR	NR	Relative risk of lower back and or lower limb injury if >= 10% LM CSA asymmetry: RR = 1.429 (95% CI 0.742 – 2.752)
Olivier 2015 (180)	Premier league cricketers from Gauteng region, South Africa. Investigate the relationship between static and dynamic balance ability, lumbo-pelvic control and injury in pace bowlers at the start and end of season	n = 32 18-26 years Mean age 21.8 years SD 1.8 years 100% male	Monthly self-report questionnaire	ID = TL & MA SM = NR	n_p = n_i = 17	IIR = NR 53% of participants injured	NR	Lower back: 4 (24%) Lower Quarter: 13 (76%) (defined as lower back and lower limb) No. of injured anatomical areas: One: 7 (41%), two: 5 (29%), three: 5 (29%)	Bowling: 16 (94%) Others not reported	NR	NR	Previous injury: n = 28 Injury sustained during bowling: 18 (64%), injury to lower back: 4 (14%)

Table 26 *(cont).*

First Author, Year and Reference	Setting / Context & Aims	Overall Participants (n), Age & Sex	Injury Data Collection Methods	Injury Definition (ID) & Severity Measure (SM)	Number of Injured participants (n_p) & Injuries (n_i)	Injury Incidence Rate (IIR), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Specific cricket activity at Injury Onset	Mechanism of Injuries	Severity of Injuries	Other Information
Olivier 2013 (181)	Premier club cricketers in South Africa. Establish whether lumbar proprioception in the neutral lumbar spine position and at front foot and ball release positions of the pace bowling action were related to previous or new injury, specifically lower back injury.	n = 17 18-26 years 100% male	Self-report questionnaire – preseason, post season and monthly during season	ID = MA & TL SM = NR	n_p = n_i = 8	EM = NR 47% of participants injured	NR	NR	Bowling 100%	NR	NR	Previous injury: n = 13 players (76%) had sustained general injuries and 3 (23%) had sustained lower back specific injuries
Twomey 2012 (172) Nested case series from same population as Finch et al (174)	U14 and U16 players in BCA junior club competition, Victorian, Australia during the 2007-08 season. Establish if an association exists between ground hardness and injury risk in junior community-level cricket and objective measurement of ground hardness on a subset of fields where some matches were played. Also examine the nature, body region and mechanisms of injuries	n = 323 n_{U14}: 203 n_{U16}: 120 Gender NR	Primary data collectors using standardised participation and injury incidence forms	ID = MA & TL SM = NR	n_p = unknown n_i = 31	IIR = per 1000 match exposures IIR = 3.49 (95% CI 2.26-4.72)	Bruise: 12 (39%) Inflammation/swelling = 5 (16%) Strain = 4 (13%) Cut/laceration = 3 (10%) Abrasion/graze = 2 (6%) Sprain = 2 (6%) Concussion = 1 (3%) Overuse = 1 (3%) Other = 1 (3%)	Head/neck & face: 5 (16%) Upper limbs: 9 (29%) Lower limbs: 12 (39%) Torso/back: 5 (16%)	NR	Struck by ball: 20 (65%) Overexertion: 3 (10%) Dive for catch: 2 (6%) Slip/trip: 2 (6%) Overuse/gradual onset: 2 (6%) Mishandling ball while fielding: 1 (3%) Twisting to change direction: 1 (3%)	1 participant required visit to hospital with facial bruising/swelling and concussion	Injuries related to ground hardness: Likely to be related: 2 (7%) – 1 each to upper and lower limbs and were either cuts/abrasions or lacerations and both due to diving for a catch) Possibly related: 5 (16%) Unlikely to be related: 23 (74%) Unknown: 1 (3%)
Kountouris 2012 (173)	Australian junior male fast bowlers followed through the 2002/03 season. Evaluate the link between Quadratus Lumborum (QL) asymmetry and lumbar spine injury in adolescent fast bowlers	n = 38 12-17 years Mean 14.9 yrs SD 1.34 yrs 100% male	Self-report with follow up medical assessment	ID = Musculoskeletal injuries to the lumbar spine: bone stress injury, soft tissue injury. SM = NR	n_p = n_i = 17	IIR = NR 44.7% of participants injured (21.1% bone stress, 23.7% soft tissue)	Bone stress = 8; (Bilateral bone stress = 4 Non-bowling side bone stress = 3 Dominant bowling side bone stress = 1) Soft tissue lower back injuries = 9	100 % lower back Bone stress injuries: L4 level = 2 L5 level = 5 L4 & L5 levels = 1	NR	NR	NR	Of the bone stress injuries, 50% (n=4) had asymptomatic radiological evidence of Lx bone stress at baseline and 12.5% (n=1) had asymptomatic evidence of soft tissue injury.

***Table 26** (cont).*

First Author, Year and Reference	Setting / Context & Aims	Overall Participants (n), Age & Sex	Injury Data Collection Methods	Injury Definition (ID) & Severity Measure (SM)	Number of Injured participants (n_p) & Injuries (n_i)	Injury Incidence Rate (IIR), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Specific cricket activity at Injury Onset	Mechanism of Injuries	Severity of Injuries	Other Information
Finch 2010 (174)	Junior level cricket in the BCA, Victoria, Australia 2007-08 season. Estimate the rates and patterns of injury across player age groups	n = 411 U12 = 88 U14 = 203 U16 = 120 M = 405, F = 6	Primary data collectors using standardised participation and injury incidence forms	ID = MA SM = TL from match and/or level of MA	n_p = n_i = 47 U12 = 1 U14 = 28 U16 = 18	IIR = Per 1000 participations. Overall IIR (match IIR (95% CI) / training IIR (95% CI)): Batting 3.98 (1.90-7.32) / 1.60 (0.59-3.48) Bowling: 2.15 (0.79-4.69) / 1.87 (0.75-3.84) Fielding: 4.27 (2.39 – 7.04) / 0.80 (0.00 – 1.70) All positions: 3.52 (2.39 – 4.99) / 4.26 (2.44 – 6.93)	Bruise = 32% Inflammation/swelling = 23% Muscle/tendon strains = 17%	Upper leg = 17% Hand/fingers = 15% Back = 13% Lower leg = 11% Pelvis/groin = 10%	Injuries occurring in matches/training = 66% / 34% Batting O/A = 34% U12 = 0%, U14 = 81%, U16 = 19% Bowling O/A = 33% U12 = 0%, U14 = 54%, U16 = 46% Fielding O/A = 32% U12 = 1%, U14 = 44%, U16 = 55%	Struck by ball = 53% Slip//trip/dive in field = 15% Overexertion = 13% Overuse/gradual onset = 6%	IR per 1000 participations: Left the field = 2.15 Received treatment = 2.07 Remained off field = 0.64 Advised to seek medical assistance = 0.48 Taken to hospital = 0.24 (n = 1)	Injury rate ratios (IRR) compared to bowling: U14 batting = 2.78 U14 fielding = 0.81 U16 batting = 0.44 U16 fielding = 2.47
Owoeye 2010 (183)	National Sport Festival (NSF) – a biennial sporting competition held February 15th -25th, 2009 in Kaduna, far North Nigeria. Investigate patterns of injury sustained by Lagos athletes during the NSF and treatment modalities used in managing such injuries	n = 655 athletes across all sports on Lagos team. Cricket numbers = 22*. Age range = 15-38 years, mean 23.3 years (SD =3.9) not specific to cricket. M: 395, F: 260 not specific to cricket	Medical team complied structured log books of assessment and treatments given to athletes on and off site	ID = MA SM = Minor –return to game immediately after treatment Moderate – unable to return to game after treatment on-site or next game after off-site treatment. Major – potentially life threatening injury requiring immediate referral	n_p = unknown n_i = 19	IIR = NR Injury risk = number of injuries / total of players for each sport. Cricket injuries = 13.6% of all injuries in Lagos team. Injury risk = 0.86 within cricket team.	NR	NR	NR	NR	NR	-
Shaw 2008 (46)	Junior club cricket in Sutherland Shire Junior Cricket Association, NSW, Australia. Describe the most common injuries and their mechanisms in junior cricket over three consecutive seasons 2002-03 to 2004-05 and assess the effect of compulsory headgear use on injury frequency both overall and specifically in batters	$n_{2002\text{-}03}$ = 1146 reg. players $n_{2003\text{-}04}$ = 1261 reg. players $n_{2004\text{-}05}$ = 1215 reg. players U8 (7% of reg. players), U10, U12, U14, U16 (19% of reg. players) Gender not reported	Original data were collected by match scorers with the Sutherland Shire Junior Cricket Association which then later provided data for this study.	ID = Any acute injury SM = NR	n_p = unknown n_i = 155	IIR = per 100 registered players. Incident proportions: U8: 0 (0%) U10: 28 (18%) U12: 47 (30%) U14: 32 (21%) U16: 48 (31%) IIR: 2002/03: 4.36 2003/04: 4.76 2004.05: 3.70	NR	Head, neck & face: 27% (95%CI 20-34%) of which 20% to the face Upper limb: 24% (95%CI 17-31%) of which 14% to the hand Lower back & Pelvis: 5% (95%CI 2-8%) Lower limb: 30% (95%CI 23-37%) Regional injury over time: Lower limb 02/03: 20%, 03/04: 33.3%, 04/05: 35.6% Upper limb 02/03: 14%, 03/04: 31.7%, 04/05: 24.4% Head/face/neck 02/03: 44%, 03/04: 18.3%, 04/05: 20%	Across all grades: Batting: 45-53%, Fielding: 24-32%	Contact with moving object: 57-70% - primary cause of injury for U10-14 and 35% (95%CI 22-48%) in U16, 100% of all wicket keeping injuries, 65% (95%CI 54-76%) of batting injuries, 47% (95%CI 32-62%) fielding injuries and 50% (95%CI 10-90%) of training injuries. Unspecified acute overexertion: 58% (95%CI 30-86%) of bowling injuries and 33% (95%CI 0-71%) of training injuries	NR	Head/neck & face injuries adjusted for batting only over time: 2002/03: 62% (95%CI 49-76%) 2003/04: 35% (95%CI 22-48%) 2004/05: 4% (95%CI 0-9%) Type of cricket played: Traditional cricket had 80% (95%CI 74-85%) of all injuries from 67% registered players. Introductory & preliminary cricket had 4% (95%CI 1-7%) of all injuries from 16% registered players

Table 26 *(cont).*

First Author, Year and Reference	Setting / Context & Aims	Overall Participants (n), Age & Sex	Injury Data Collection Methods	Injury Definition (ID) & Severity Measure (SM)	Number of Injured participants (n_p) & Injuries (n_i)	Injury Incidence Rate (IIR), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Specific cricket activity at Injury Onset	Mechanism of Injuries	Severity of Injuries	Other Information
Dennis 2005 (51)	Club & District (Premier) cricket in NSW, Australia, 2002-03 season. Investigate bowling workload as a risk factor for injury and evaluate bowling guidelines.	n = 44 12-17 years Mean 14.7 yrs SD 1.4 yrs 100% male	Self-recorded log books	ID = MTL & MA SM = NR	$n_p = n_i = 11$	IIR = NR 25% of participants reported injury	Stress reactions = 4 Lumbar musculo-ligamentous strains = 2, bi-lateral stress fractures = 1, others = 4 (muscular strains and apophysitis)	Lower back = 7 Others = 4 (1 calcaneal apophysitis)	100% Bowling	NR	NR	Lower back pain reported by 52% (n = 23) of bowlers at some stage during the season.
Foster 1989 (175)	Potential high performance bowlers from club and school cricket in Australia, 1986-87 season. Investigate the relationship between back injuries in cricket with biomechanical, physiological and kinanthropometric characteristics of young fast bowlers	n = 82 Age range 15-22 yrs Mean age 16.8 yrs 100% male	Injuries assessed during season by sports physician	ID = Lower back injuries SM = Grouped into vertebral fractures, disabling soft tissue and mild ST	$n_p = n_i = 31$	IIR = NR Prevalence = 38%	Stress fractures = 29% (n=9) Soft tissue injury = 71% (n=22)	Stress fractures L4 = 1, L5 = 7, S1 = 1, tibia = 1 Soft tissue injury = 100% lower back	100% Bowling	NR	38% had at least one disabling injury and 27% of bowlers missed at least one match due to soft tissue injury	Single tibia stress fracture noted but not technically part of study outcomes

NR = Not Reported, MA = Medical Attention, MTL = Match Time Loss, TL = Time Loss, IR = Injury Rate.

3.4.2.2 Critical assessment and risk of bias

Table 27 shows the summary of critical assessment and likelihood of bias for studies collecting injury data through prospective in-the-field methods. Overall, there were three (n = 3, 20%) studies found to have a low likelihood of bias (51, 178, 183) and one study found to have a high likelihood of bias (171).

Overall, prospective injury studies covered 59% of the critical appraisal items fully. Item 4 of the critical appraisal tool was the least well covered with 7% of studies fully addressing this. Item 5 (47%), pertaining to injury and severity definitions, and item 2 (40%), covering the study setting, subjects and populations, were also underreported (less than half of the studies reviewed). The major reasons for an unclear likelihood of bias in prospective injury data studies was due to a lack of clarity around recruitment (item 2), and a lack of information on, or statement around, any missing data (item 4).

Table 27. Summary of critical appraisal and likelihood of bias for studies reporting on prospectively, in the field, collected injury data in community cricket (n = 15).

Study (First author & year)	Likelihood of bias[a]	**1.** Were the study aims and design described adequately & are they compatible?	**2.** Was the study setting, subjects, source, target population and size described adequately?	**3.** Was the method of data collection described adequately and did it seek to minimise information bias?	**4.** Has there been appropriate reporting of attrition of subjects or missing data?	**5.** Was there an injury definition and or injury severity measure/definition provided and were they suitable for the study design?	**6.** Were the injury outcomes and exposure measures reported in a standardised, justified and reasonable manner?	**7.** Were limitations to the study discussed adequately?	**8.** Is there a summary of key results, their potential generalisability and whether they and any conclusions match the aims and/or reflect the limitations of the study?	**9.** Does the study explain any ethics requirements, author conflicts of interest and or funding arrangements?
Gamage 2019 (182)	Unclear[1]	Yes	Yes	Yes	Partial	Partial	Yes	Yes	Yes	Yes
Pote 2019 (176)	Unclear[2]	Yes	Partial	Partial	Partial	Partial	Partial	Partial	Yes	Yes
Soomro 2018 (171)	High[3]	Partial	Partial	Partial	Partial	Yes	Yes	Partial	Partial	Yes
Martin 2017 (177)	Unclear[4]	Yes	Partial	Yes	Partial	Partial	Yes	Partial	Yes	Yes
Martin 2017 (178)	Low	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Olivier 2016 (179)	Unclear[5]	Yes	Partial	Partial	Partial	Partial	Partial	Partial	Yes	Yes
Olivier 2015 (180)	Unclear[6]	Yes	Partial	Yes	Partial	Yes	Partial	Partial	Yes	Yes
Olivier 2013 (181)	Unclear[7]	Yes	Partial	Partial	Partial	Partial	Partial	Partial	Yes	Yes
Twomey 2012 (172)	Unclear[8]	Yes	Yes	Partial	Partial	Yes	Yes	Yes	Yes	Yes
Kountouris 2012 (173)	Unclear[9]	Yes	Partial	Yes	Partial	Partial	Yes	Yes	Yes	Yes
Finch 2010 (174)	Unclear[10]	Yes	Partial	Yes	Partial	Yes	Yes	Yes	Yes	Yes

Study (First author & year)	Likelihood of bias[a]	1. Were the study aims and design described adequately & are they compatible?	2. Was the study setting, subjects, source, target population and size described adequately?	3. Was the method of data collection described adequately and did it seek to minimise information bias?	4. Has there been appropriate reporting of attrition of subjects or missing data?	5. Was there an injury definition and or injury severity measure/definition provided and were they suitable for the study design?	6. Were the injury outcomes and exposure measures reported in a standardised, justified and reasonable manner?	7. Were limitations to the study discussed adequately?	8. Is there a summary of key results, their potential generalisability and whether they and any conclusions match the aims and/or reflect the limitations of the study?	9. Does the study explain any ethics requirements, author conflicts of interest and or funding arrangements?
Owoeye 2010 (183)	Low	Yes	Yes	Yes	Partial	Yes	Partial	Yes	Yes	Partial
Shaw 2008 (46)	Unclear[11]	Yes	Yes	Partial	Partial	Partial	Yes	Yes	Yes	Partial
Dennis 2005 (51)	Low	Yes	Yes	Yes	Partial	Yes	Partial	Yes	Yes	Yes
Foster 1989 (175)	Unclear[12]	Yes	Partial	Yes	Partial	Partial	Partial	No	Yes	No
Proportion of yes answers		93%	40%	60%	7%	47%	53%	53%	93%	80%

Shaded questions represent items used to determine likelihood of bias.

Notes on Likelihood of bias:

[1] Response rates included but there was no clear information on how missing information (if any) was dealt with.

[2] Unclear on how subjects were recruited. Unclear how the data were collected, i.e. how often. There was no clear information on how missing information (if any) was dealt with.

[3] Unclear from abstract to text what level of competition (i.e. 1st XI only or across all grades) was sampled. Lacking clarity on recruitment and consent procedures. Proxy injury evidence provided from coach or captain then followed up. There was no clear information on how missing information (if any) was dealt with.

[4] No rationale around why the nine high schools were chosen. There was no clear information on how missing information (if any) was dealt with.

[5] Unclear what pre-defined geographical area was used and why. Non-validated questionnaire used to collect injury data. There was no clear information on how missing information (if any) was dealt with.

[6] Unclear on how subject numbers were determined. There was no clear information on how missing information (if any) was dealt with.

[7] Unclear how many subjects were contacted or where they are from. Non-validated questionnaire was used to collect injury data. There was no clear information on how missing information (if any) was dealt with.

[8] Primary data collectors (PDC) used to collect data but then biomechanical experts assess likelihood of ground hardness influence on injury from PDC data. There was no clear information on how missing information (if any) was dealt with.

[9] Unclear on recruitment process. There was no clear information on how missing information (if any) was dealt with.

[10] Coaches used to select players for inclusion – possible selection bias. There was no clear information on how missing information (if any) was dealt with.

[11] Match scorers used to collect injury data – unsure of training. There was no clear information on how missing information (if any) was dealt with.

[12] Unclear on rationale for subject selection (coaches involved in selection process). There was no clear information on how missing information (if any) was dealt with.

3.4.2.3 *Injury rates*

Table 28 shows the studies that reported IIR. There was no consistency in the exposure denominator making it impractical to compare rates. Finch et al and Shaw et al reported on junior cricket levels in Victoria and NSW, Australia, respectively (46, 174). Finch et al reported match IIR were lower than training IIR for players under 16 years of age over a single season, but not significantly (174). For school boy cricketers in Sri-Lanka, there was no significant difference in IIR from U15s to U17s, although the U15 IIR was found to be higher. Fielding in Sri-Lankan school boys was reported to have a significantly higher IIR than batting or bowling, and non-match time loss (non-MTL) injuries had a significantly higher IIR than match time loss injuries (182).

Table 28. *Studies reporting injury incidence rates (IIR) for prospectively collected injury data (n = 4).*

Study	n participants	n injuries	Study Design	Injury Case Definition	Exposure	Injury Incidence Rate for Cricket-Related Cases
Gamage 2019	573	744	Prospective injury data collection from division 1 schoolboy tournament teams	Injuries defined in JECS survey	Per 100 Match Days Played (MDP)	Overall 28.0 per 100 MDP (95% CI 26.0 – 30.2) U15 30.3 per 100 MDP (95% CI 27.5 – 33.2) U17 24.8 per 100 MDP (95% CI 21.9 – 28.0) Batting 7.1 per 100 MDP (95% CI 6.1 – 8.3) Bowling 5.7 per 100 MDP (95% CI 4.8 – 6.7) Fielding 12.7 per 100 MDP (95% CI 11.5 – 14.4) Wicket keeping 2.1 per 100 MDP (95% CI 1.6 – 2.8) MTL injuries 6.1 per 100 MDP (95% CI 5.2 – 7.1) Non-MTL injuries 21.9 per 100 MDP (95% CI 20.1 – 23.9)
Soomro 2018	408	86	Prospective injury data collection from Sydney Grade Cricketers over a single season.	Match time loss injuries	Per 10,000 hours match time	Overall IR = 35.54 per 10,000 hours match time
Finch 2010 [a]	411	47	Prospective injury data collection from junior club cricket over a single season	Medical attention injuries	Per 1,000 participations (i.e. batting, bowling, or fielding)	For all positions: match = 3.52 injuries per 1,000 participations (95% CI 2.39 – 4.99), training = 4.26 injuries per 1,000 participations (95% CI 2.44 – 6.93)
Shaw 2008 [a]	1207 average registered players / year	155	Cross sectional data collected over three consecutive seasons in junior club cricket	Any acute injury	Per 100 registered players	2002/03 = 4.36 per 100 reg. players 2003/04 = 4.76 per 100 reg. players 2004/05 = 3.70[2] per 100 reg. players

JECS = Juniors Enjoying Cricket Survey, [2] reported as non-significant difference between years.

3.4.2.4 *Injury prevalence*

Table 29 shows the studies that reported the number of participants and number of injured participants and any age group distributions. The proportion of players injured varied from 11% to 71%. For studies that reported only on bowlers, the range varied from 25% to 62%. Two studies provided age group proportions (174, 182). Sri-Lankan under 15 school boys accounted for 64% (n = 449) of the injuries while representing 61% of the participants. The under 17 age group accounted for 36% (n = 255) of injuries from 39% of the participants. The proportions of injured to uninjured in each age group was not available (182). In Australian junior cricket, the U16 age group had the highest proportion by age group (15% and 21%) in the only two studies reporting by age group (46, 174).

Table 29. *Studies reporting proportion of injured participants and by age groups for prospectively collected data (n = 13).*

Proportion of Injured Players											
	All players			**Within Age Group**							
Prospective Cohort Studies	**n participants**	**n_p injured participants**	**n_p / n**	**U8**	**U10**	**U12**	**U14**	**U15**	**U16**	**U17**	**U18**
Gamage 2019 (182)	573	404	70.5%	-	-	-	-	-	-	-	-
Pote 2019 (176)	12	2	16.7%	-	-	-	-	-	-	-	-
Soomro 2018 (171)	418	65	15.6%	-	-	-	-	-	-	-	-
Martin 2017[1] (177)	28	11	39.3%	-	-	-	-	-	-	-	-
Martin 2017[1] (178)	27	10	37.0%	-	-	-	-	-	-	-	-
Olivier 2016[1] (179)	26	16[b]	61.5%	-	-	-	-	-	-	-	-
Olivier 2015[1] (180)	32	17[d]	53.1%	-	-	-	-	-	-	-	-
Olivier 2013[1] (181)	17	8[d]	47.1%	-	-	-	-	-	-	-	-
Kountouris 2012[1] (173)	38	17[c]	44.7%	-	-	-	-	-	-	-	-
Finch 2010 (174)	411	47	11.4%	-	-	1.1%[2]	13.8%[2]	-	15.0%[2]	-	-
Shaw 2008	1,207[3]	155	12.8%	0%[4]		12.0%[4]			21.0%[4]		
Dennis 2005[1] (51)	44	11[b]	25.0%	-	-	-	-	-	-	-	-
Foster 1989[1] (175)	82	31[c]	37.8%	-	-	-	-	-	-	-	-

[1] bowler only cohort, [2] U12: 1 injury in 88 participants, U14: 28 injuries in 203 participants, U16: 18 injuries in 120 participants, [3] based on annual average (range 1,146 to 1,261), [4] no U8 players injured of the 7% registered players, 77% of registered players were within the U10 to U14 age bracket with n = 107 injuries, 16% of registered players with in the U16 age group with n = 48 injuries.

3.4.2.5 Injury nature

Of the seven studies that reported injury nature, five were specific to bowling cohorts (Table 30). Four studies reported injury in all activities, including two bowling cohort studies. All but one study reported on junior and/or adolescent age groups. Strain, sprain or bruising were most common in junior level and school cricket (174, 182). Stress fractures in the lower back were more common in bowler cohorts and ranged from 29% to 47% of injuries (51, 173, 175).

Table 30. Studies reporting injury nature in prospectively collected data (n = 7).

Study	n injuries	Concussion / closed head injury	Eye, nose, dental injury	Fracture	Avulsion / dislocation	Stress fracture	Rupture / Tear	Open wound	Sprain	Strain	Bruising	Overuse	Inflammation	Other / NR
Gamage 2019 (182)	744	1.9%	2.5%	1.9%	2.6%	-	-	18.7%	15.5%[1]	14.1%	18.0%	-	-	24.8%[3]
Martin 2017[2] (177)	14	-	-	-	-	-	-	-	-	-	-	42.9%	-	57.1%
Martin 2017[2] (178)	13	-	-	-	-	-	-	-	-	-	-	53.8%	-	46.2%
Kountouris 2012[2] (173)	17	-	-	-	-	47.1%	-	-	-	52.9%	-	-	-	-
Finch 2010 (174)	47	-	-	-	-	-	-	-	-	17.0%	31.9%	-	23.4%	27.7%
Dennis 2005[2] (51)	11	-	-	-	-	45.5%	9.1%	-	18.2%	27.3%	-	-	-	-
Foster 1989[2] (175)	31	-	-	-	-	29.0%	-	-	-	71.0%	-	-	-	-

[1] includes joint injury (6.6%), [2] bowling cohort studies, [3] includes 4.2% 'not sure'

3.4.2.6 Injured body region

There were five studies where information about the broad injured body region was described (Table 31). For studies that did not focus on bowlers only, the lower limb was the most common broad body region injured, accounting for 24% to 43% of all injuries. Junior cricket had lower limb injury proportions ranging from 24% to 31% (46, 182). One study that analysed cricketers whose ages ranged from 14 to 53 years reported the higher proportion of lower limb injuries (43%) (171). Two studies focused on bowling cohorts and reported the highest proportion of trunk/back injuries (43% to 46%) with similar proportions in upper and lower limb at aournd 25% each (177, 178). The only studies that reported head/face or neck injuries were in junior cricketers, with proportions ranging from 6% to 13% (174, 182).

Over time, head/face/neck injuries appear to show a reduction in proportion for junior level cricketers. Shaw et al (46) reported an average proportion of 27% over three years (dropping from 44% to 20%) from 2002 to 2004, Finch et al (174) reported 13% in the 2007/08 season and Gamage et al (182) reported 6% for Sri Lankan schoolboys in the 2016 season.

Shaw et al (46) reported that the introduction of compulsory headgear, had a significant effect of the proportion of head/face/neck injuries in batters, dropping from 62% (95% CI 49% - 76%) in 2002/03 to 35% (95% CI 22% - 48%) in 2003/04 and to 4% (95% CI 0% - 9%) in 2004/05.

Two studies reported more extensively on specific injured body locations (171, 182). Soomro et al (171) reported that in Sydney Grade cricket, the lower back (n = 17, 20%), foot (n = 12, 14%), hand/wrist (n = 11, 13%), knee (n = 9, 11%) and abdomen (n = 8, 9%) were the top five specific injured locations. Gamage et al (182) reported that in Sri Lankan school boy cricket, the knee (n = 93, 13%), hand (n = 75, 11%), thigh (n = 59, 8%), elbow (n = 45, 6%), and lower back (n = 44, 6%) were the top five specific body locations injured. Shaw et al (46) noted that of the fielding injuries in Australian junior cricketers, the hand (33%, 95% CI 19% - 47%) and knee (24%, 95% CI 12% - 36%) were the most common specific locations injured.

Table 31. Studies reporting broad body locations of injury in prospectively collected data (n = 6).

Study	n injuries	Head/Face/Neck	Upper Limb	Trunk/Back	Lower Limb	Other/Unspecified
Gamage 2019 (182)	744	5.8%	18.7%	5.9%	27.6%	42.0%
Soomro 2018 (171)	86	-	18.6%	30.2%	43.1%	8.1%[1]
Finch 2010 (174)	47	13.0%	13.0%	13.0%	31.0%	-
Shaw 2008[3] (46)	155	27.1%	23.9%	7.1%	29.6%	12.3%
2002[4]	50	44.0%	14.0%	6.0%	20.0%	16.0%
2003[4]	60	18.3%	31.7%	5.0%	33.3%	11.7%
2004[4]	45	20.0%	24.4%	11.1%	35.6%	8.9%
Martin 2017[2] (177)	14	-	21.4%	42.9%	21.4%	14.3%
Martin 2017[2] (178)	13	-	23.1%	46.2%	23.1%	7.6%

[1] includes 5.8% illness, [2] Bowling cohorts, [3] proportions are averages over 3 seasons (2002 -2004), [4] Proportions shown for individual years of study to highlight reduction in head/face/neck injury.

3.4.2.7 Injury activity, setting and mechanism

Five studies reported the cricket activity at injury onset (Table 32). All studies analysed junior to adolescent age groups and two studies were of bowling cohorts. Fielding was typically the most common activity of injury onset ranging in proportion from 32.0% to 57.1%. Injury due to bowling was more common than batting in the two studies that focused on bowling subjects (177, 178), whereas batting was proportionally more common in the studies looking at subjects that involved players who may or may not specialise in any particular activity (174, 182). Only one study differentiated wicket keeping from fielding and reported wicket keeping as the lowest proportion of injury onset (182).

Table 32. Studies that reported cricket activity at injury onset in prospectively collected data (n = 5).

Study	n injuries	Bowling	Batting	Fielding	Other / NR
Gamage 2019 (182)	744	20.3%	25.4%	46.0%	8.3%[1]
Martin 2017[a] (177)	14	30.8%	8.0%	38.5%	22.7%
Martin 2017[a] (178)	13	21.1%	7.1%	57.1%	14.7%
Finch 2010 (174)	47	33.0%	34.0%	32.0%	-
Shaw 2008 (46)	155	45% – 53%	NR	24 – 32%	NR

[1] 8.3% wicket keeping.

Table 33 shows studies that reported the mechanisms of injury. Two studies reported specific mechanisms of injury wherein being struck by the ball was the most common mechanism, ranging from 22% to 53% of injuries. Falls or dive for a catch was the second most common mechanism (174, 182). The two other studies reported on bowling cohorts and only distinguished injuries as contact or non-contact without specifically identifying the agent of contact (177, 178).

For Sri Lankan schoolboy cricketers, being struck by the ball was most common during batting (n = 93, 51% of batting injuries), fielding (n = 59, 18% of fielding injuries), and wicket keeping (n = 15, 28% of wicket keeping injuries). Overexertion was the most common injury mechanism for Sri Lanka schoolboy bowlers (n = 44, 31% of bowling injuries). Diving for a catch was the most common injury mechanism for all injuries and specifically fielding, for Sri Lankan school boy cricketers (n = 119, 36% of fielding injuries and 17% of all injuries).

Table 33. Studies that reported some form of injury mechanism from prospectively collected data (n = 5).

Study	n injuries	Struck by Ball	Fall / Dive in Field	Mishandling ball	Non-specific Overexertion	Non-specific Overuse	Non-specific Falls	Other / NR
Gamage 2019 (182)	744	22.4%	17.5% [1]	6.3%	10.1%	-	5.2%	38.5%
Martin 2017[2] (177)	14	-	-	-	-	57.1%	-	42.9%[3]
Martin 2018[2] (178)	13	-	-	-	-	53.8%	-	46.2%[3]
Finch 2010 (174)	47	53.2%	14.9%	-	12.8%	6.4%	-	12.8%
Shaw 2008 (46)	155	54.8%[4]	-	-	17.4%[5]	-	-	27.8%[6]

[1] 'dive for catch', [2] bowling cohort, [3] 'contact' injuries not specifically identified, [4] 'contact with moving object', [5] includes 3.2% 'sudden or rapid change in direction', [6] includes 2.6% 'cutting/tearing'

Only one study reported on different settings of injury (174) (Table 34). In junior cricket in Australia the majority of injuries occurred in the match setting. Soomro et al (171) distinguished the type of cricket match played where the injury occurred in Sydney Grade cricket, with n = 44 (51%) injuries occurring in the long format (i.e. 2 innings matches, usually played over consecutive weekends), n = 36 (36%) occurring in 1-day matches and n = 11, (13%) occurring in 20/20 matches(171).

Table 34. Prospectively collected injury data studies reporting injury setting (n = 1).

Study	n injuries	Match	Practice
Finch 2010 (174)	47	66.0%	34.0%

3.4.2.8 Injury severity

The injury severity for junior cricketers in Australia was reported in terms of IIR per 1,000 participations. Finch et al (174) 2.15 injuries per 1,000 participations required a player to leave the field, 2.07 injuries per 1,000 participations requiring a player to remain off the field, 0.48 injuries per 1,000 participations lead to advice to seek medical treatment and 0.24 injuries per 1,000 participations requiring hospital treatment.

Soomro et al (171) reported that the lower back was, on average, the most severe injury in terms of match time loss for Sydney Grade cricketers with 7.9 weeks per injury. The knee (6.7 weeks), hand (4.3 weeks) and calf (3.8 weeks) were then next most severe. Elbow injuries were the most commonly associated with recurrent injury (66.7%), followed by the calf (33.3%) and knee (22.2%).

For Sri Lankan school boy cricketers, fielding injuries resulted in the most match time loss injuries (n = 61, 39.9%), followed by bowling (n = 42, 27.5%), batting (n = 40, 26.1%) and wicket keeping (n = 9, 5.9%). Fielding also accounted for the most non-match time loss injuries (n = 263, 47.7%), followed by batting (n = 139, 25.2%), bowling (n = 101, 18.3%) and wicket keeping (n = 44, 8.0%). Table 35 shows the most common specific body locations and injury diagnosis resulting in match time loss (MTL) injuries and the most commonly associated cricket activity involved. For fielding, it was the wrist and hand fractures that were most commonly associated with MTL, for batting it was facial and head injuries, whilst for bowling it was lower limb (thigh and lower leg) strains (182).

Table 35. *Match time loss (MTL) injuries for Sri Lankan school boy cricketers by specific body location and diagnosis (182).*

Match time loss (MTL) injury by specific body location and diagnosis	**Proportion of injuries being MTL[1]**	**Most common cricket activity associated and number of injuries.**
Hand and wrist bone injury (fractures)	92.9%	Fielding (n = 10)
Facial organ injuries (ears, eyes, nose, dental)	61.1%	Batting (n = 8)
Head injury (concussion, nerve)	42.9%	Batting (n = 8)
Ankle ligament sprain	42.1%	Fielding (n = 8)
Thigh muscle/tendon strain	40.7%	Bowling (n = 11)
Lower leg muscle/tendon strain	31.3%	Bowling/fielding (n = 7 each)

[1] Total injury n = 744

3.4.3 Other retrospective injury studies

There were 11 studies that used retrospective methods to collect injury data on community cricketers. Because two of the studies retrieved were a part of the same longitudinal data collection (184, 185), only the latter study was used in this review (185), leaving 10 studies summarised in detail in this review.

3.4.3.1 Study characteristics

The majority of retrospective studies were conducted in South Africa (185-188). The most common form of data collection was via a self-administered questionnaire (n = 8), followed by two studies using face-to-face interviews and one using a telephone survey. Five studies reported historical injuries within the last 12 months (187-191), one study reported historical injuries over a 12-24 month period (186) and one at annual injuries over a five season (5 years) period (185). It was not clear with the latter two studies if the data collection was done annually. One study collected data monthly (135), and another two did not explicitly state a timeframe (170, 190, 192). Table 36 shows the characteristics of the retrospective injury data studies.

Table 36. *Characteristics of studies that used other retrospective methods of data collection (e.g. survey, questionnaire) (n = 10).*

First Author, Year and Reference	Setting / Context & Aims	Overall Participants (n), Age & Sex	Injury Data Collection Methods	Injury Definition (ID) & Severity Measure (SM)	Number of Injured participants (n_p) & Injuries (n_i)	Injury Incidence Rate (IIR), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Specific cricket activity at Injury Onset	Mechanism of Injuries	Severity of Injuries	Other Information
Akodu 2016 (189)	Club cricket committee league of Lagos State, Nigeria. Investigate the prevalence of generalised joint hypermobility and its association with sports injuries in recreational cricket players	n = 102 18-38 years Mean age = 23.3 years 100% male	Interview questionnaire on injuries in previous 12 months	ID = Not specified – questions recorded information on injury to upper and lower limbs. SM = TL, Mild < 1 wk, Moderate > 1 wk < 1 month, Severe > 1 month	n_p = unknown n_i = 69	IIR = NR	NR	Lower limb 35 (50.7%) Of which ankle 20.3%, thigh 11.6%, knee 8.7%, groin/hip 2.9%, lower leg 2.9%, foot 2.9% Upper limb: 34 (49.3%) of which hand/fingers 17.4%, shoulder 14.5%, wrist 11.6%, elbow 4.3%, upper arm 2.9%	In matches: 45 (65%) In training: 24 (35%) Bowler: 21 (30.4%) Batting: 16 (23.2%) All-rounder: 13 (18.8%) Fielder: 11 (15.9%) Wicket-keeper: 4 (5.8%) Umpire: 4 (5.8%)	NR	Mild: 33 (48%) Moderate: 27 (39%) Severe: 9 (13%)	No association between generalised joint hypermobility and upper limb injuries (p = 0.061), but significant association for lower limb injuries (p = 0.011)
Khan 2015 (193)	1st, 2nd, 3rd divisions of clubs playing cricket, football (soccer), and badminton in Dhaka, Bangladesh, from January - June 2012. Understand associated factors of Tendo-Achilles Injury in football, cricket, and badminton in Dhaka, Bangladesh	n = 131 O/A, 57 cricket. Age range = 17-35 years not specific for cricket. 100% male	Structured questionnaire done via face-to-face interview	ID = Tendo-Achilles Injury as diagnosed by physician based on participant recall. Other injuries PR. SM = Unable to continue playing, continued playing after treatment, continue to play without treatment.	n_p = 57 n_i = 26	IIR = Per 1,000 football, cricket & badminton players (not specific to cricket). 20% of TAI were cricket related with 5.3% of cricketers having had TAI. 37% of all other injuries were cricket related with 40.4% of cricketers having had other injuries.	Tendo-Achilles Injury Others - unknown	Achilles = 3 (11.5%) Other unknown = 23 (88.5%)	NR	NR	NR	-

Table 36 (cont).

First Author, Year and Reference	Setting / Context & Aims	Overall Participants (n), Age & Sex	Injury Data Collection Methods	Injury Definition (ID) & Severity Measure (SM)	Number of Injured participants (n_p) & Injuries (n_i)	Injury Incidence Rate (IIR), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Specific cricket activity at Injury Onset	Mechanism of Injuries	Severity of Injuries	Other Information
Stretch 2014 (185) Includes data from: Stretch 2012 (184)	16 provincial age group schoolboy cricket teams in national age group (U15, U17, U18) competitions. Determine the incidence of injuries and demographics of elite schoolboy cricketers over five years 2007-08 to 2011-12 in South Africa.	n = 2080 U15 = 712 U17 = 680 U18 = 688 100% male	Voluntary response to self-reported questionnaire	ID = injury that prevented a player from being fully available for selection for a match or which prevented the player completing the match. SM = TL	n_p = 572 n_i = 658 $n_{p(U15)}$ = 207 $n_{i(U15)}$ = 239 $n_{p(U17)}$ = 205 $n_{i(U17)}$ = 230 $n_{p(U18)}$ = 160 $n_{i(U18)}$ = 189	IIR = NR 27% of all players injured 29% of U15 30% of U17 23% of U!8	Fracture n = 32, U15 = 13, U17 = 10, U18 = 9 Stress fracture n = 33, U15 = 14, U17 9, U18 = 10 Muscle n = 249, U15 = 91, U17 = 87, U18 = 71 Joint n = 45, U15 = 24, U17 = 10, U18 = 11 Dislocation n = 19, U15 = 5, U17 = 8, U18 = 6 Tendon n = 46, U15 = 18, U17 = 13, U18 = 15 Ligament n = 59, U15 = 20, U17 = 22, U18 = 17 Eye = 2, U17 = 2 Unconscious n = 3, U15 = 1, U17 = 2 Acute/Chronic: Acute = 49%, U15 = 45%, U17 = 53%, U18 = 51% Chronic = 41%, U15 = 47%, U17 = 37%, U18 = 39%	Head = 3% U15 = 2%, U17 = 3%, U18 = 3% Upper limbs = 26% U15 = 26%, U17 = 27%, U18 = 24% Back & Trunk = 33% U15 = 33%, U17 = 34%, U18 = 33% Lower limbs = 38% U15 = 39%, U17 = 36%, U18 = 40%	Bowling = 48% U15 = 48%, U17 = 45%, U18 = 52% Fielding = 30% U15 = 29%, U17 = 30%, U18 = 31% Batting = 11% U15 = 11%, U17 = 14%, U18 = 9%	Most common mechanisms: Bowling: U15-U18 = run up and delivery & over bowling. Fielding: U15 = running to catch/field & catching ball, U17 = catching ball & running to slide and field, U18 = running to catch and field & running to slide and field. Batting: Most common mechanisms: U15 & U17 = overuse, U18 = running between wickets	1-3 days = 28% U15 = 32%, U17 = 28%, U18 = 28% 4-7 days = 21% U15 = 26%, U17 = 17%, U18 = 17% 8-14 days = 15% U15 = 11%, U17 = 15%, U18 = 18% 15-21 days = 9% U15 = 7%, U17 = 10%, U18 = 10% < 21 days = 28% U15 = 24%, U17 = 29%, U18 = 33%	Overall seasonal injury: In season injury 63%, pre-season = 22%, off-season = 15% Overall new or recurrent injury: New injury = 27% Recurrent in season = 47% Recurrent previous season = 26% Injury onset: 1-day match = 30%, practice = 29%, gradual = 21%, warm up = 6%, 20/20 match = 4%, other = 10%
Ellapen 2012 (190)	Schoolboy cricketers in High Way Secondary School Cricket League, South Africa. Compare findings of prevalence of musculoskeletal pain amongst adolescent male recreational cricketers to elite levels.	n = 234 Mean age = 15.62 years SD = 1.07 years 100% male	Questionnaire of injury in previous 12 months	ID = musculoskeletal distress which inhibited from engaging in practice or competition for at least 24 hours. SM = intensity of pain using Kee and Seo pain rating scale	n_p = 188 n_i = 285	previous 12 months 80.3% of participants reported injury	Musculoskeletal pain	Lower limb 36.28% of which knee 26.41%, ankle 8.33%,tibia/fibula 1.54% Upper limb 26.33% of which shoulder 10.69%, elbow 7.11%, hand 5.36%, forearm 3.17% Back 29.84% Neck 7.49%	NR	Struck by ball 39.45% Overuse 21.08% Struck by bat 17.68% Rapid rotational movement 11.56% Collision with another player 10.20%	Worst pain ever 4.39% High 15.93% Uncomfortable 17.58% Moderate 35.16% Low 26.92%	-

Table 36 (cont).

First Author, Year and Reference	Setting / Context & Aims	Overall Participants (n), Age & Sex	Injury Data Collection Methods	Injury Definition (ID) & Severity Measure (SM)	Number of Injured participants (n_p) & Injuries (n_i)	Injury Incidence Rate (IIR), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Specific cricket activity at Injury Onset	Mechanism of Injuries	Severity of Injuries	Other Information
Jagger 2009 (170)	Four Private schools each from England and Australia. Determine the prevalence and distribution of head, face and dental injuries sustained by schoolboy cricketers and compare between England and Australia	n = 411 207 England 204 Australia Mean age for England: 15.0 years Mean age for Australia: 14.7 years. 100% male	Questionnaire of all previous injury.	ID = Not provided but asked questions relating to head, face and teeth injury. SM = NR	n_p = 102 English = 50 Australian = 52 n_i = 269 English: 109 Australian: 160	IIR = NR 24.1% of English players injured 25.5% of Australian players injured	Loss of consciousness: Eng: 3, Aus: 8 Bruising: Eng: 24, Aus: 35 Cut: Eng: 23, Aus: 33 Fracture: Eng: 2, Aus: 3 Loose tooth: Eng: 2, Aus: 7 Avulsed tooth: Eng: 1, Aus: 1 Fractured tooth: Eng: 5, Aus: 2	Head injuries: Eng: 52 (48%) Aus: 79 (49%) Face/lip injuries: Eng: 49 (45%) Aus: 71 (44%) Dental injuries: Eng: 8 (7%) Aus: 10 (6%)	NR	NR	Loss of consciousness, facial and tooth fractures considered significant events: n =23 (9%) of all injuries	-
Milsom 2007 (188)	Schoolboy cricketers representing provincial teams in the 2004 under 19 Coca-Cola Khaya Majola cricket week. Identify incidence and nature of injuries sustained by elite South African schoolboy cricketers and use the results to develop protocols in order to decrease the incidence of first time and recurrent injuries	n = 196 16-19 years Mean age 17.6 years SD 0.6 years 100% male	Questionnaire data collected at 2004 under 19 Khaya Majola cricket week for the 12 months June 2003-May 2004	ID = Player reported injury which prevented the player completing a match, practice or training session. SM = TL 1-7 days 8-21 days > 21 days considered severe	n_p = 60* n_i = 67	IIR = Seasonal Incidence reported as 34.2%	Muscle tears & strains: 61.2% Fractures: 19.4% Ligament tears & sprains: 11.9% Stress fractures: 3% Dislocations: 1.5% Meniscal injuries: 1.5% Anterior knee pain: 1.5% Top three injuries: Bowling: Lower back strain or stress fracture 47.1% Groin strains: 14.7% Ankle injuries: 11.8% Fielding: Phalangeal fractures or dislocations: 50% Rotator cuff & deltoid strains: 13.6% Groin strains: 9.1% Batting: Hamstring & quad strains: 30% Lower back strains: 20% Anterior knee pain: 10%	Head/neck & face = 0% Upper limbs: 23 (34.3%) Lower limbs: 23 (34.3%) Trunk & back: 21 (31.3%) Bowling: Upper limb: 5 (21.7%) Lower limb: 11 (47.8%) Trunk & back: 18 (85.7%) Fielding: Upper limb: 16 (69.6%) Lower limb: 5 (21.7%) Trunk & back: 1 (5.8%) Batting: Upper limb: 1 (4.3%) Lower limb: 7 (30.4%) Trunk & back: 2 (9.5%)	Bowling: 34 (50.7%) Fielding: 22 (32.8%) Batting: 10 (14.9%) Other: 1 (1.5%) Warm up or training Match: 71.6% Practice: 11.9% Other: 1.5%	Bowling: 73.5% occurred in delivery stride, 11.8% in follow through, 11.8% d/t incorrect foot placement, 2.9% in run up overload Fielding: 31.8% from direct impact of cricket ball when attempting a catch, 22.7% from chasing the ball, 18.2% from diving for a catch and landing incorrectly, 18.2% trying to stop the ball on the ground, 4.5% due to overload on shoulder through throwing, 4.5% due to overuse from throwing. Batting: 30% due to impact from ball, 30% due to running between wickets, 20% in the action of playing a shot, 20% overuse from prolonged batting.	26 (38.8%) injuries were severe and required > 21 days recovery. (17 of 26 (65%) were due to bowling) 86.6% of injuries were first time injuries, 13.4% were reported as reoccurrences of injuries from previous season	No significance between injury rates for batsmen, bowlers and all-rounders (fielders not compared) Higher proportion of injuries occurred during September (pre-season) and the December-January period.

Table 36 (cont).

First Author, Year and Reference	Setting / Context & Aims	Overall Participants (n), Age & Sex	Injury Data Collection Methods	Injury Definition (ID) & Severity Measure (SM)	Number of Injured participants (n_p) & Injuries (n_i)	Injury Incidence Rate (IIR), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Specific cricket activity at Injury Onset	Mechanism of Injuries	Severity of Injuries	Other Information
Finch 2006 (191)	Household survey of regional area La Trobe Valley in Gippsland Victoria over 12 months (year not stated). Estimate the rate of sports and active recreation injury in a defined population in Australia as well as their public health impacts.	n = 1084 O/A surveyed 648 had participated in sport ~ 262 related to cricket. Age ranges: 5-14: 19.4% 15-39: 40.1% 40+: 40.5% Not cricket specific 48.1% M 51.9% F Not cricket specific	Telephone survey of injury in previous 12 months.	ID = Any reported injury occurring during the participation whether or not it required treatment or impacted participation SM = Significant injury was one which required treatment or interfered with performance of ADLs and or had adverse effects on participation or performance in subsequent activity	NR	IIR = per 10,000 population, per 1,000 participants. 51 injuries per 10,000 population 242 injuries per 1,000 participants	NR	NR	NR	NR	83 significant injuries per 1,000 participants.	Cricket ranked 1st for significant injuries
Stretch 1995 (186)	School cricket from schools in Border region, Eastern and Western Cape, South Africa. Determine the seasonal incidence of common injuries sustained by schoolboy cricketers and identify possible risk factors associated with these injuries over two seasons 1989-90, 1990-91.	n = 116 Mean age 17.6 years SD 1.01 years 100% male	Questionnaire of injury in previous 2 seasons.	ID = Player reported SM = TL	n_p = 49* n_i = 57 8 participants sustained either 2 or 3 injuries	IIR = seasonal Seasonal incidence = 49%	Of lower back and trunk injuries 28.1% were muscle & ligament injuries Of the lower limb injuries 71.4% were muscle strains and 28.6% ankle sprains	Head/neck & face: 11 (19.3%) Upper limbs: 14 (24.6%) Lower limbs: 13 (22.8%) Trunk & back: 19 (33.3%)	Bowling: 47.4% 26.3% back & trunk, 14% lower limbs, 5.3% upper limbs, 1.8% head/neck & face Fielding: 22.8% 17.5% upper limbs, 5.3% lower limbs Batting: 29.8% 17.5% Head/face & neck 7% trunk & back, 3.5% lower limbs, 1.8% upper limbs.	Head/face & neck and upper limb injuries whilst batting were due to being struck by the ball. Lower limb injuries whilst batting occurred whilst running between wickets.	Time to recover: 1-7 days: 63% 8-21 days: 23% > 21 days: 14%	Injury setting: 45.6% occurred during a match 47.4% occurred during practice 7% occurred in match/practice

Table 36 (cont)

First Author, Year and Reference	Setting / Context & Aims	Overall Participants (n), Age & Sex	Injury Data Collection Methods	Injury Definition (ID) & Severity Measure (SM)	Number of Injured participants (n_p) & Injuries (n_i)	Injury Incidence Rate (IIR), Incidence / Prevalence	Nature of injuries	Body region/part Injured	Specific cricket activity at Injury Onset	Mechanism of Injuries	Severity of Injuries	Other Information
Harris 1993 (187)	First teams from five clubs and five schools in Western Cape, South Africa. Describe the prevalence of lower back pain (LBP) in cricketers in the 1991-92 season.	n = 110 55 players from first teams at club level and 55 from school teams – 97 responses. 15-35 years Mean age 20.2 years Gender NR	Questionnaire and some qualitative information collected about practice and matches	ID = Not specified Used lower back pain as main outcome. SM = Pain grade: G1: ache but could play on G2: pain which forced player to leave field G3: pain that prevented playing a match	n_p = 61* n_i = unknown	61.6% of participants reported LBP, 78.7% of these were due to cricket (48.5% of LBP reported due to cricket)	Lower back pain	100% lower back	75.6% of fast bowlers had LBP	Front on action type had 85.7% prevalence of LBP Side on action type had 72.4% prevalence of LBP	Grade 1 = 72.1% Grade 2 = 6.7% Grade 3 = 21.3% 62.3% of cases required treatment for LBP	55.7% of players who reported lower back pain knew techniques to protect their backs
Weightman 1975 (135)	Surveyed injuries in 11 sports through sporting clubs in four northern counties: Northumberland, Durham, Cumberland and Westmorland, England, aiming to identify the injuries sustained in the sports of hockey, cricket, badminton, fencing, cycling, judo, rowing, boxing, sub-aqua and swimming.	213 of 271 sporting clubs responded (no overall numbers of players) Ages NR Gender NR	Questionnaires sent out to clubs and club Secretaries were approached every month for the season between April – September 1972	ID = NR SM = TL & MA Days of play lost First aid Attendance to hospital	n_p = unknown n_i = 251 (author extrapolated this to 319 assuming non-responders were similar)	IIR = Per 10,000 man-hours of play 2.6 injuries per 10,000 man-hours overall	Fracture, bruising and dislocations of fingers – no figures Concussion: 7 Fractures to bones of feet: 5	Head/face & neck: ~25%, Lower limb: ~25% Upper limb: no values but reported as most often injured (fingers) 1.0 per 10,000 man-hours of play for each region: head/neck & face, upper limb, lower limb and mid-body	Concussions 100% due to being struck by ball	NR	Received first aid at the ground: 42% Went to hospital: 43% Admitted to hospital: n=5 Saw GP: 31% No treatment: 16% Upper limb averaged 5 days loss of play (range 0-56 days). Lower limb ave 6 days loss of play, mid-body ave 9 days loss of play Median days off per injury: ~4	-

NR = Not Reported, MA = Medical Attention, MTL = Match Time Loss, TL = Time Loss.

3.4.3.2 Critical assessment and risk of bias

Table 37 shows the summary of critical assessment and likelihood of bias for studies collecting injury data through retrospective methods such as surveys and questionnaires. Overall, no study was found to have a low likelihood of bias, seven studies (70%) had an unclear likelihood of bias and three studies (30%) had a high likelihood of bias.

Overall, retrospective injury studies covered 32% of the critical appraisal items fully. Items 3 and 4 of the critical appraisal tool were the least well covered with none of the studies fully addressing these. Item 5 (30%), pertaining to injury and severity definitions, item 2 (20%), covering the study setting, subjects and populations, item 7 (20%), regarding discussion of limitations, and item 9 (20%), ethical and funding considerations, were items that were not fully covered in less than half of the studies reviewed. The major reasons for an unclear or high likelihood of bias in prospective injury data studies was due to a lack of clarity around recruitment, methods such as convenience and purposive sampling methods (item 2), lack of clarity and information around the methods of data collection, the use of non-validated questionnaires, the length of self-recall required (item 3) and a lack of information on or statement around any missing data (item 4).

Table 37. Critical assessment and likelihood of bias summary of studies reporting community cricket injury from retrospective injury data.

Study (First author & year)	Likelihood of bias[a]	**1.** Were the study aims and design described adequately & are they compatible?	**2.** Was the study setting, subjects, source, target population and size described adequately?	**3.** Was the method of data collection described adequately and did it seek to minimise information bias?	**4.** Has there been appropriate reporting of attrition of subjects or missing data?	**5.** Was there an injury definition and or injury severity measure/definition provided and were they suitable for the study design?	**6.** Were the injury outcomes and exposure measures reported in a standardised, justified and reasonable manner?	**7.** Were limitations to the study discussed adequately?	**8.** Is there a summary of key results, their potential generalisability and whether they and any conclusions match the aims and/or reflect the limitations of the study?	**9.** Does the study explain any ethics requirements, author conflicts of interest and or funding arrangements?
Akodu 2016 (189)	Unclear[1]	Yes	Partial	Partial	No	Partial	Yes	No	Yes	Yes
Khan 2015 (193)	Unclear[2]	Yes	Partial	Partial	Partial	Partial	Partial	Partial	Yes	Yes
Stretch 2014 (185)	High[3]	Yes	Partial	No	Partial	Yes	Yes	No	Partial	Partial
Ellapen 2012 (190)	Unclear[4]	Partial	Partial	Partial	Partial	Yes	Yes	No	Partial	No
Jagger 2009 (170)	Unclear[5]	Yes	Partial	Partial	Partial	Partial	Yes	Yes	Yes	No
Milsom 2007 (188)	High[6]	Yes	Yes	Partial	No	Partial	Yes	Partial	Partial	No
Finch 2006 (191)	Unclear[7]	Yes	Yes	Partial	Partial	Yes	Yes	Yes	Yes	Partial
Stretch 1995 (186)	Unclear[8]	Yes	Partial	Partial	Partial	Partial	Yes	Partial	Yes	No
Harris 1993 (187)	Unclear[9]	Partial	Partial	Partial	Partial	Partial	Yes	Partial	Partial	No
Weightman 1975 (135)	High[10]	Partial	Partial	Partial	No	Partial	Partial	No	Partial	Partial
Proportion of yes answers		70%	20%	0%	0%	30%	80%	20%	50%	20%

Shaded questions represent items used to determine likelihood of bias.

Notes on Likelihood of bias:

[1] No information on target population or how participants were recruited. An adapted questionnaire was used, but only validated in different sport and no information on level of training for interviewers. Non-responders not discussed and there was no clear information on how missing information (if any) was dealt with.

[2] Purposive sampling used. A non-validated questionnaire was used and no information on the level of training for interviewers. They checked data for completeness and internal consistency but there was no clear information on how missing information (if any) was dealt with.

[3] Minimal information on recruitment of participants. Unclear when questionnaires were handed out and collected. There was no clear information on how missing information (if any) was dealt with.

[4] A reasonable attempt was made to ensure a representative sample of school pupils was obtained, however it was not clear how the schools were contacted. A validated questionnaire was adapted, but no description of how this was done. There was no clear information on how missing information (if any) was dealt with.

[5] Convenience sample used. Questionnaire was a pilot trial and non-validated. Response rates included but there was no clear information on how missing information (if any) was dealt with.

[6] Unclear when interviews took place relative to season of interest. No indication of qualification or training of interviewers. Non-responders not discussed and there was no clear information on how missing information (if any) was dealt with.

[7] Aimed to minimise recall bias with two week recall, however proxy respondents may have been used on occasion. Response rates included but there was no clear information on how missing information (if any) was dealt with.

[8] Not clear how subjects were selected. Unclear if questionnaire was validated but it was standardised. Response rates included but there was no clear information on how missing information (if any) was dealt with.

[9] Not clear how subjects were selected. Unclear if questionnaire was validated and when applied in relation to season of interest. Response rates included but there was no clear information on how missing information (if any) was dealt with.

[10] Unsure how many clubs in each county could have been sampled. No information on the validity of questionnaire, but responses were sought monthly. Response rates included but there was no clear information on how missing information (if any) was dealt with. They have also used existing data to extend an assumption on missing data.

3.4.3.3 Injury rates

Table 38 shows the studies that reported IIR from retrospectively collected injury data. Cricket was ranked first for injuries per 1,000 participants in the La Trobe Valley, Victoria, Australia and also for significant injury, which was defined as one that impaired activities of daily living and/or subsequent sporting performance (191). Weightman et al (135) found cricket to have lower IIR than hockey during the mid-1970s in Northern England(135)(135)(135)(135)(135)(135)(135)(135)(180)(180)(180).

Table 38. *Studies reporting injury incidence rates (IIR) from retrospective injury data (n = 2).*

Study	n participants	n injuries	Study Design	Injury Case Definition	Exposure	Injury Incidence Rate for Cricket-Related Cases
Finch 2006 (191)	1084 surveyed, 262 participated in cricket	NR	Telephone survey of single geographical region	Any reported injury during participation regardless of requiring treatment or impacting participation	Per 10,000 population Per 1,000 participants	51 injuries per 10,000 population, 242 injuries per 1,000 participants 83 significant injures per 1,000 participants
Weightman 1975 (135)	Unknown	251	Club survey over 4 counties in a single season.	NR	Per 10,000 man-hours played	2.6 injuries per 10,000 man-hours played

3.4.3.4 Injury prevalence

The proportion of injured participants varied from 27.5% to 80.3% (Table 39). The two studies (187, 190) that used pain as an injury definition reported much higher proportions of injury than those using a time loss definition. For time loss injuries, there was little difference in the proportions of injured players between U15 and U17 South African schoolboy cricketers, however the proportion in the U18 was lower than both the U15 and U17 groups (185).

Table 39. *Studies reporting proportions of injured participants and by age group from retrospective injury data (n = 5).*

	All players			By Age Group							
Study	n participants	n_p injured participants	n_p / n	U8	U10	U12	U14	U15	U16	U17	U18
Khan 2015 (193)	57	26	45.6%	-	-	-	-	-	-	-	-
Stretch 2014 (185)	2,080	572	27.5%	-	-	-	-	29.0%	-	30.0%	23.0%
Ellapen 2012 (190)	234	188[1]	80.3%	-	-	-	-	-	-	-	-
Stretch 1995 (186)	116	49	42.2%	-	-	-	-	-	-	-	-
Harris 1993 (187)	99	61[2]	61.6%	-	-	-	-	-	-	-	-

[1] musculoskeletal pain, [2] lower back pain

3.4.3.5 Injury nature

Table 40 shows the studies reporting injury nature. Two studies investigating school boy cricket in South Africa reported on all injury natures, strain was the most common injury nature (185, 188). Of the fractures reported by these studies, 78% to 92% (185, 188) occurred to the upper limbs (85% to fingers in one study (188)). Achilles tendon injuries were reported to have a prevalence of 11.5% in Bangladesh cricketers (193). Head, face and dental injuries were reported to be most commonly bruising and open wounds in school boy cricketers from England and Australia (170).

Table 40. *Studies reporting injury nature as a proportion of all injury from retrospective injury data (n = 7).*

Study	n injuries	Concussion / closed head injury	Fracture	Avulsion / dislocation	Stress fracture	Rupture / Tear	Open wound	Sprain	Strain	Bruising	Pain	Other / NR
Khan 2015 (193)	26	-	-	-	-	11.5%[1]	-	-	-	-	-	88.5%
Stretch 2014 (185)	658	0.5%	4.9%	-	5.0%	-	-	15.8%	44.8%	-	-	26.1%
Ellapen 2012[2] (190)	285	-	-	-	-	-	-	-	-	-	100%	-
Jagger 2009[3] (170)	269	4.1%	4.5%	0.7%	-	-	20.8%	-	-	21.9%	-	50.0%
Milsom 2007 (188)	67	-	19.4%	1.5%	3.0%	-	-	13.4%	61.2%	-	1.5%	-
Stretch 1995 (186)	57	-	-	-	-	-	-	7.0%	26.3%	-	-	66.7%
Harris 1993[4] (187)	61	-	-	-	-	-	-	-	-	-	100%	

[1] Achilles tendon injuries, [2] Musculoskeletal pain, [3] Head, facial & dental injury only, [4] Lower back pain only.

3.4.3.6 Injured body part

Five studies reported broad body regions of injury (Table 41). The proportion of injuries across upper and lower limbs and trunk/back were, typically, relatively equally distributed. The exception to this was the study on South African schoolboy cricketers over the 1989/91 and 1991/92 seasons, which had the highest proportion of head/face/neck injuries (19%) (186). A later study by the same author (185), reported lower head/face/neck injury proportion of 3% over a five year period from 2007/08 to 2011/12. In those same studies lower limb injuries increased from 23% to 38%.

Table 41. *Studies reporting broad body regions of injury from retrospective injury data (n = 5).*

Study	n injuries	Head/Face/Neck	Upper Limb	Trunk/Back	Lower Limb
Akodu 2016 (189)	69	-	49%	-	51%
Stretch 2014 (185)	658	3%	26%	33%	38%
Ellapen 2012 (190)	285	7%	26%	30%	36%
Milsom 2007 (188)	67	-	34%	31%	34%
Stretch 1995 (186)	57	19%	25%	33%	23%

3.4.3.7 Injury activity, setting and mechanism

There were four studies that reported the cricketing activity at time of injury onset (Table 42). Three of these studies reported on similar cohorts of schoolboy cricketers in South Africa over three distinct time periods (185, 186, 188). The proportion of bowling injuries was relatively similar across these three studies, ranging from 47.4% to 50.7% of all injuries.

Table 42. *Studies reporting injury activity from retrospective injury data (n = 4).*

Study	n injuries	Bowling	Batting	Fielding	Other / NR
Akodu 2016 (189)	69	30.4%	23.2%	21.7%[1]	24.7%[2]
Stretch 2014 (185)	658	48.0%	10.9%	29.9%	11.1%[3]
Milsom 2007 (188)	67	50.7%	14.9%	32.8%	1.5%[4]
Stretch 1995 (186)	57	47.4%	29.8%	22.8%	-

[1] includes 5.8% wicket keeping injuries, [2] includes 18.8% all-rounder injuries, [3] 5% occurred during fitness activities, [4] occurred at other forms of training.

Table 43 shows the studies that reported the setting in which the injury occurred. The proportion of match injuries varied across studies, ranging from 33.4% to 71.6% and similarly, the proportions of injuries occurring at practice varied from 11.6% to 47.3%.

Table 43. *Studies reporting injury setting from retrospective injury data (n = 4).*

Study	n injuries	Match	Practice	Warm Up	Other Fitness Training	Gradual Onset	Not Specified
Akodu 2016 (189)	69	65.2%	34.8%	-	-	-	-
Stretch 2014 (185)	658	33.4%	29.0%	6.0%	10.0%	21.0%	-
Milsom 2007 (188)	67	71.6%	11.6%	-	1.5%	-	15.8%
Stretch 1995 (186)	57	45.6%	47.3%	-	7.0%	-	-

Table 44 shows the studies which reported injury mechanism for retrospectively collected data. For South African school boys, bowling was typically the most common activity when injured, and it was mostly during the run up and/or delivery stride in which it occurred (185). Batting injuries were reported to occur almost equally across running between wickets, being struck by the ball and overuse injury, and fielding injuries occurred predominantly due to being struck by the ball while catching or a non-contact injury when running to catch or field the ball. (185, 188).

Table 44. *Studies reporting injury mechanism from retrospective injury data (n = 4).*

Study	n injuries	Run Up & Delivery Stride	Follow Through	Overuse - Bowling	Struck by Ball	Struck by Bat or Equipment	Running b/w Wickets	Playing a Shot	Overuse – Batting	Fall / Dive in Field	Mishandling ball	Attempting a Catch	Chasing / sliding in Field	Throwing	Player collision	Other / NR
Stretch 2014 (185)	658	36.9%	-	11.2%	2.0%	-	2.3%	-	3.0%	-	2.0%	5.9%	13.1%	5.2%	1.7%	14.0%
Ellapen 2012 (190)	285	-	-	-	39.3%	21.1%	-	-	-	-	-	-	-	-	10.2%	29.5%
Milsom 2007 (188)	67	38.8%[1]	6.0%	-	4.5%	-	4.5%	3.0%	3.0%	11.9%	6.0%	10.4%	7.5%	3.0%	-	1.4%
Stretch 1995 (186)	57	-	-	-	5.3%	-	1.8%	-	-	-	-	-	-	-	-	92.9%

[1] 37.3% of all injuries in delivery stride.

3.4.3.8 Injury severity

Table 45 shows the studies that reported injury severity in retrospectively collected data. Stretch reported that in adolescent South African school boys, in the early 1990s as well as in the mid to late 2000s and early 2010s, time loss injuries were mostly one to seven days (185, 186). Stretch (186) reported that in the 1989/91 and 1991/92 seasons, the head/face/neck injuries required one to seven days recovery time and injuries to the trunk/back and lower limbs made up 87% of the injuries requiring greater than 21 days recovery time. Stretch (185) reported that from 2007/08 to 2011/12, U15 South African schoolboys had higher proportions of time loss from cricket injury in the 1 to 3 and 4 to 7 days categories than the U17 and U18 schoolboys, but lower proportions in categories greater than eight days. Milsom et al (188) reported that the majority of injuries required greater than 21 days recovery. Bowling injuries accounted for the majority of greater than 21 days recovery (65%) and also accounted for 25.4% all lost time injuries.

Table 45. *Studies reporting injury severity by time loss in retrospective injury data (n = 5).*

Study	n injuries	Time Loss 1 - 7 days	Time Loss 8 - 14 days	Time Loss 15 - 21 days	Time Loss > 21 days	Time Loss > 1 month	Not Specified
Akodu 2016 (189)	69	47.8%		39.1%[1]		13.0%	-
Stretch 2014 (185)	658	48.9%	15.0%	8.9%	27.2%	-	-
Milsom 2007 (188)	67	34.3%	22.4%[2]		38.8%	-	4.5%
Stretch 1995 (186)	57	63.2%	22.8%	14.0%	-	-	-
Harris1993 (187)	61	21.3%	-	-	-	-	-

[1] 1 week to 1 month, [2] 8-21 days

3.5 Summary of key findings

This chapter has reported a systematic review of peer reviewed studies presenting injury information on community level cricketers. This is, currently, the only systematic review of its kind in this field and is an important update on the general knowledge of published injury information on injury in cricket community level since Finch et al (194) reported a general summary in 1999 and Stretch (195) provided an update in 2007. Note, there have been two published articles resulting from information drawn from this chapter (196, 197). Key findings include:

- The majority of studies (61%) with reference to community cricket injury were found to be based on acute medical attention data. Twenty-three percent were based on prospective, in-the-field, collected data and 16% were based on retrospective data collection methods. Most of the outcomes were related to injuries to males with only one study specific to females (86). Of the prospectively collected injury data studies, the overall participant numbers were relatively small and the study durations short.
- From studies of medical-attention injuries requiring hospital visits in community cricket, fractures, bruising and open wounds/lacerations were identified as relatively more common than other injury types. The majority of these injuries were likely sustained by players being struck by the ball. Medical attention injuries derived from insurance claims were primarily soft tissue injury and while only the moderate to serious and serious injuries were included, this implied the vast majority of community cricket injuries claimed were of a minor severity. Head/neck and face injuries were relatively common in medical attention injuries, suggesting that further investigations of their injury mechanism and the use of appropriate personal protective equipment, are needed.
- The majority of prospective injury data in community cricket, has focused on junior levels and adolescent bowlers, with little information on adult community cricketers. Fielding was often reported as the most common activity of injury, perhaps a surprise finding given the propensity of focus on bowlers, particularly pace bowlers. Longitudinal studies in community cricket, inclusive of all playing positions, incorporating collection of injury diagnosis and mechanism over multiple seasons, are required. Such studies should also consider both match and training settings and the various associated activities (e.g. warm up), in order to gain a more complete understanding of injury at this cricket level.
- Retrospective injury data studies in community cricket, whilst often reporting greater detail for injury nature, activity and mechanism, are inherently susceptible to biases which can limit the generalisability of the outcomes. The evidence from retrospective

studies was further inhibited by a relatively low critical appraisal outcome compared to studies that used other data collection methods.

- The overall level of evidence from across the different methods in the published studies to date was compromised by an unclear likelihood of bias. Future studies need to be more clear on their recruitment, case selection and data reporting, especially around missing data.

Chapter 4. A descriptive analysis of medical attention injuries to male community cricketers in Victoria, Australia: emergency department presentations and hospital admissions from 2002/03 to 2016/17

4.1 Chapter rationale

Chapter 3 showed that much of the information on acute medical attention injury in community cricket stemmed from hospital data, with only one of those studies specifically investigating cricket (86). Hence, there is scope to further utilise hospital data to better investigate this important section of the sports injury pyramid (Figure 8). Typically, hospital data is difficult to access in Australia, especially on a national basis, due to strict controls around privacy. However, Victoria is one Australian state that has a central repository (the Victorian Injury Surveillance Unit (VISU)) of emergency department (ED) presentations and hospital admissions data that provides almost complete coverage of the Victorian public hospital system. Much of the existing literature, summarised in Chapter 3, is now outdated. Therefore, there was an opportunity to examine hospital data over a broader time period and assess any long term injury trends in this PhD thesis. Because female numbers have been traditionally low in other analysis (136) thereby precluding formal comparison, and Perera et al (86) recently described female hospital treated cricket-related injuries from the same source, this Chapter will utilise the VISU data to examine hospital treated injuries in Victorian males only from the financial years of 2002/03 to 2016/17.

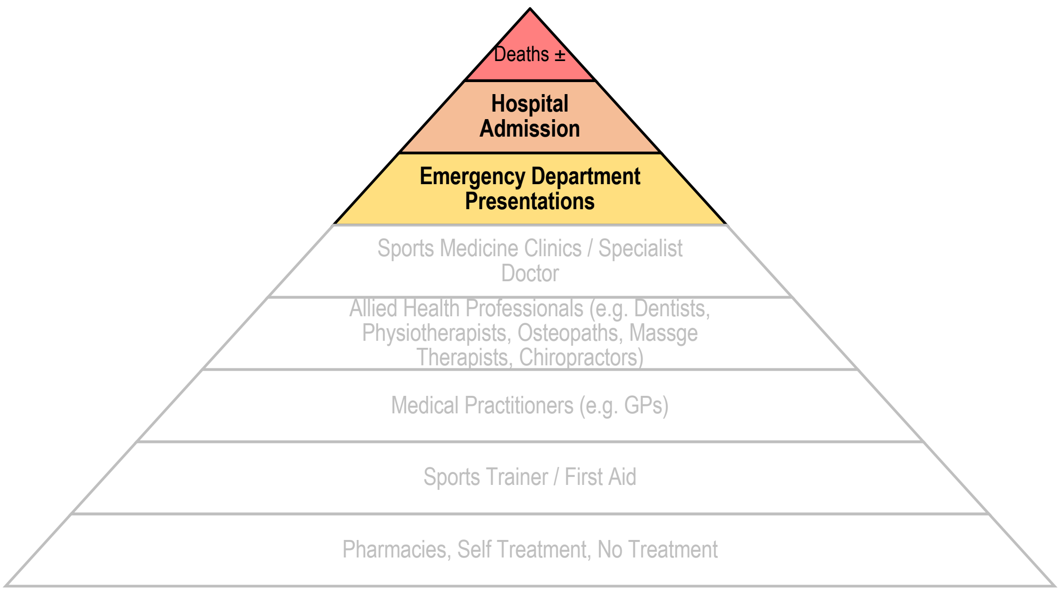

Figure 8. *Sport injury pyramid - hospital data. Note, not all injury deaths will go to hospital.*

4.2 Aim

While hospital attended injuries comprise a small proportion of the overall injuries sustained in sport, they are highly relevant to the overall injury burden and it is therefore worthwhile to monitor their occurrence. An update of injury profiles is valuable to direct modern injury prevention strategies. This is important because being physically active is vital to the well-being of people of all ages who play community level sport and injuries have been shown to negatively affect participation levels (6, 7, 198). Hence the aim of this Chapter was to analyse hospital-treated cricket injuries in Victoria, Australia, over a 15-year period from 2002/03 to 2016/17.

4.3 Methods

The study is a descriptive analysis of existing data on hospital-treated injuries. The study was initially approved by the Federation University Australia Human Research Ethics Committee (HREC C17-026), and later transferred to Edith Cowan University Human Research Ethics Committee (2019-001444-FORTINGTON). Refer to Appendix D for copies of ethics approvals.

Data source

Data were sourced from the VISU, Monash University, initially via their online enquiry form (https://www.monash.edu/muarc/research/research-areas/home-and-community/visu), and then refined through email and phone contact with the VISU staff.

Hospital admissions

Hospital admissions were extracted by the VISU from the Victorian Admitted Episodes Dataset (VAED) from 1st July 2002 to 30th June 2017. The VAED is a state-wide collection of data on all admissions (i.e. 100% capture) to Victorian hospitals (public and private). Data are coded to the International Classification of Diseases, version 10, Australian Modification (ICD-10-AM).

Cases were extracted if a principal diagnosis of unintentional community injury (ICD-10-AM codes S00-T75 or T79), had an activity code of U51.1 cricket. Admissions as a result of transfer from another hospital or due to a statistical separation from the same hospital were excluded to avoid double counting of cases. For the same reason, readmissions from day treatments within 30 days of initial admission were also excluded.

Emergency presentations

Emergency department presentations were extracted by the VISU from the Victorian Emergency Minimum Dataset (VEMD) for the period 1st July 2002 – 30th June 2017. The VEMD is a repository of presentations to 38 Victorian public hospital emergency departments. From 2004, 100% of Victorian public hospitals with a 24-hour service have reported data to the

VEMD. The VEMD is collected in accordance with the National Minimum Data Standards (NMDS) for injury surveillance (199). While the ED data is not coded to ICD-10-AM system, the majority of data items are based on similar definitions and code sets from the National Health Data Dictionary (NHDD) (200). Cases were extracted if the sport code was cricket. Specific cause of injury was extracted using a text variable of 'Description of event'. Search terms of 'ball', 'bat', 'batting', 'collided', 'collision', 'fielding' and 'bowling' were used. Cases selected using the text variable were manually reviewed to ensure relevance. Cases were retained if the 'Human intent' was coded to "Non-intentional harm". In order to maximise the likelihood of capturing only organised community cricket, cases were excluded if the 'Description of event' variable indicated the injury occurred at home, at the beach or in the street.

Variables

Independent variables obtained for both hospital admission and emergency presentations were:

- For population based injury incidence rates (IIR), ages (5- 14, 15-24, 25-44, 45-64 years) were chosen to be representative of the likely participation age ranges for organised community cricket. Cricket Australia and its Victorian state affiliate, Cricket Victoria, have development programs (201) that are designed for participants aged from 5 years of age and have been around in some form since the early 1980s, and more formally since the early 2000s;
- For other injury outcomes (below), ages groups of 5-14, 15-24, 25-44 and 45+ years were adopted.
- Injured body part (head (including face), shoulder and upper arm, elbow and forearm, wrist and hand, trunk, hip and thigh, knee and lower leg, ankle and foot);
- Injury nature (fracture, dislocation, sprain and strain, open wound, superficial injury, injury to muscle or tendon, intracranial injury);
- Injury cause/mechanism (hit/struck/crush, fall, overexertion and or strenuous movements, cutting/piercing);
- Severity. For ED presentations (VEMD), subsequent admission/transfer to hospital admissions. For hospital admissions, hospital bed stay (measured in days) (VAED) were used as proxies for injury severity.

Population data were used as the denominator to calculate injury incidence rates (IIR). Population data for Victoria over the 2002/03 to 2016/17 time period was sourced from the Australian Bureau of Statistics (ABS) website (202). Population values were taken at June 30th at the start of each financial year (e.g. 30th June 2002 for 2002/03 year, measured from 1st July 2002 to 30th June 2003). Population data were used because there was found to be insufficient continuous annual participation data publically available over the 15 year time period investigated.

Statistical analysis

Annual IIR were calculated with 95% Confidence Intervals (95% CI) as per the following equation:

$$IIR_i = \frac{injury\ count\ (n_i)}{population\ of\ interest\ (p_i)} \times 100{,}000$$

Descriptive statistical analyses were performed using Microsoft Excel (2016) and confidence intervals were calculated using a Poisson exact method ('epitools' package) (203) in R, version 3.6.0 (R Core Team 2019) (204). Trend information on IIR data were calculated assuming a Poisson distribution (205) within a generalised linear model using a log link function in R. Where Poisson models were over dispersed, then a Quasi–Poisson analysis was performed. Trends were considered statistically significant if the p-value was less than 0.05.

Descriptive statistics were tabulated for the five most common body locations and injury types and the top three broad and specific injury causes and reported as number and proportions. The proportion of injury per year were calculated for the five most common injury types (ED n = 15,046, admissions n = 4,099) and injured body locations (ED n = 15,593, admissions n = 4,149).

4.4 Results

4.4.1 Overall numbers and age group proportions

From 134,456 hospital admissions reported in the VAED from sports-related injury, 4,955 (3.7%) were cricket-related. When injury locations of 'home/residential institution', 'road, street, highway/farm', and 'other specified places' were removed, there were 4,770 cricket-related hospital admissions, of which 4,604 (96.5%) were male. From 675,330 ED presentations from sports-related injury extracted from the VEMD, 18,821 (2.8%) were cricket-related, with 17,581 (93.4%) were male. Figures 9 and 10 show the proportions of injury cases by age groups for admissions and ED presentations, for males.

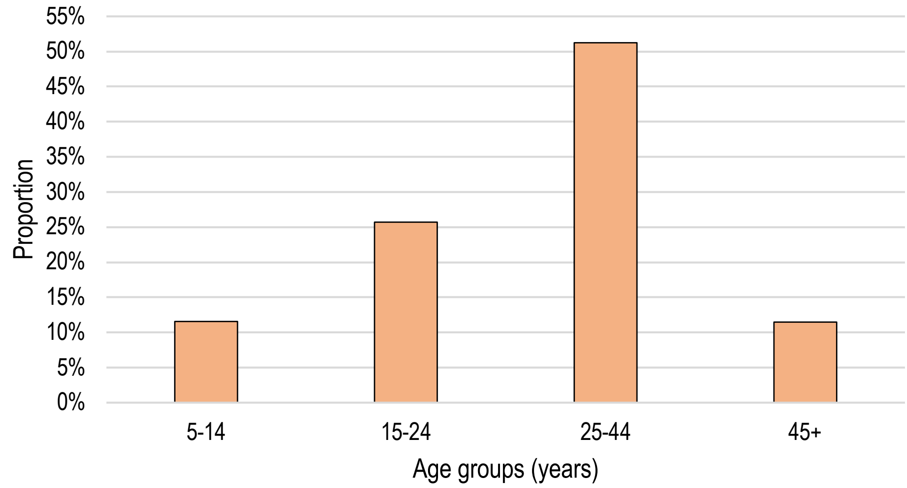

Figure 9. *Proportion of cricket-related injury hospital admissions in Victorian males by age groups (2002/03 to 2016/17) (n = 4,604 injury cases).*

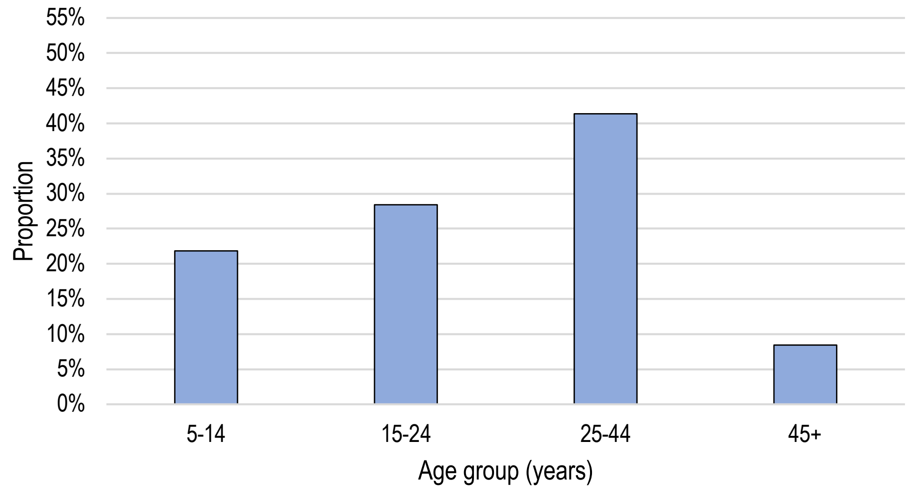

Figure 10. *Proportion of cricket-related injury ED presentations in Victorian males by age groups (2002/03 to 2016/17) (n = 17,581 injury cases).*

4.4.2 Cases per year and injury incidence rates (IIR)

There were, on average, 303 hospital admissions per year for males between the ages of 5 to 64 years. For ED presentations, there were an average of 1,165 cases per year for males aged 5 to 64 years old.

When looking at incidence rates based on a standardised population between ages 5 to 64 the overall average IIR for hospital admissions for males was 14.2 per 100,000 population and 54.6 per 100,000 for ED presentations. Figure 11 shows the annual IIR and those for admissions and ED presentations. There was a non-significant trend in the IIR of ED presentations, increasing on average by 1.2% per year (95% CI -0.44% - 2.8%, p = 0.16). Hospital admissions IIR also had a non-significant trend, increasing on average by 0.7% per year (95% CI -2.4% - 3.9%, p = 0.66).

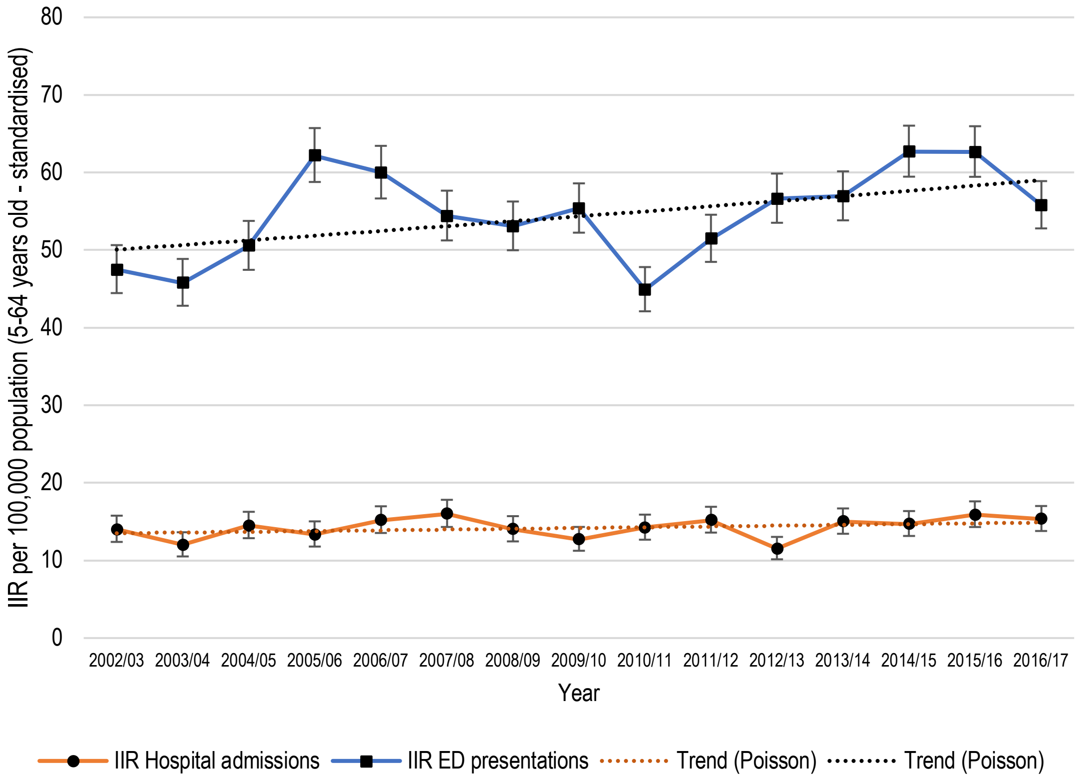

Figure 11. *Injury incidence rates (IIR) for admissions and ED presentations for Victorian males aged between 5 and 64 years (2002/03 to 2016/17).*

Note: The scale of Figure 11 makes it difficult to see individual differences in 95% CI shown. Values are available for reference in Appendix E.

On an age group basis, the 5 to 14 year old group had a non-significant downward trend of 1.6% (95% CI -5.0% - 1.9%, p = 0.37) per year in hospital admissions (Figure 12) and a statistically significant increasing IIR trend of 2.2% (95% CI 0.66% - 3.7%, p = 0.01 Quasi-Poisson) per year in ED presentations (Figure 13).

The average IIR for admissions for 5 to 14 year olds was 10.4 per 100,000 population (95% CI 9.5 – 11.3), and for ED presentations 74.3 per 100,000 population (95% CI 72.1 – 76.9).

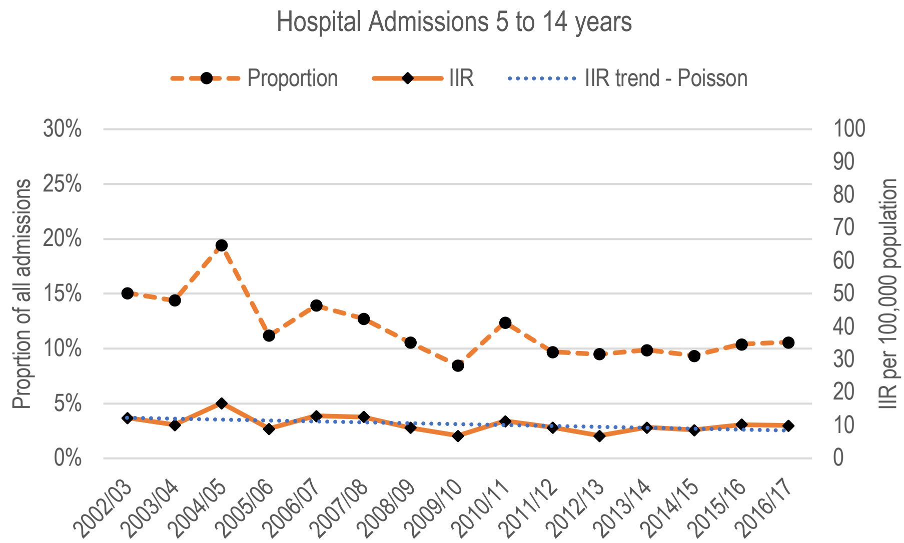

Figure 12. *Annual proportion and IIR of admission cases for Victorian males aged 5 to 14 (2002/03 to 2016/17).*

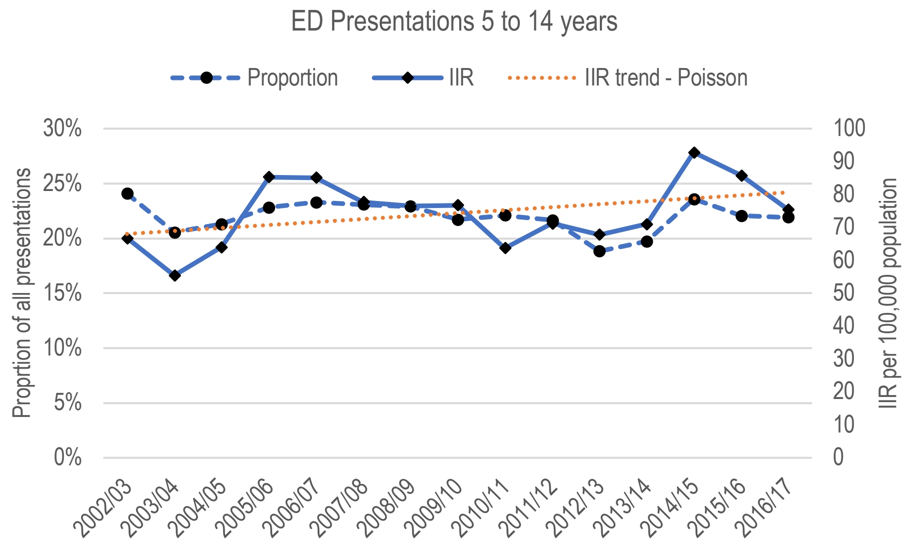

Figure 13. *Annual proportion and IIR of ED presentation cases for Victorian males aged 5 to 14 showing a significant upward trend in IIR (2002/03 to 2016/17).*

The 15 to 24 year old group had a non-significant downward trend of 0.68% (95% CI -3.2% - 1.9%, p = 0.61) per year in hospital admissions (Figure 14) and a non-significant decreasing IIR trend of 0.06% (95% CI -1.3% - 1.2%, p = 0.93) per year in ED presentations (Figure 15).

The average IIR for admissions for 15 to 24 year olds was 20.8 per 100,000 population (95% CI 19.6 – 22.0), and for ED presentations 87.7 per 100,000 population (95% CI 85.3 – 90.2).

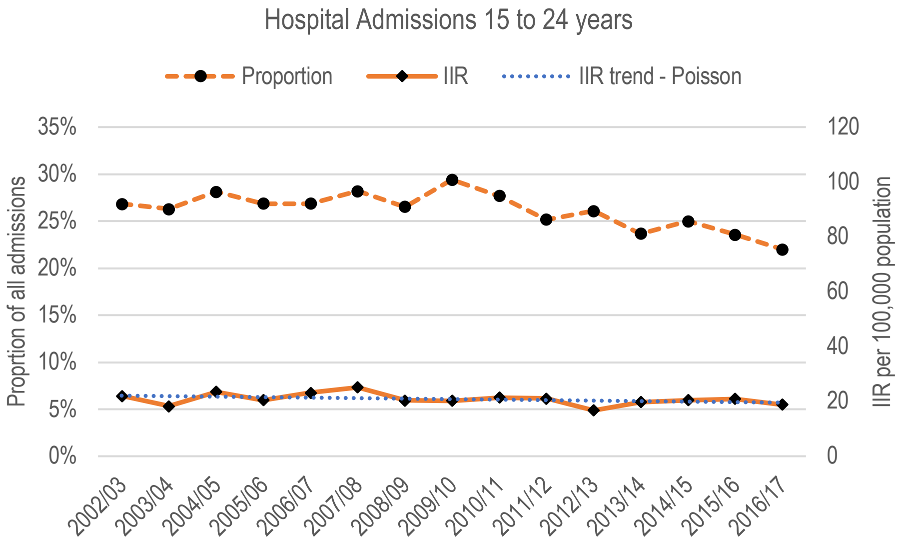

Figure 14. Annual proportion and IIR of admission cases for Victorian males aged 15 to 24 (2002/03 to 2016/17).

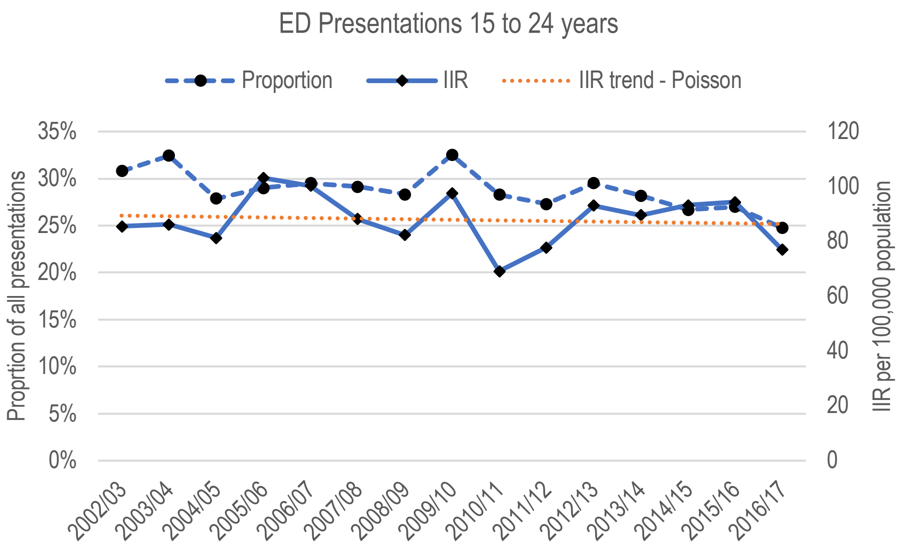

Figure 15. Annual proportion and IIR of ED presentation cases for Victorian males aged 15 to 24 (2002/03 to 2016/17).

The 25 to 44 year old group had a non-significant increasing trend of 1.3% (95% CI -1.3% - 3.9%, p = 0.33) per year in hospital admissions (Figure 16) and a non-significant increasing IIR trend of 0.95% (95% CI -0.52% - 2.4%, p = 0.21) per year in ED presentations (Figure 17).

The average IIR for admissions for 25 to 44 year olds was 20.0 per 100,000 population (95% CI 19.2 – 20.8), and for ED presentations 61.7 per 100,000 population (95% CI 60.3 – 63.1).

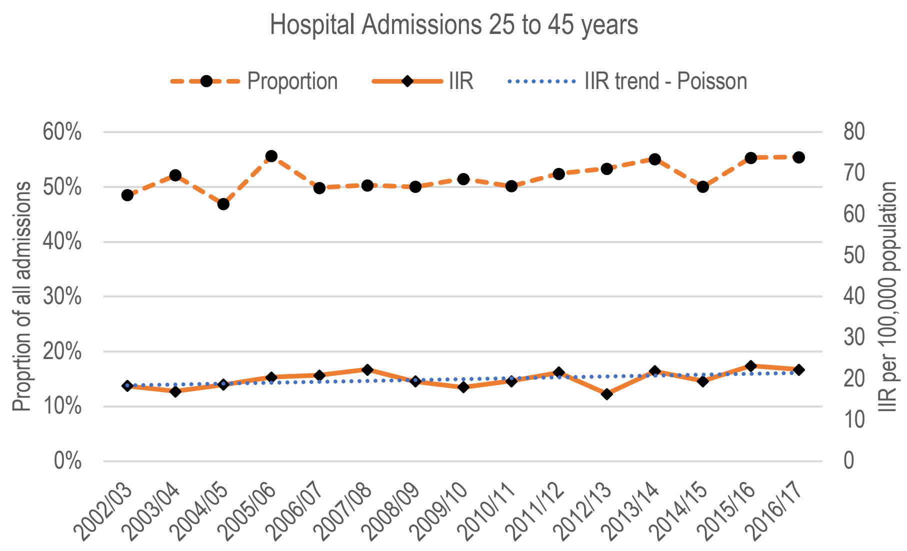

Figure 16. *Annual proportion and IIR of admission cases for Victorian males aged 25 to 44 (2002/03 to 2016/17).*

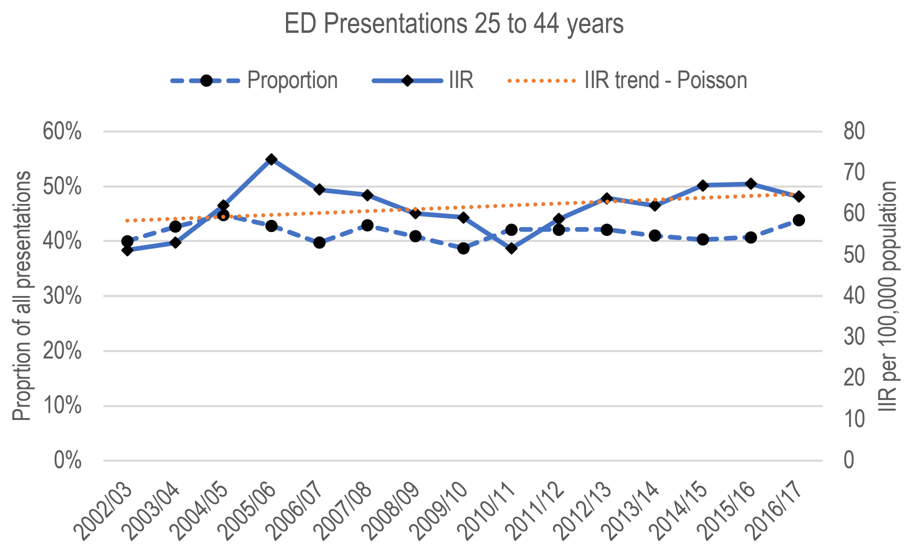

Figure 17. *Annual proportion and IIR of ED presentation cases for Victorian males aged 25 to 44 (2002/03 to 2016/17).*

The 45 to 64 year old group had a non-significant increasing trend of 4.4% (95% CI -1.2% - 10.4%, p = 0.13) per year in hospital admissions (Figure 18) and a statistically significant increasing IIR trend of 6.5% (95% CI 3.1% - 10.1%, p < 0.001) per year in ED presentations (Figure 19).

The average IIR for admissions for 45 to 64 year olds was 4.7 per 100,000 population (95% CI 4.5 – 5.4), and for ED presentations 13.8 per 100,000 population (95% CI 13.1 – 14.6).

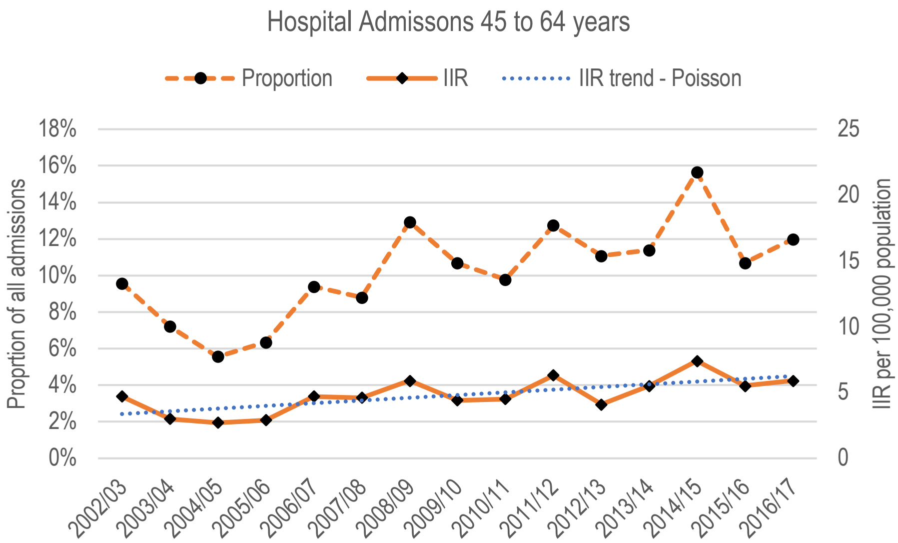

Figure 18. *Annual proportion and IIR of admission cases for Victorian males aged 45 to 64 (2002/03 to 2016/17).*

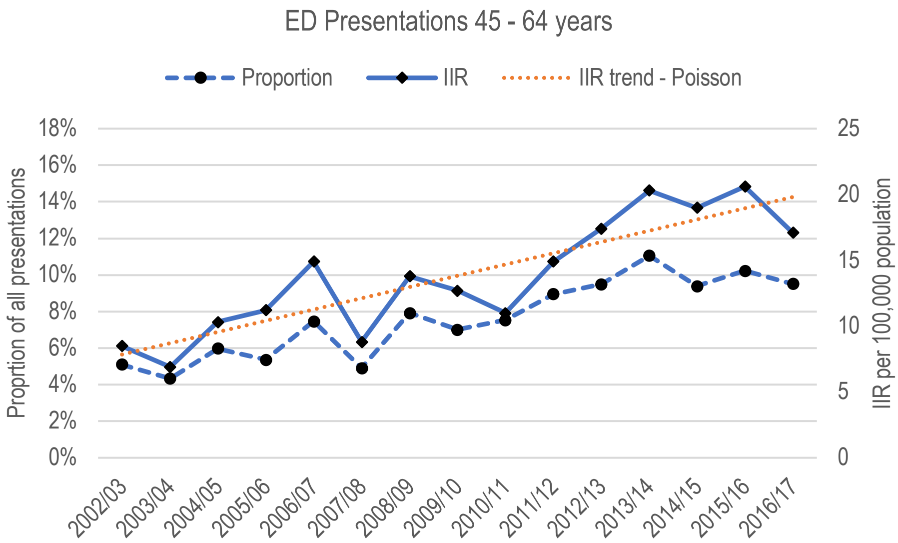

Figure 19. *Annual proportion and IIR of ED presentation cases for Victorian males aged 45 to 64, with a significant upward trend in IIR (2002/03 to 2016/17).*

4.4.3 Injury nature

For hospital admissions, fracture was the most common injury nature (53.2%), followed by dislocation, sprain and strain (18.0%). Intracranial injuries represented 2.8% of hospital admissions (Figure 20).

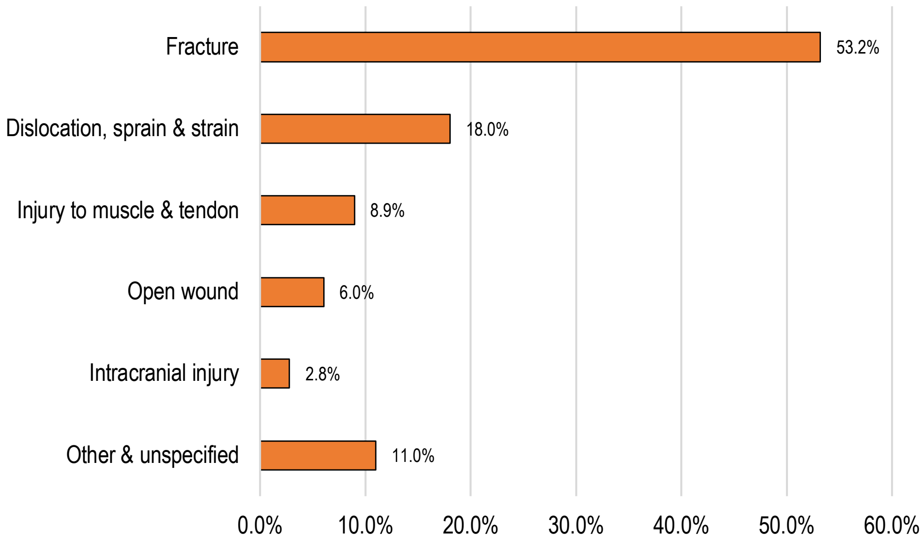

Figure 20. *Top five injury natures requiring hospital admissions for Victorian males aged 5+ years (2002/03 to 2016/17) (n = 4,604).*

For ED presentations, dislocation, sprain and strain was the most common injury nature (29.4%), followed by fracture (25.5%) and open wounds (13.4%) (Figure 21).

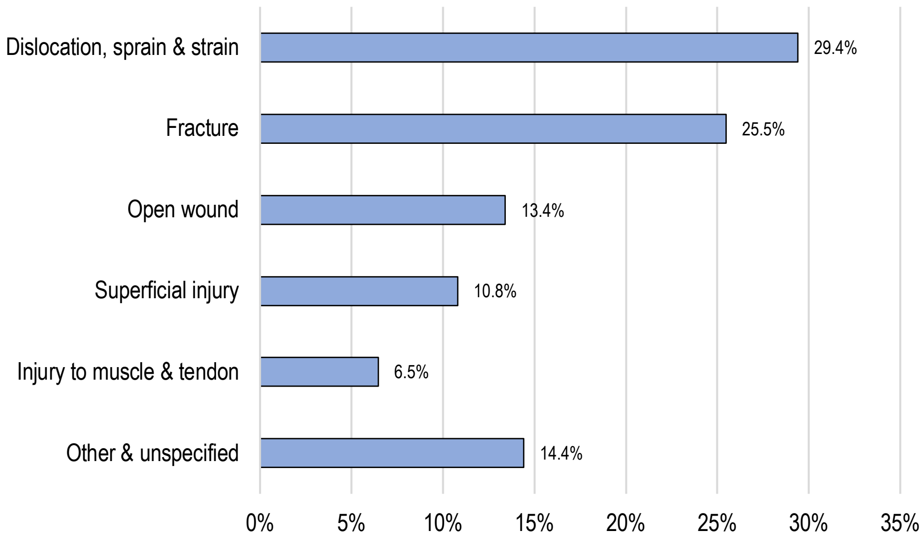

Figure 21. *Top five injury natures requiring ED presentations for Victorian males aged 5+ years (2002/03 to 2016/17) (n = 17,581).*

Table 46 shows numbers and proportions by injury nature across age groups requiring hospital admission. Fracture was the most common injury nature for admissions, with 5 to 14 and 15 to 24 year olds being more represented proportionally compared to older age groups. Dislocation, sprain and strain was the second most common nature in all but the 45+ and the 5 to 14 years old age groups, where injury to muscle and tendon was the second most common injury nature. Injury to muscle and tendon become proportionally more common in older age groups. Conversely, open wounds were more common in younger age groups, with the 5 to 14 year old age group being the most proportionally represented.

Table 46. *Number and proportion of injury nature by age groups for Victorian males aged 5+ years admitted to hospital (2002/03 to 2016/17).*

Injury Nature	5-14 years	15-24 years	25-44 years	45 + years	Total (All)
Fracture	313 (59%)	659 (56%)	1,236 (52%)	242 (46%)	2,450 (53%)
Dislocation, sprain & strain	24 (4%)	262 (22%)	470 (20%)	74 (14%)	830 (18%)
Injury to muscle & tendon	* (< 7%)	* (< 5%)	259 (11%)	132 (25%)	412 (9%)
Open wound	83 (16%)	58 (5%)	119 (5%)	18 (3%)	278 (6%)
Intracranial injury	* (< 7%)	* (< 5%)	38 (2%)	15 (3%)	129 (3%)
Other & unspecified	75 (14%)	146 (12%)	237 (10%)	47 (9%)	505 (11%)
Category total	**534 (12%)**	**1,183 (26%)**	**2,359 (51%)**	**528 (11%)**	**4,604**

* Data suppressed due to counts ≤ 4.

For ED presentations, Table 47 shows dislocation, sprain and strain was the most common injury nature across all age groups, with the 15 to 24 years old age group being most represented. Fractures were most common in the 25 to 44 years old age group. Superficial injury was most proportionally more common in younger age groups and similarly for admissions, injury to muscle and tendon proportions increased with older age groups.

Table 47. *Number and proportion of injury nature by age groups for Victorian males aged 5+ years presenting to ED (2002/03 to 2016/17).*

Injury Nature	5-14 years	15-24 years	25-44 years	45 + years	Total (All)
Dislocation, sprain & strain	880 (23%)	1,734 (35%)	2,171 (30%)	387 (26%)	5,172 (29%)
Fracture	839 (22%)	1,210 (24%)	2,050 (28%)	380 (26%)	4,479 (25%)
Open wound	657 (17%)	534 (11%)	951 (13%)	216 (15%)	2,358 (13%)
Superficial injury	588 (15%)	532 (11%)	654 (9%)	126 (8%)	1,900 (11%)
Injury to muscle & tendon	152 (4%)	279 (5%)	560 (8%)	146 (10%)	1,137 (7%)
Other & unspecified	722 (19%)	708 (14%)	884 (12%)	221 (15%)	2,535 (14%)
Category total	**3,838 (22%)**	**4,997 (28%)**	**7,270 (41%)**	**1,476 (8%)**	**17,581**

Trends in injury nature

Figure 22 shows the annual proportions of the top five injury nature cases for hospital admissions. There are no appreciable trends over the 15 year time period examined, with fractures varying around 60% and dislocation, sprain and strain varying around 20%. Intracranial injury has a small upward trend from 2013/14, as does open wound.

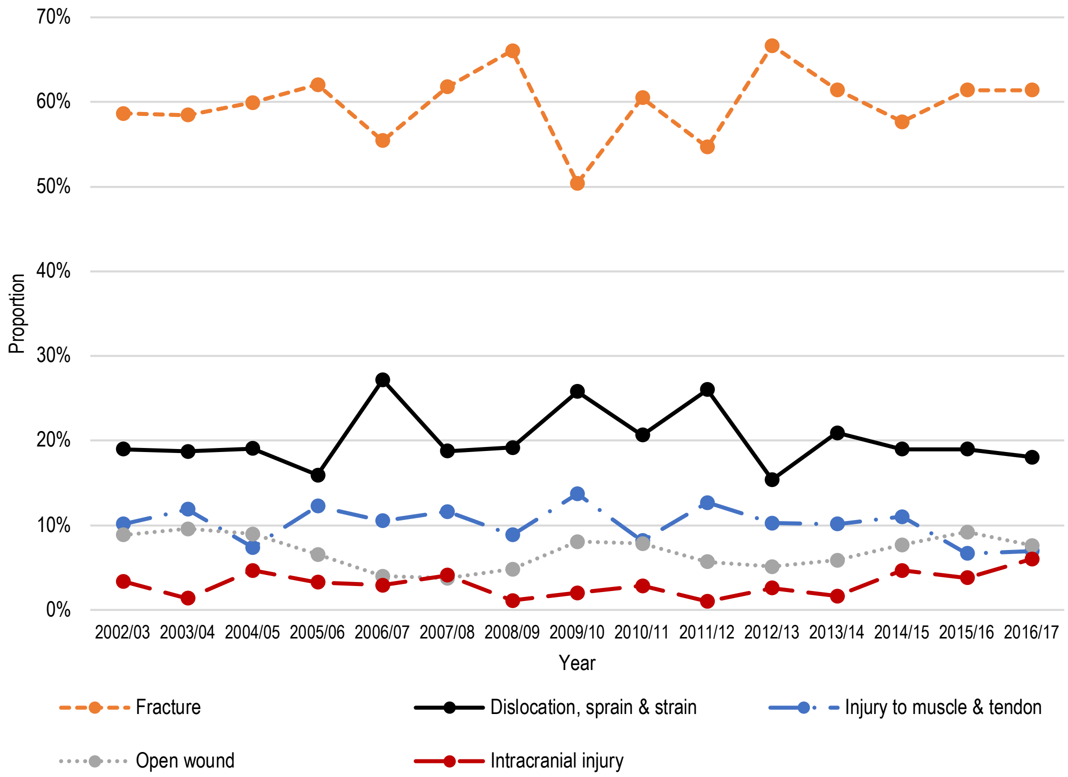

Figure 22. *Annual proportions of the top five injury natures (n = 4,099) for Victorian males aged 5+ years admitted to hospital (2002/03 to 2016/17).*

Figure 23 shows the proportions of the top five injury nature cases presenting to ED per year. The most common injury nature, dislocation, sprain and strain varied around the 35% mark. However, the fractures presenting to ED has trended upwards since 2009/10. Fracture counts increased significantly on average 4.4% (95% CI 3.4% - 5.3%, $p < 0.001$) per year. The proportion of factures exceeded dislocation, sprain and strain as the most common injury nature in the 2016/17 year. Open wounds and superficial injury had an overall downward trend over the 15 year period.

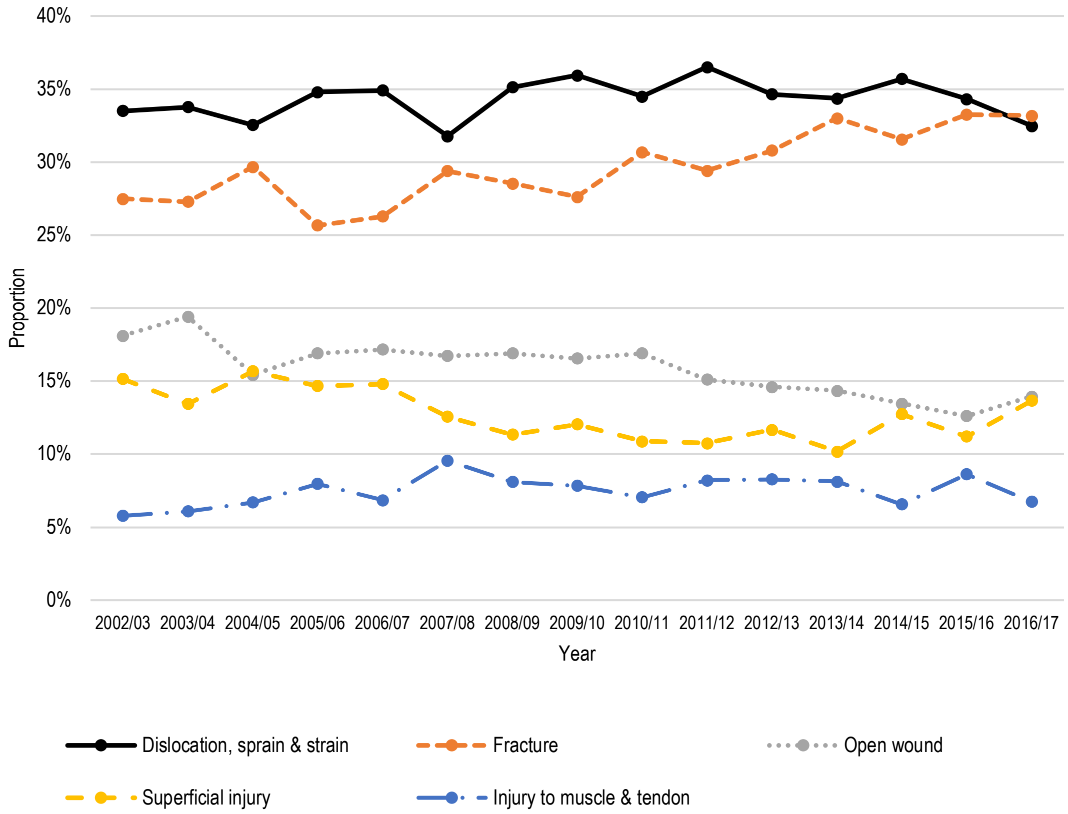

Figure 23. *Annual proportions of the top five injury natures (n = 15,046) for Victorian males aged 5+ years presenting to ED (2002/03 to 2016/17).*

4.4.4 Body part injured

For both hospital admissions and ED presentations, the wrist/hand and head were the two most common body regions injured (Figures 24, 25). The wrist and hand represented 37.1% of admission cases and 35.3% of ED presentations. The head represented 23.3% of admission cases and 27.1% of ED presentations.

The upper limb was more represented in hospital admissions, with the elbow/forearm (5.4%) the fifth most common body region injured, whilst the lower limb was more represented in ED presentations with the ankle/foot (11.3%) being the third most common body region injured. The knee and lower leg was more common in admissions (17.0%) than ED presentations (8.6%).

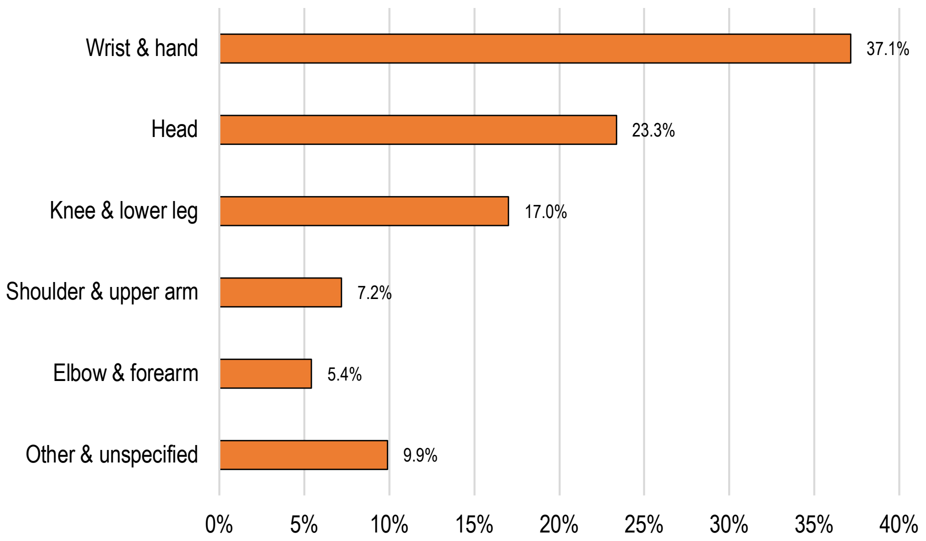

Figure 24. Top five injured body regions requiring hospital admissions for Victorian males aged 5+ years (2002/03 to 2016/17).

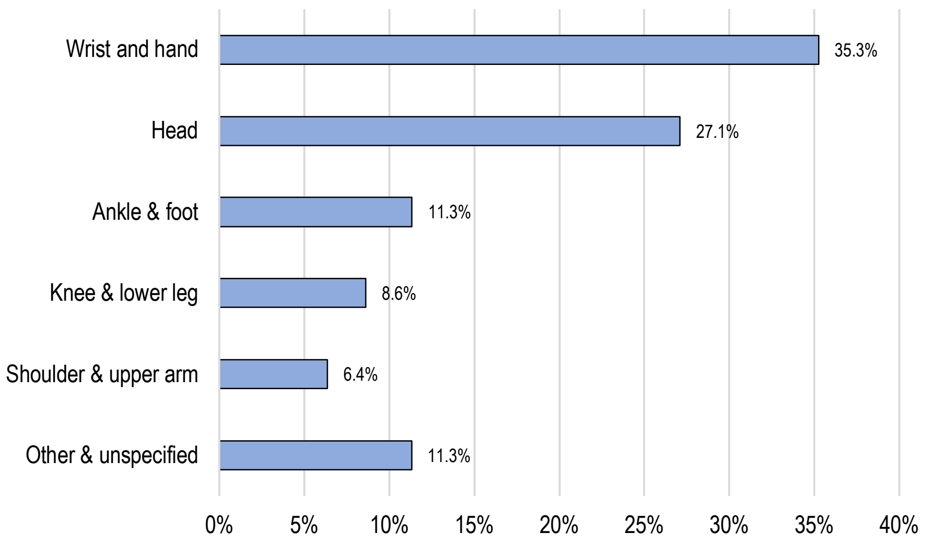

Figure 25. Top five injured body regions requiring ED presentation for Victorian males aged 5+ years (2002/03 to 2016/17).

Table 48 shows that, for hospital admissions, wrist and hand was proportionally the most common body part injured, except for the 5 to 14 years old age group, where the head was the most commonly injured body region. Knee and lower leg injuries were proportionally more common with increasing age group.

Table 48. *Number and proportion of body region injured by age groups for Victorian males aged 5+ years presenting to ED (2002/03 to 2016/17).*

Body region injured	5-14 years	15-24 years	25-44 years	45 + years	Total (All)
Wrist and hand	117 (22%)	480 (41%)	956 (41%)	157 (30%)	1,710 (37%)
Head	221 (41%)	290 (25%)	458 (19%)	106 (20%)	1,075 (23%)
Knee & lower leg	44 (8%)	172 (14%)	447 (19%)	120 (23%)	783 (17%)
Shoulder & upper arm	12 (2%)	77 (6%)	178 (8%)	64 (12%)	331 (7%)
Elbow & forearm	81 (15%)	38 (3%)	105 (4%)	26 (5%)	250 (5%)
Other & unspecified	59 (11%)	126 (11%)	215 (9%)	55 (10%)	455 (10%)
Category total	**534 (12%)**	**1,183 (26%)**	**2,359 (51%)**	**528 (11%)**	**4,604**

Table 49 shows a similar pattern to hospital admissions with ED presentations. Wrist and hand injuries were proportionally most common in injured males aged 15 and over, whilst head injuries were proportionally more common in the 5 to 14 years old age group. Lower limb injuries (ankle/foot and knee and lower leg) increased with increasing age group.

Table 49. *Number and proportion of body region injured by age groups for Victorian males aged 5+ years presenting to ED (2002/03 to 2016/17).*

Body region injured	5-14 years	15-24 years	25-44 years	45 + years	Total (All)
Wrist and hand	1,121 (29%)	1,827 (37%)	2,795 (38%)	456 (31%)	6,199 (35%)
Head	1,593 (42%)	1,145 (23%)	1,662 (23%)	366 (25%)	4,766 (27%)
Ankle & foot	291 (7%)	613 (12%)	913 (13%)	177 (12%)	1,994 (11%)
Knee & lower leg	198 (5%)	471 (9%)	690 (9%)	156 (10%)	1,515 (9%)
Shoulder & upper arm	158 (4%)	362 (7%)	479 (7%)	120 (8%)	1,119 (6%)
Other & unspecified	477 (12%)	579 (12%)	731 (10%)	201 (14%)	1,988 (11%)
Category total	**3,838 (22%)**	**4,997 (28%)**	**7,270 (41%)**	**1,476 (8%)**	**17,581**

Trends in body regions injured

Figure 26 shows the annual proportions of the top five injured body regions admitted to hospital over the 15 year period. Wrist and hand injuries have increased over time from 30% in 2002/03 to 46% in 2016/17 of the top five injured body regions. Wrist and hand injury counts increased significantly on average by 4.6% (95% CI 3.8% - 5.6%, $p < 0.001$) per year. Head injuries have dropped from 33% in 2002/03 to 27% in 2016/17, however there has been a recent upward trend since 2013/14. Overall, admission head injury counts have decreased on average by 3.3% (95% CI -2.4% - 1.7%, $p = 0.75$). Knee and lower leg injuries have also decreased proportionally over time from 21% in 2002/03 to 15% in 2016/17.

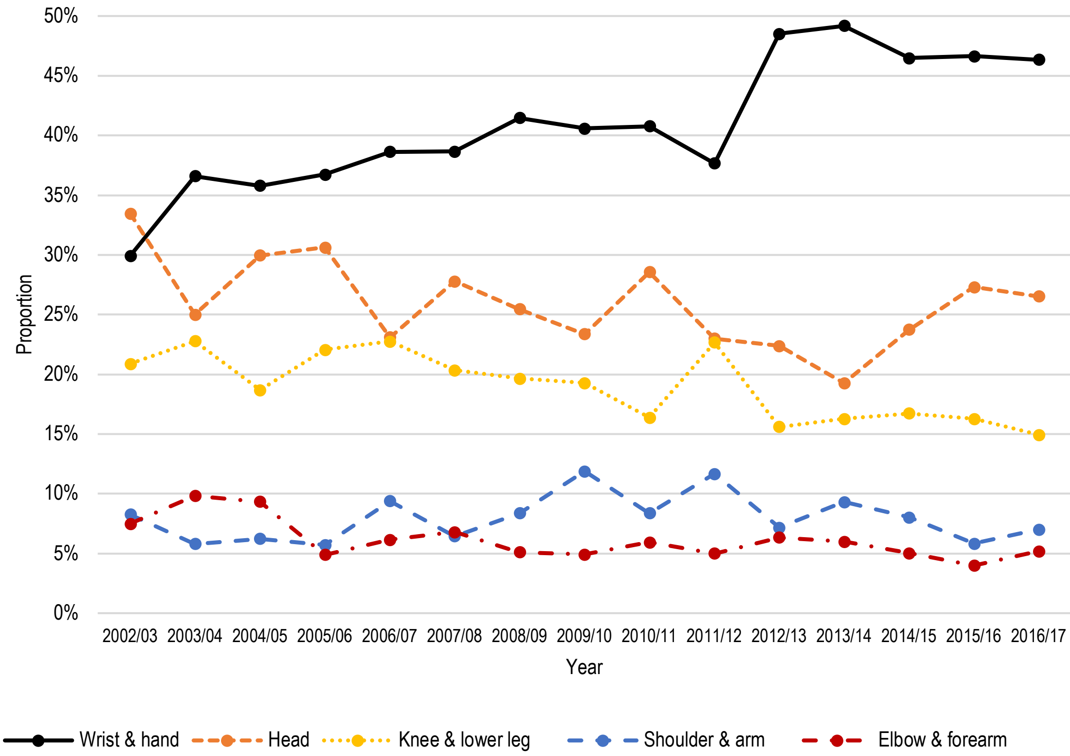

Figure 26. *Annual proportions of the top five injured body regions for Victorian males aged 5+ years admitted to hospital (2002/03 to 2016/17).*

Figure 27 shows the annual proportions of the top five injured body regions presenting to ED over the 15 year period. Wrist and hand injuries increased over the time period, from 35% in 2002/03 to 44% in 2016/17. Wrist and hand injury counts increased significantly on average by 4.2% (95% CI 3.4% - 5.2%, $p < 0.001$) per year. Head injuries had dropped from 37% in 2002/03 to 29% in 2016/17, however in a similar vein to admissions, there had been an upward trend since 2013/14. Overall, head injury counts have decreased on average by 1.6% (95% CI -1.8% - 1.5%, $p = 0.85$). The lower limb and shoulder body regions all varied without any appreciable upward or downward trend.

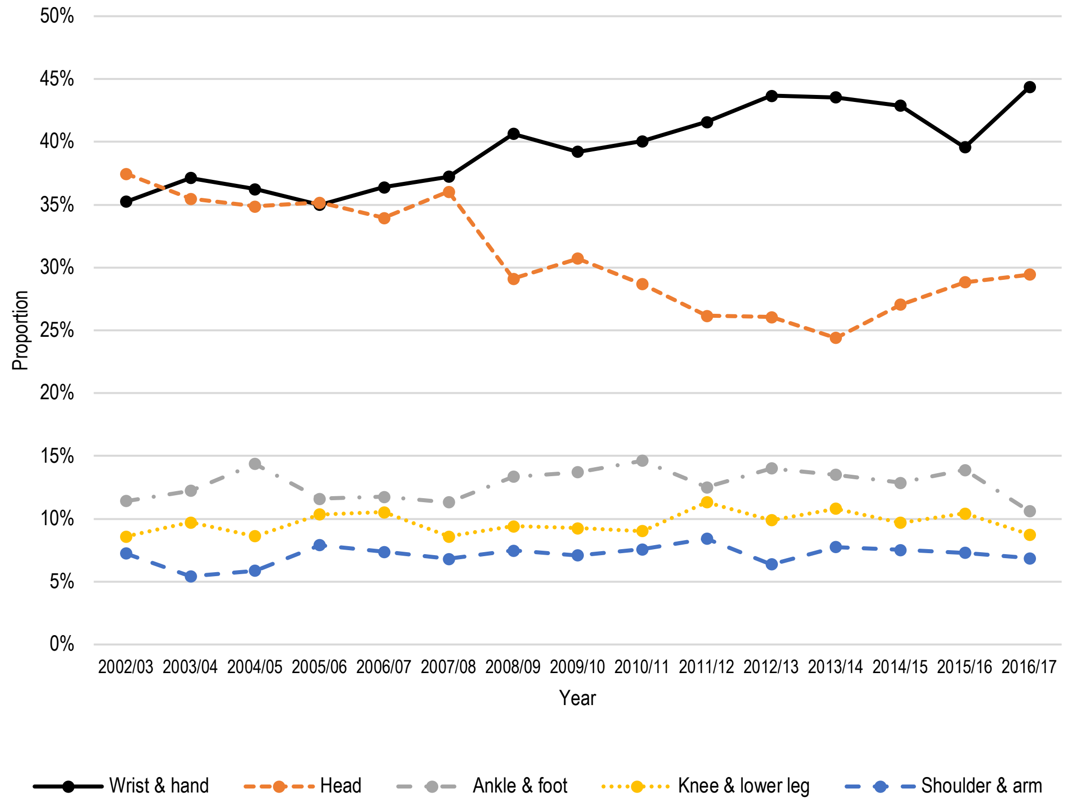

Figure 27. *Annual proportions of the top five injured body regions for Victorian males aged 5+ years presenting to ED (2002/03 to 2016/17).*

4.4.5 Injury nature by body region

Table 50 shows the top five injury natures and corresponding body regions for hospital admission injuries. The wrist and hand was the most common body region associated with fracture (54%), followed by the head (26%). The wrist and hand (41%) was also the most common body region associated with dislocation, sprain and strain, followed by the knee and lower leg (36%). Two thirds (66%) of open wound injuries were to the head and almost three quarters (73%) of injuries to muscle and tendon occurred to the knee and lower leg.

Table 50. *Injury nature by body region for Victorian males aged 5+ years admitted to hospital (2002/03 to 2016/17).*

Top 5 Injury Types (n = 3,908)	Wrist & Hand	Head	Knee & Lower leg	Shoulder & Upper arm	Elbow & Forearm	Total (All)
Fracture	1,282 (54%)	611 (26%)	178 (8%)	77 (3%)	225 (9%)	2,373 (61%)
Dislocation, sprain & strain	325 (41%)	5 (1%)	281 (36%)	161 (20%)	16 (2%)	788 (20%)
Injury to muscle & tendon	14 (4%)	0 (0%)	269 (73%)	*	*	366 (9%)
Open wound	64 (25%)	167 (66%)	18 (7%)	*	*	252 (6%)
Intracranial injury	0 (0%)	129 (100%)	0 (0%)	0 (0%)	0 (0%)	129 (3%)
Total	**1,685 (43%)**	**912 (23%)**	**746 (19%)**	**319 (8%)**	**246 (6%)**	**3,908**

* Data suppressed due to counts ≤ 4.

Table 51 shows the top five injury natures and corresponding body regions for ED presentation injuries. Dislocation, sprain and strain (43%) and fracture (66%) were the most common wrist and hand injury natures. Open wound (68%) and superficial injuries (52%) were most common to the head.

Table 51. *Injury nature by body region for Victorian males aged 5+ years presenting to ED (2002/03 to 2016/17).*

Top 5 Injury Types (n = 13,429)	Wrist & Hand	Head	Ankle & Foot	Knee & Lower leg	Shoulder & Upper arm	Total (All)
Dislocation, sprain & strain	1,987 (43%)	119 (3%)	994 (22%)	806 (18%)	671 (15%)	4,577 (34%)
Fracture	2,687 (66%)	708 (17%)	418 (10%)	79 (2%)	180 (4%)	4,072 (30%)
Open wound	625 (27%)	1,567 (68%)	* (< 1%)	71 (3%)	*	2,298 (17%)
Superficial injury	339 (22%)	816 (52%)	195 (12%)	166 (11%)	* (< 4%)	1,570 (12%)
Injury to muscle & tendon	205 (22%)	85 (25%)	206 (23%)	275 (30%)	141 (15%)	912 (7%)
Total	**5,843 (44%)**	**3,295 (25%)**	**1,845 (14%)**	**1,397 (10%)**	**1,049 (8%)**	**13,429**

* Data suppressed due to counts ≤ 4.

4.4.6 Mechanism of injury

Table 52 shows the broad and specific mechanisms for hospital admissions by age group. The majority of the injuries were due to the broad mechanism of hit/struck/crush (57%). The proportion of hit/struck/crush injuries was similar across the 5 to 44 years old age groupings (range 56% - 61%) but dropped off slightly in the 45 + years old bracket (48%). Falls were proportionally more common in the 5 to 14 years old age group, while overexertion and or strenuous movements were proportionally more common in the 45 + years old age group.

Of the hit/struck/crush injuries, 82% were due to being struck by the ball. Collisions with other players or with the cricket bat were proportionally more common in the 5 to 14 years old age group.

Table 52. *Injury mechanism for Victorian males aged 5+ years admitted to hospital (2002/03 to 2016/17).*

Broad Cause	**5 – 14 years**	**15 – 24 years**	**25 – 44 years**	**45 + years**	**Total**
Hit/struck/crush	326 (61%)	709 (60%)	1,332 (56%)	254 (48%)	2,611 (57%)
Fall	138 (26%)	150 (13%)	312 (13%)	85 (16%)	685 (15%)
Overexertion and or strenuous movements	21 (4%)	137 (11%)	333 (14%)	91 (17%)	582 (13%)
Other & unspecified	49 (9%)	187 (16%)	392 (17%)	98 (19%)	726 (16%)
Category total	**534 (12%)**	**1,183 (26%)**	**2,359 (51%)**	**528 (11%)**	**4,604**
Specific Cause (subset of Hit/struck/crush n = 2611)					
Injury caused by cricket ball	178 (62%)	580 (89%)	1,156 (94%)	220 (92%)	2,134 (82%)
Injury caused by collision with other person	45 (16%)	43 (7%)	46 (4%)	14 (6%)	148 (6%)
Injury caused by cricket bat	65 (22%)	26 (4%)	24 (2%)	6 (2%)	121 (5%)
Category total	**288 (11%)**	**649 (25%)**	**1,226 (47%)**	**240 (9%)**	**2,611**

Table 53 shows the broad and specific mechanisms for ED presentations by age group. Hit/struck/crush was the most common broad mechanism (66%), followed by falls (16%). Hit/struck/crush was slightly more common, proportionally, in the 5 to 14 years age group. The proportion of falls injuries was similar across age groups (range 15% to 17%).

Of the hit/struck/crush injuries, 82% were due to being struck by the ball and 54% of all ED presentations were due to being struck by the ball. Being struck by the bat was much more common in the 5 to 14 years age group (25%) and represented 5.6% of all injuries presenting to ED in this age group.

Table 53. Injury mechanism for Victorian males aged 5+ years presenting to ED (2002/03 to 2016/17).

Broad Cause	5 – 14 years	15 – 24 years	25 – 44 years	45 + years	Total
Hit/struck/crush	2,682 (70%)	3,210 (64%)	4,731 (65%)	909 (62%)	11,532 (66%)
Fall	589 (15%)	847 (17%)	1,152 (16%)	253 (17%)	2,841 (16%)
Cutting/piercing	67 (2%)	70 (1%)	64 (1%)	15 (1%)	216 (1%)
Other & unspecified	500 (13%)	870 (17%)	1,323 (18%)	299 (20%)	2,992 (17%)
Category total	**3,838 (22%)**	**4,997 (28%)**	**7,270 (41%)**	**1,476 (8%)**	**17,581**
Specific Cause					
Injury caused by cricket ball	1,604 (42%)	2,820 (56%)	4,234 (58%)	840 (57%)	9,498 (54%)
Injury caused by cricket bat	982 (25%)	140 (3%)	153 (2%)	29 (2%)	1,304 (7%)
Other & unspecified	1,252 (33%)	2,037 (41%)	2,883 (40%)	607 (41%)	6,779 (39%)
Category total	**3,838 (22%)**	**4,997 (28%)**	**7,270 (41%)**	**1,476 (8%)**	**17,581**

Mechanism and injured body region

When examining the broad mechanism of injury by injured body region for hospital admitted injuries (Figure 28), the head (95%) and wrist/hand (90%) were the most commonly associated with the hit/struck/crush mechanism. The knee and lower leg (64%) was more commonly associated with overexertion or strenuous movements and the shoulder/arm (53%) and elbow/forearm (74%) were more commonly associated with falls.

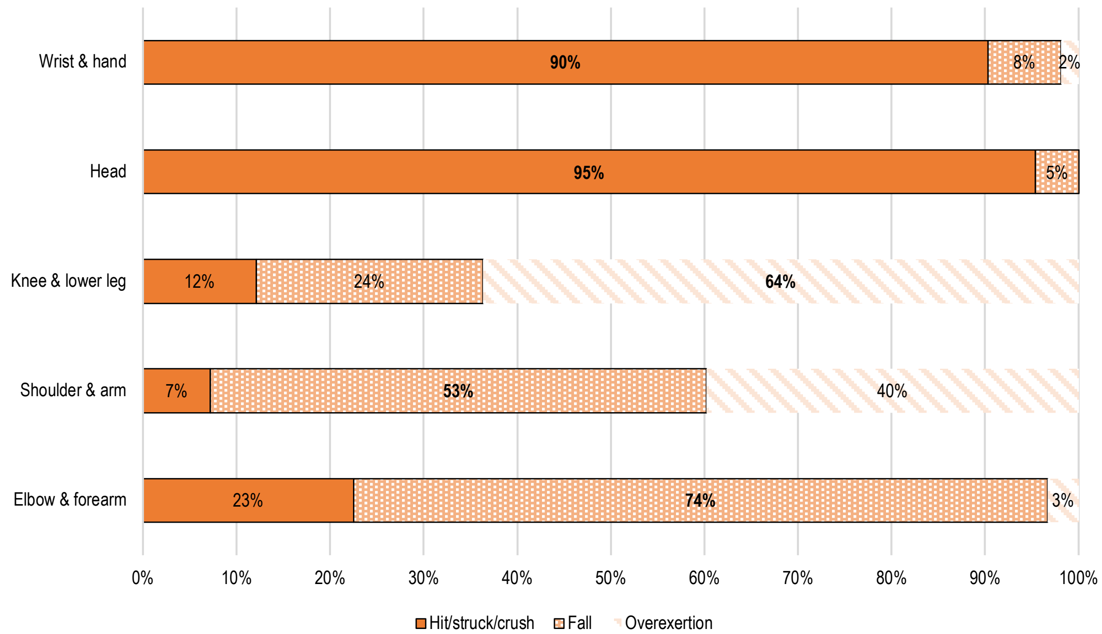

Figure 28. Top three broad mechanisms of injury by injured body region for Victorian males aged 5 + years admitted to hospital (2002/03 to 2016/17) (n = 3,878).

When examining the broad mechanism of injury by injured body region for injuries presenting to ED (Figure 29), the picture was similar to hospital admissions for head (95%) and wrist/hand (87%) with presentations being largely due to hit/struck/crush mechanisms. The ankle and foot (56%) was also more commonly injured by the hit/struck/crush mechanism, whilst falls accounted for the majority of injures to the knee and lower leg (57%) and shoulder and upper arm (74%).

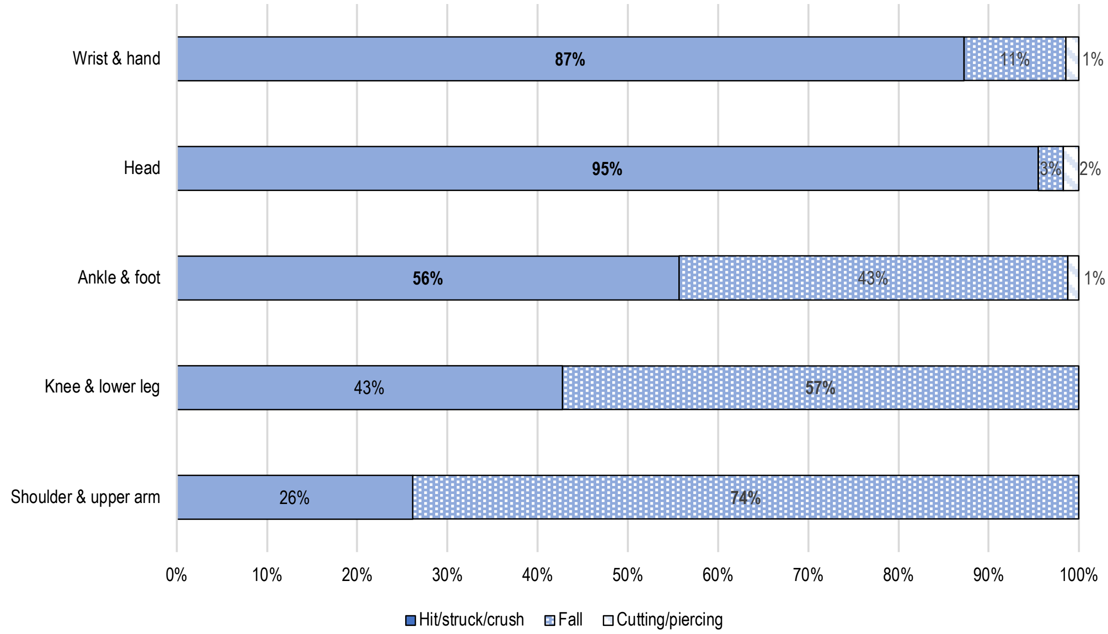

Figure 29. *Top three broad mechanisms of injury by injured body region for Victorian males aged 5 + years presenting to ED (2002/03 to 2016/17) (n = 14,589).*

4.4.7 Injury severity

Of the ED presentations, 5.6% were subsequently admitted to hospital, which equates to an average of 66 cases per year. Of the hospital admissions, 13.5% (n = 648) were required to stay for two or more days. The majority (86.5%) required bed stays of less than two days and this was typical across all age groups (Figure 30). Bed stays of two days or more were increasingly more common in older age groups.

Fracture (50%) was the leading injury type requiring a bed stay greater than two days. Of those fractures, 32% were to the knee and lower leg and 26% to the head. Overexertion was the second leading injury cause requiring a bed stay longer than two days with 73% of those related to the knee and lower leg. The knee and lower leg was the most common body location requiring a bed stay greater than two days (36%), followed by the head (19%) and wrist/hand (12%). Forty-one percent of all injuries requiring a stay of greater than two days were due to being struck by the cricket ball, 25% were due to a fall and 19% due to overexertion.

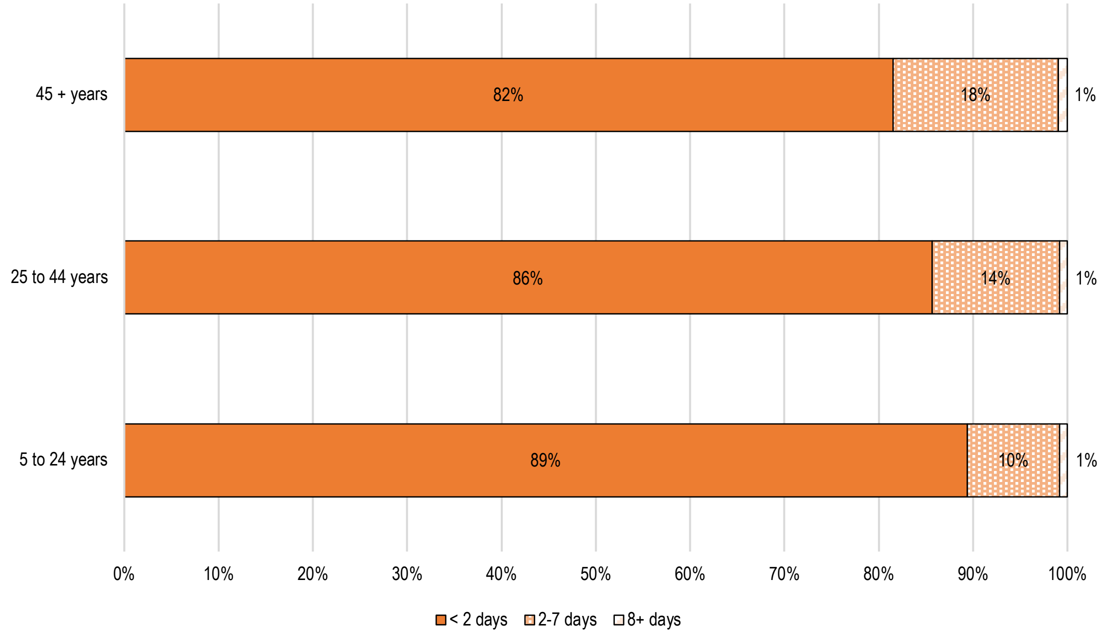

Figure 30. *Proportions of bed stays in hospital admissions by age groups for Victorian males aged 5+ years (5-24 years aggregated) (2002/03 to 2016/17) (n = 4,604).*

4.4.8 Regional versus metropolitan areas

Table 54 shows the annual number and proportion of Admissions and ED presentations by metropolitan (metro) and regional areas of Victoria. ED presentations were over-represented for regional cases and under-represented for metro cases compared to the average available ABS census population counts (74% metro, 26% regional).

Table 54. *Annual proportion of admission and ED presentations by metro and regional location (2002/03 to 2016/17).*

	Hospital admissions					ED presentations				
Year	**Metro**	**%**	**Regional**	**%**	**Total**	**Metro**	**%**	**Regional**	**%**	**Total**
2002/03	189	69.7%	82	30.3%	271	617	67.9%	292	32.1%	909
2003/04	173	72.7%	65	27.3%	238	597	66.6%	299	33.4%	896
2004/05	210	72.4%	80	27.6%	290	704	71.0%	288	29.0%	992
2005/06	184	68.4%	85	31.6%	269	893	72.2%	344	27.8%	1,237
2006/07	219	70.9%	90	29.1%	309	833	68.8%	378	31.2%	1,211
2007/08	248	75.2%	82	24.8%	330	727	66.0%	375	34.0%	1,102
2008/09	224	75.9%	71	24.1%	295	746	68.3%	347	31.7%	1,093
2009/10	173	64.1%	97	35.9%	270	771	65.8%	401	34.2%	1,172
2010/11	202	68.2%	94	31.8%	296	629	66.6%	316	33.4%	945
2011/12	225	69.4%	99	30.6%	324	700	63.2%	407	36.8%	1,107
2012/13	186	74.4%	64	25.6%	250	862	70.3%	364	29.7%	1,226
2013/14	267	80.9%	63	19.1%	330	868	69.1%	389	30.9%	1,257
2014/15	273	82.5%	58	17.5%	331	970	69.6%	424	30.4%	1,394
2015/16	288	79.3%	75	20.7%	363	1,022	71.9%	400	28.1%	1,422
2016/17	284	79.8%	72	20.2%	356	945	73.9%	333	26.1%	1,278
Total	**3,345**	**74.0%**	**1,177**	**26.0%**	**4,522**	**11,884**	**68.9%**	**5,357**	**31.1%**	**17,241**

Table 55 shows the age group distributions by metro and regional areas for admissions and ED presentations. The 15 to 24 years old age group was significantly more represented in regional areas (30.8%, 95% CI 29.6% - 32.1%, Wilson method) compared to metro (27.1%, 95% CI 26.3% - 27.9%, Wilson method) in ED presentations. Hospital admissions in the 25 to 44 years old age group were significantly over represented in the metro area (52.6%, 95% CI 50.9% - 54.2%, Wilson method) compared to regional areas (47.1%, 95% CI 44.2% - 49.9%) as well as in ED presentations (metro: 42.0% (95% CI 41.1% - 42.9%)) compared with regional (39.6%, 95% CI 38.3% - 41.0%).

Table 55. *Proportion of Victorian male admissions and ED presentations for metro and regional locations by age group (2002/03 to 2016/17).*

	Hospital admissions					ED presentations				
Year	**Metro**	**%**	**Regional**	**%**	**Total**	**Metro**	**%**	**Regional**	**%**	**Total**
5-14 years	377	11.3%	150	12.7%	527	2,632	22.1%	1,164	21.7%	3,796
15-24 years	829	24.8%	330	28.0%	1,159	3,221	27.1%	1,652	30.8%	4,873
25-44 years	1,758	52.6%	554	47.1%	2,312	4,992	42.0%	2,123	39.6%	7,115
45+ years	381	11.4%	143	12.1%	524	1,039	8.7%	418	7.8%	1,457
Total	**3,345**		**1,177**		**4,522**	**11,884**		**5,357**		**17,241**

Figure 31 shows the IIR for regional and metro cases for hospital admissions. The regional hospital admissions IIR was clearly (based on non-overlapping 95% CI) higher in the 2011 census year, but decreased to a level below the metro IIR in 2016, which had increased since 2011.

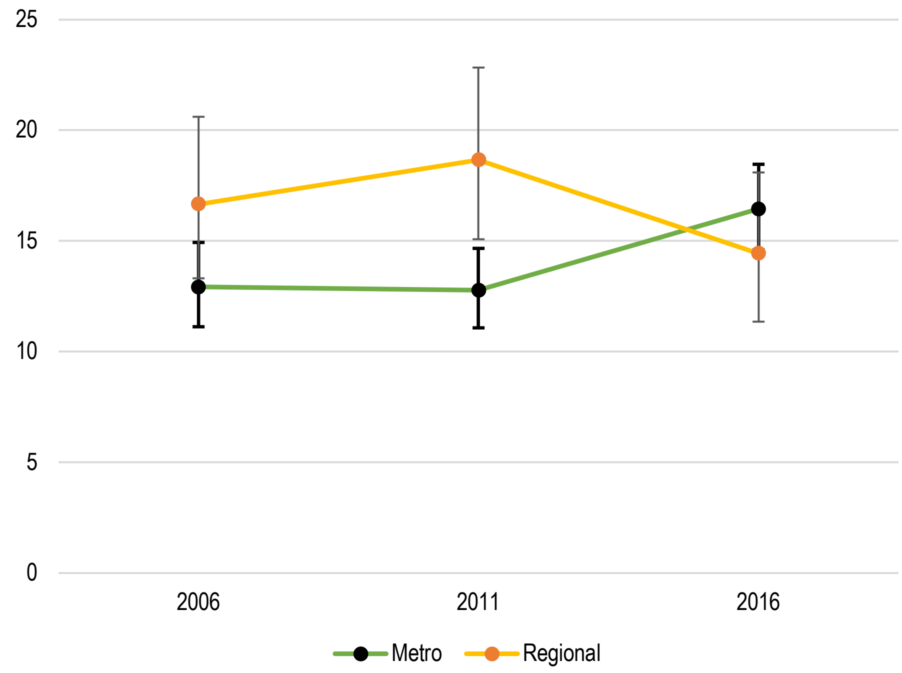

Figure 31. *Metro and regional hospital admission IIR for Victorian males by ABS census years (2002/03 to 2016/17).*

Figure 32 shows the IIR per 100,000 population comparing regional and metro cases based on ABS census data for ED presentations. The regional areas IIR was clearly larger than metro (based on non-overlapping 95% CI) in the 2011 and 2016 years.

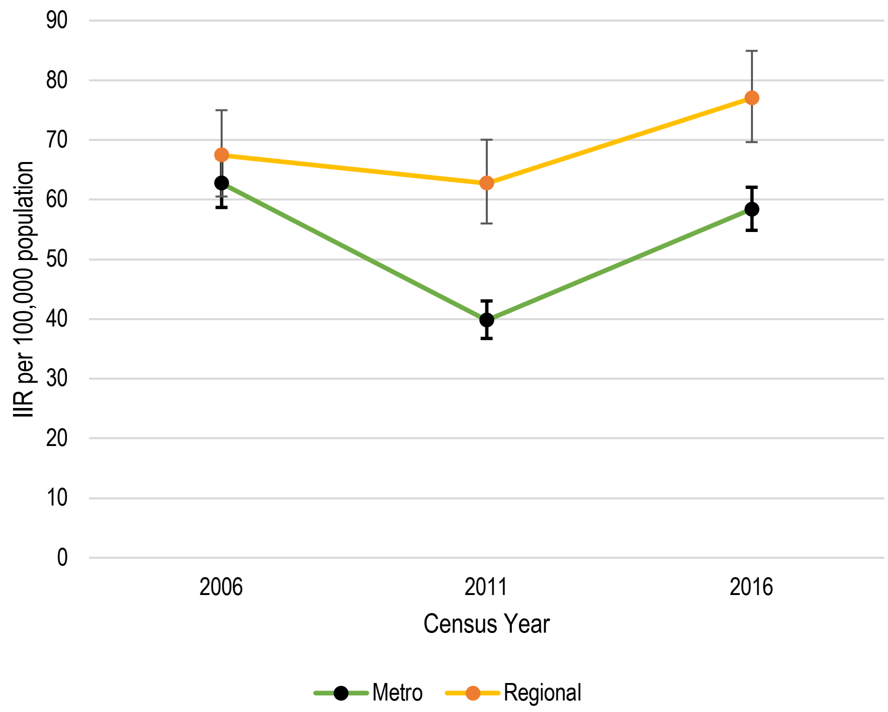

Figure 32. *Metro and regional ED presentations IIR for Victorian males by ABS census years (2002/03 to 2016/17).*

4.5 Summary of key findings

This chapter has presented an analysis of 15 years of injury presentation to ED and admissions to hospital for male cricket-related injury in Victoria, Australia. Compared to the studies reviewed in Chapter 3, the unique detail and longitudinal timeframe presented in this chapter had been missing in previous studies using hospital data. Key findings include:

- Male cricket-related injuries requiring hospital attention are mainly fractures, dislocations and sprains and strains.
- There was a non-significant trend in hospital admission IIR, increasing on average by 0.7% per year (95% CI -2.4% - 3.9%) and ED presentations IIR increasing on average by 1.2% per year (95% CI -0.4% - 2.8%).
- The wrist/hand was the most commonly injured body region followed by the head.
- Wrist/hand injuries in both ED presentations and admissions increased significantly over the time period investigated (2002/03 to 2016/17).
- Head injuries decreased overall, however, they began to trend upward from 2013/14.
- Head injury was more common in younger males (5 to 14 years old) as well as injury from being struck by the bat and collisions with other players.

- Lower limb injuries were more common in older males (45 to 64 years) and they were more susceptible to lower limb injuries and having greater proportion of bed stays of two or more days than younger age groups.
- Being struck by the ball was the most common mechanism of injury for both ED presentation and admission.
- The majority of admissions required less than two days bed stay.

Chapter 5. A descriptive analysis of injuries in community cricketers in New Zealand: data from a national insurance scheme from 2008/09 to 2018/19.

5.1 Chapter rationale

Chapter 4 has shown that routinely collected hospital data can provide a useful source of information to inform a broad injury profile for acute medically treated cricket injury. However, the data has several important limitations when it comes to representativeness and informing injury prevention measures.

Chapters 2 and 3 showed that insurance claims data has been used to report on cricket-related injury in the past (99, 102, 104). The reporting has come exclusively out of NZ, where the Accident Compensation Corporation (ACC) operates a national insurance scheme for all accidental injury. The potential usefulness of the ACC system is highlighted by its widespread use in studies reporting on sports injury through insurance data in the last 20 years (Chapter 2). However, there have been no studies using insurance claims reporting specifically on cricket alone. Therefore, the potential to use this data source to further explore the injury profile of community cricket is the focus of the Chapter. With this analysis, injuries are potentially captured from additional layers of the injury pyramid than seen in Chapter 4.

5.2 Aim

There have been no studies that have specifically detailed community-level cricket injuries using the ACC data. Therefore this study aims to investigate ACC claims for organised community-level cricket injury with the following objectives:

- to understand the profile of injuries (number, type, nature, mechanism) in cricket specific activities (batting, bowling, fielding and wicket keeping);
- to investigate time lost to work due to cricket-related injury as a measure of injury burden for community players.

5.3 Methods

This study is a descriptive analysis of existing insurance claims data from July 1, 2008 to June 30, 2018, supplied, on request, by the ACC. The study was approved by the Edith Cowan University Human Research Ethics Committee (2019-01144-FORTINGTON). Refer to Appendix D for a copy of the ethics approval.

Data Source & Variables

Data on new claims, for both males and females, were provided by the ACC of New Zealand initially via an email data request. Cricket claims were identified by the ACC in the following manner:

1. Extracting accepted cricket claims from the claims data with an accident date in the time period (i.e. claims where the claim cover decision is accepted, AND sport field is "Indoor Cricket" or "Outdoor Cricket", AND accident date is between July 2008 and June 2018, inclusive);
2. Creating batting, bowling and wicket keeping indicators by using the accident description field (reported by claimants or providers on the ACC45 claim form) using search terms “batting”, “bowling”, “field*”, and “wicketkeep*”.;
3. Join information from item 2 to the client’s data in item 1 to get claimant’s demographics;
4. Join information from item 3 to payments data to get their weekly compensation details;
5. Aggregate item 4 to the final output data level (i.e. summed up the claim counts).
6. Data file was emailed as an Excel workbook file.

Because the ACC scheme works on a no-fault basis, the electronic claim form used (ACC45) to collect injury data has fields that are not mandatory. The description of injury, as reported by the claimant or their health provider, is one such field and as such limits the information gathered to being largely representative but not a completely definitive measure of all claims.

Injury variables assessed were injury nature/type:

- soft tissue (includes strain, sprain, and contusion);
- fracture/dislocation;
- cut/laceration;
- concussion;
- dental injury;
- other (includes internal organ injuries).

Body regions injured were grouped as follows:

- head/neck/face (includes head, face, eye, ear, nose, neck/spine);
- upper limb (includes shoulder, upper and lower arm, elbow, hand/wrist and finger/thumb);
- lower limb (includes hip, upper leg, thigh, knee, lower leg, ankle, foot, toes);
- trunk (includes abdomen/pelvis, upper back/spine, chest, lower back/spine, lung);
- multiple locations;

- unknown/unobtainable.

Age groupings supplied by the ACC were in 5 year intervals, except for the 0-9 year old age group. An additional request was made to split out the 0-4 and 5-9 years old ages in order to better identify the age group likely associated with community level, organised cricket. Due to the dynamic nature of the ACC database, any future retrieval of data over a particular time frame may be subject to changes when new claims are submitted. Subsequent assessment of the new dataset against the original dataset identified a single new claim had been added, which was deemed to have negligible effect on the existing analysis.

Injury factors supplied within the data investigated included:

- External agency (includes recreation/sports equipment-ball, ground/path, recreation/sports equip-other and self, and other);
- injury contact (includes impact/contact with object, impact/contact with ground/floor, strenuous movement without lifting, strenuous movement with lifting, and other);
- injury cause (includes loss of balance/personal support, collision/knocked over by object, twisting movement, lifting/carrying/strain, slipping/skidding on foot, and other).

An example of the method of presentation of the injury factor information is shown in Figure 33.

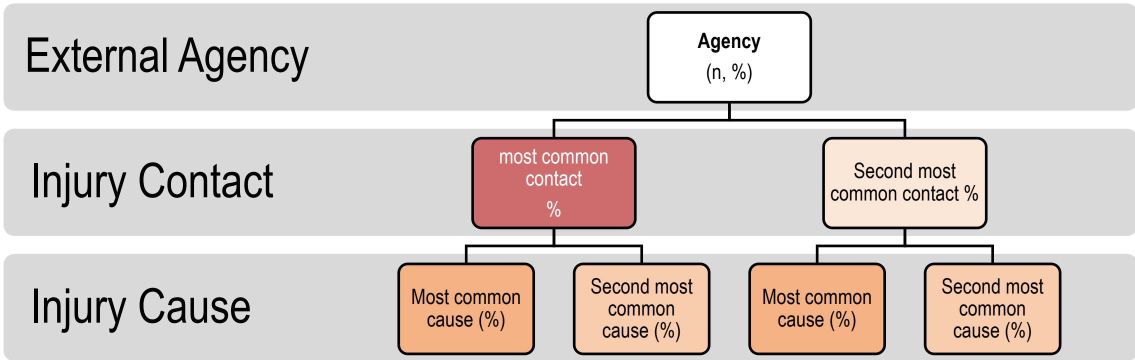

Figure 33. *Example of presentation of injury factors.*

In order to maximise the potential to identify injuries sustained in organised forms of cricket, only those claims that occurred at a place of recreation or sports were included. Because of a lack of available participation data on community level cricket in New Zealand, population data were used for injury incidence rate (IIR) calculations per 100,000 population based on ages 5 to 64 years old. These ages represent the broad spectrum of likely participants from junior development to veterans. Population data were sourced from the New Zealand bureau of statistics (206).

Injury severity is often measured by days missed from sport (207), however this information is unavailable through the ACC system. For this study we have assigned the number of work days paid, that is where income has been paid to claimants for work time lost due to injury, as a proxy for injury severity with the following groups:

- one to seven days (mild severity);
- 8 to 29 days (moderate);
- 30 to 179 days (major);
- 180 + days (severe).

The work days paid variable is not a definitive measure of injury severity as the claimants work will pay the first week before the scheme begins payment. Therefore it will underestimate the lower severity injuries that require less than one week off work. Descriptive analysis on the treatment provider is also performed.

Unless specified/identified in the tables/charts, the claims presented represent both indoor and outdoor forms of the game.

Statistical analysis

Annual IIR, per 100,000 population were calculated using crude population values with 95% Confidence Intervals (95% CI) as per the following equation:

$$IIR_i = \frac{injury\ count\ (n_i)}{population\ of\ interest\ (p_i)} \times 100{,}000$$

Descriptive statistical analysis was performed using Microsoft Excel (2016) and R, version 3.46.0 (R Core Team 2019) (204). Confidence intervals for IIR were calculated using a Poisson exact method ('epitools' package) (203) in R. Trends in the IIR data were calculated assuming a Poisson distribution (205) within a generalised linear model using a log link function in R. Where Poisson models were over dispersed, then a Quasi–Poisson analysis was performed. Trends were considered statistically significant if the p-value was less than 0.05.

Descriptive statistics (n, %, 95%CI) were tabulated for body regions injured by activity of onset with confidence intervals calculated using Wilson methods ('DescTools' package) (208) in R. Confidence intervals for the proportions of work days paid and odds ratios of female to male counts were calculated using the OpenEpi tool (209) for proportions and 2x2 tables in counts.

5.4 Results

5.4.1 Overall claim numbers

Covering the period of 10 financial years, from 2008/09 to 2017/18, there were 84,942 claims made in relation to injury associated with cricket. The vast majority of injuries occurred at a place of recreation or sports n = 62,776 (73.9%). The remainder was made up of injuries occurring at the home (12.7%), school (7.6%) and other scenes (5.8%) which included commercial/service locations, road/street, place of medical treatment, industrial place, farm and those not obtainable (Figure 34).

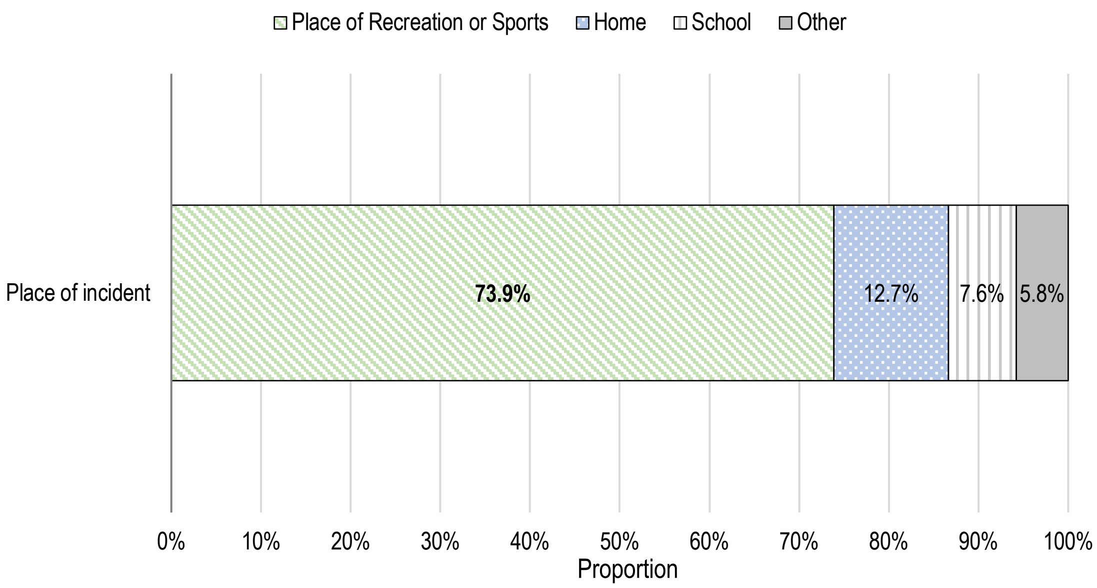

Figure 34. *Proportion of cricket-related ACC claims by place of incident (2008 – 2018) (n = 84,942).*

5.4.2 Age and sex characteristics

Of the 62,776 claims relating to a place of recreation or sports, 5,430 (8.6%) were by females and 57,346 (91.4%) were for males. Overall, the 15-19 years old age group was the most frequently injured, followed by the 25-29 and 20-24 years old age groups (Figure 35). Of the females injured, the most common age group was the 15-19 years old group, followed by the 10-14 and 20-24 years old age group. For males the most common age group was also the 15-19 years old group, followed by the 25-29 and 20-24 years old age group (Figure 36).

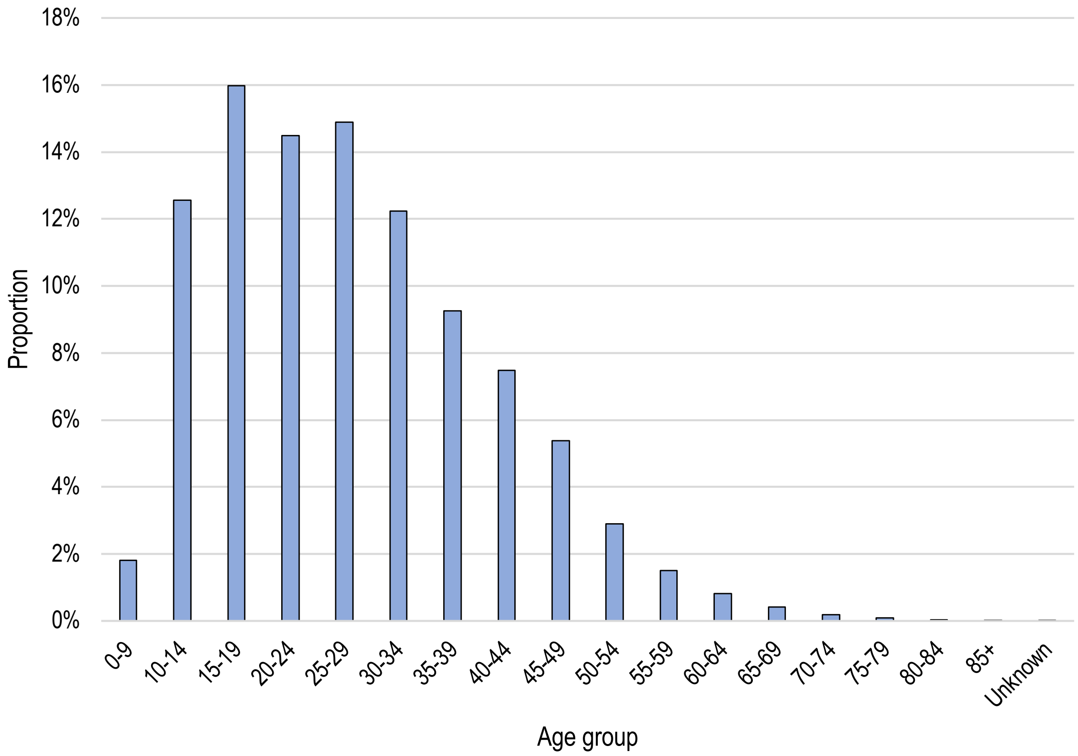

Figure 35. *Overall proportion of cricket-related ACC claims by age group relating to a place of recreation or sports for males and females (2008 – 2018) (n = 62,776).*

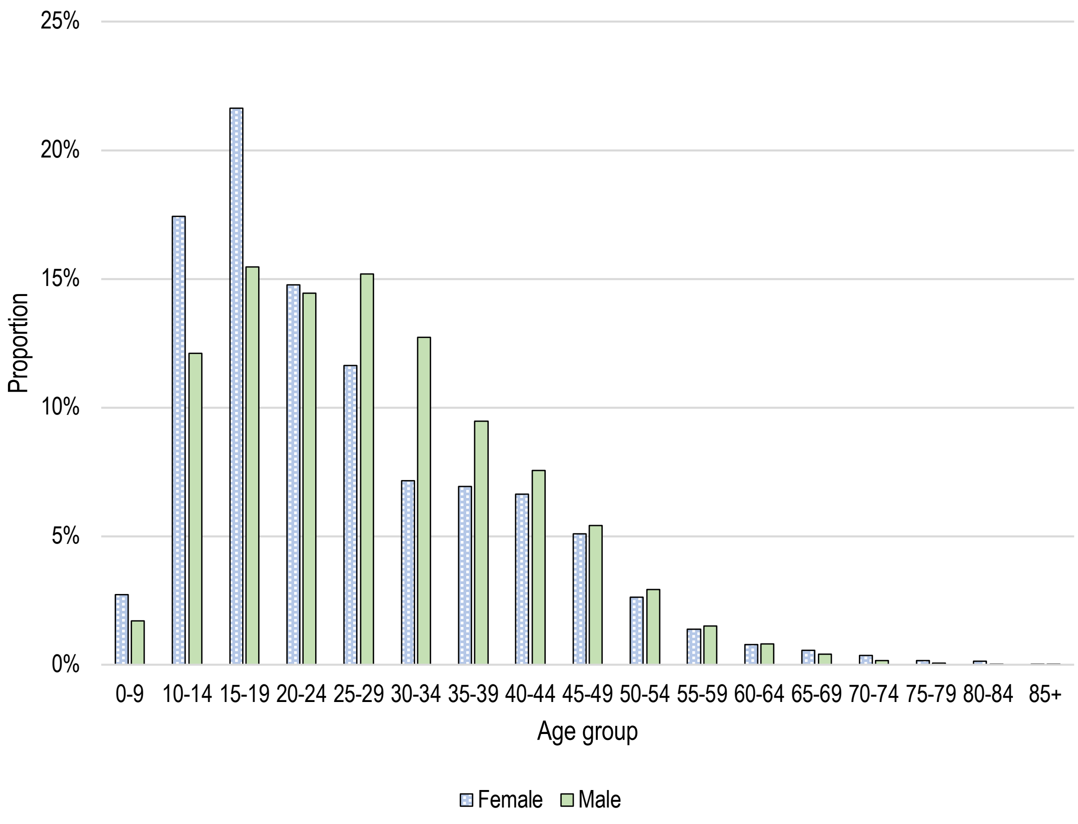

Figure 36. *Overall proportion of cricket-related ACC claims by age group and sex, relating to a place of recreation or sports (2008 – 2018).*

5.4.3 Overall claims per year

Overall, the number of claims per year increased on average by 1.5% (95% CI 0.33% – 2.7%, p = 0.04, Quasi-Poisson) (Figure 37). Figure 38 shows the annual trends for male and female IIR by population (5 to 64 years old). The male IIR had an average increase of 0.2% per year (95% CI -1.1%-1.4%, p = 0.81), and the female IIR increased on average by 0.3% per year (95% CI -4.0%-4.6%, p = 0.91). Table 56 shows the male and female IIR with 95% confidence intervals.

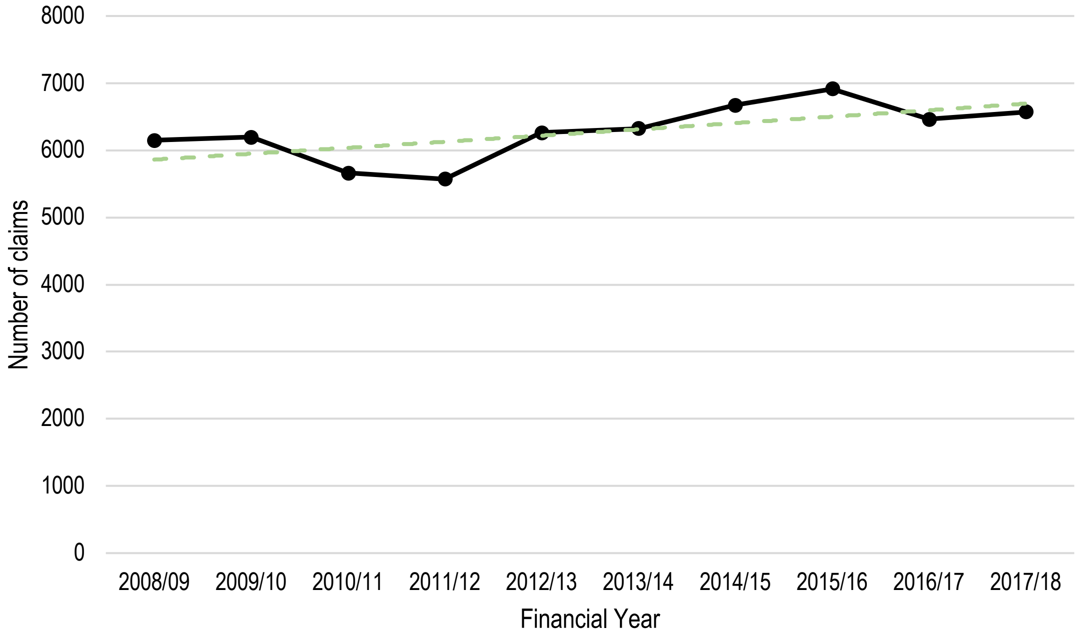

Figure 37. *Annual cricket-related ACC claims relating to a place of recreation or sports (with assumed Poisson distribution trend line) (2008 – 2018).*

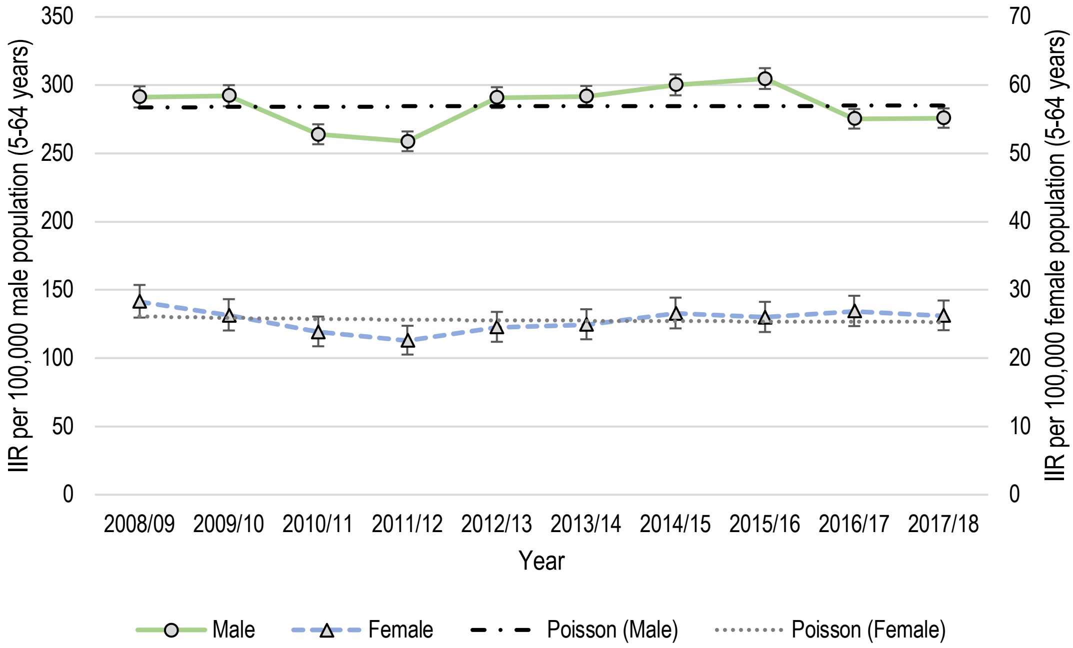

Figure 38. *Annual IIR per 100,000 population (male & female aged 5 to 64 years) for cricket-related ACC claims relating to a place of recreation or sports (with assumed Poisson distribution trend line) (2008 – 2018).*

Table 56. *Annual cricket-related ACC claims and IIR per 100,000 population, for males and females (aged 5 to 64 years), relating to a place of recreation or sports (2008 – 2018).*

	Males		95% CI for IIR		Females		95% CI for IIR	
Financial Year	n claims (5-64 years old)	**IIR**	lower	upper	n claims (5-64 years old)	**IIR**	lower	upper
2008/09	5466	291.3	283.7	299.2	549	28.3	26.0	30.7
2009/10	5527	292.2	284.5	300.0	515	26.3	24.1	28.6
2010/11	5039	264.0	256.7	271.3	472	23.8	21.7	26.1
2011/12	4971	258.8	251.7	266.1	450	22.6	20.5	24.8
2012/13	5616	290.8	283.2	298.5	492	24.5	22.4	26.9
2013/14	5686	291.7	284.2	299.4	504	24.9	22.8	27.2
2014/15	5950	300.1	292.5	307.9	545	26.5	24.4	28.9
2015/16	6176	304.8	297.2	312.5	543	26.0	23.8	28.3
2016/17	5706	275.3	268.2	282.5	573	26.9	24.7	29.1
2017/18	5832	275.8	268.8	283.0	570	26.2	24.1	28.5

Figures 39 to 42 show individual age group claims per year for males and females. For clarity, the figures have been split into those age groups exhibiting upward trends and those which exhibit either stable or downward trends Figure 39 highlights the male age groups which exhibited an increasing number of claims from 2008/09 to 2017/18; being the 10-14, 30-34, 40-44, 45-49 and 50-54 years old age groups.

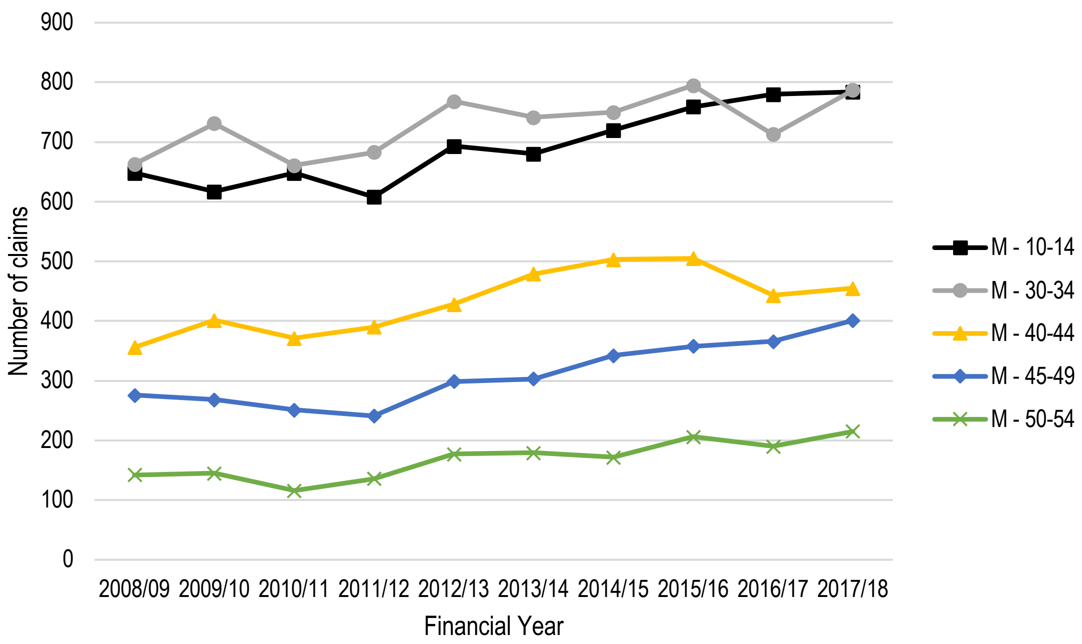

Figure 39. *Annual cricket-related ACC claims for males with age groups exhibiting an increasing number of claims relating to a place of recreation or sports (2008 – 2018).*

Figure 40 highlights the male age groups which exhibited an a relatively stable or decreasing number of claims; being the 0-9, 15-19, 25-29, 35-39 and 60-64 years old age groups.

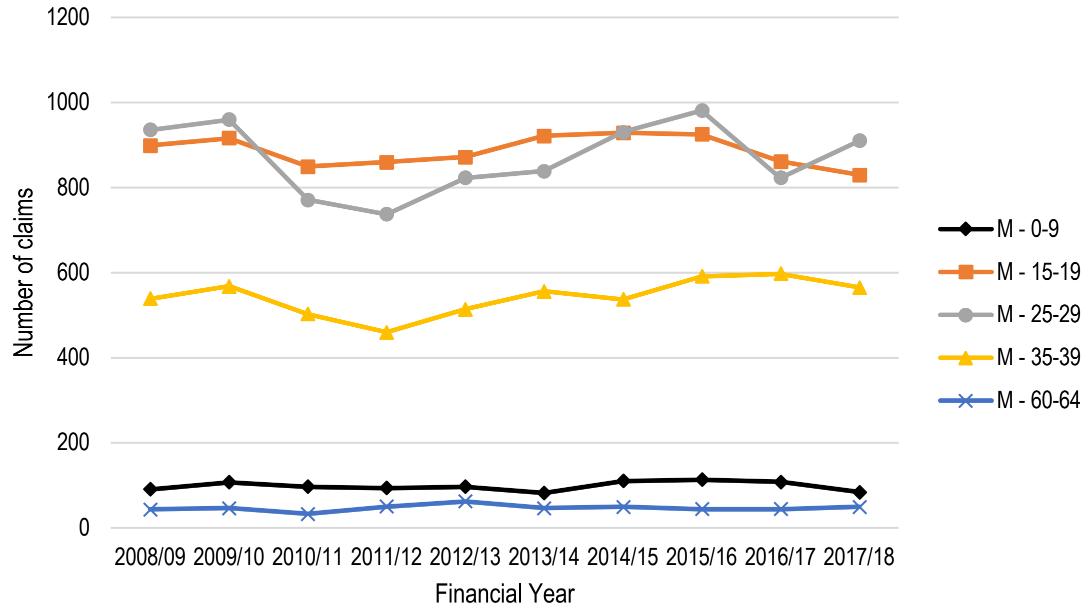

Figure 40. *Annual cricket-related ACC claims for males with age groups exhibiting either a relatively stable or decreasing number of claims relating to a place of recreation or sports (2008 – 2018).*

Figure 41 highlights the female age groups which exhibited an increasing number of claims; being the 0-9, 10-14, and 55-59 years old age groups. The 10-14 years old age group has had an appreciable rise in annual claims numbers since 2012/13.

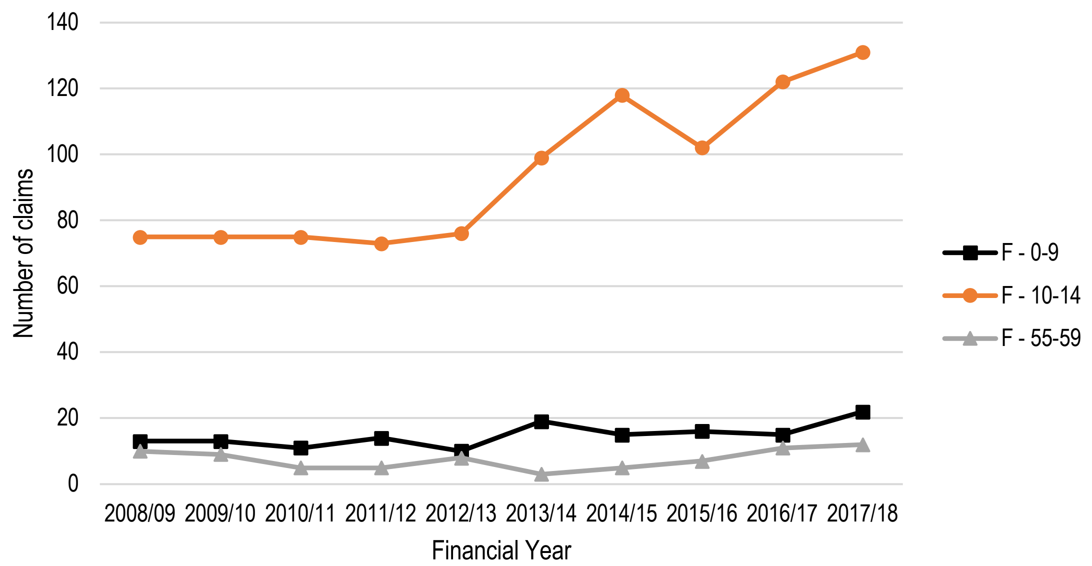

Figure 41. *Annual cricket-related ACC claims for females with age groups exhibiting an increasing number of claims relating to a place of recreation or sports (2008 – 2018).*

Figure 42 highlights the female age groups which exhibited relatively stable or decreasing number of claims; being the age groups from 15-19 through to 50-54 years old. The 20-24 years old and 25-29 years old age groups, whilst having little appreciable overall trend over the 10 year period, have begun to trend upward since 2013/14 and 2014/15 respectively.

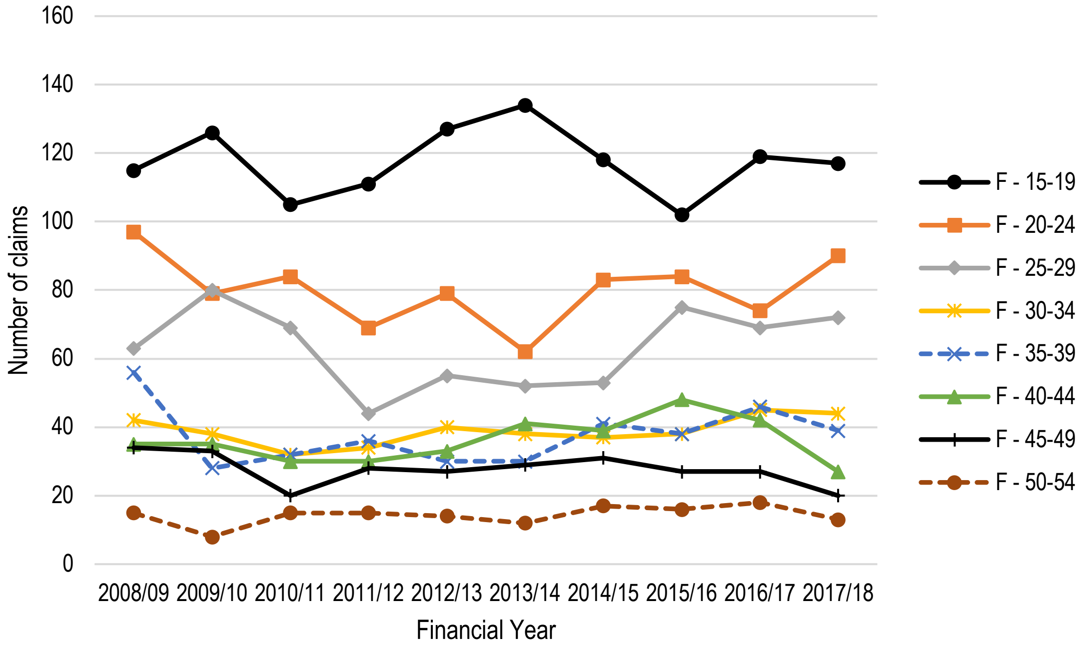

__Figure 42.__ Annual cricket-related ACC claims for females with age groups exhibiting either a relatively stable or decreasing number of claims relating to a place of recreation or sports (2008 – 2018).

In order to identify trends in organised cricket at the youngest age group, Figure 43 shows the relative number of claims for males and females in the 5-9 years old age group, which accounts for 96.1% of claims in the 0-9 years old age group.

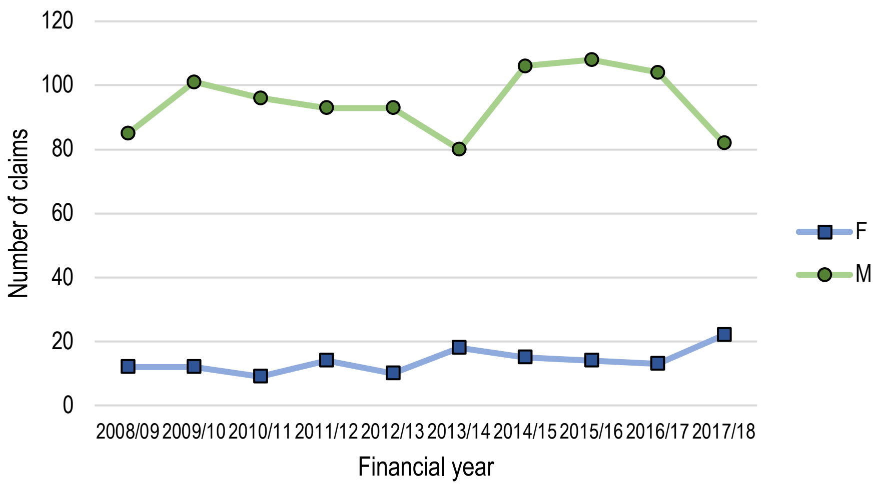

__Figure 43.__ Annual cricket-related ACC claims for males and females in the 5 to 9 years old age group relating to a place of recreation or sports (2008 – 2018).

5.4.4 Age, sex, cricket type and activity

Of the 62,776 injury claims recorded at a place of recreation and sports, 19,791 (31.5%) were identifiable as occurring whilst either batting, bowling, fielding or wicket keeping whilst playing indoor or outdoor cricket.

All Activity

Figures 44 and 45 show the overall age distribution for female and male injury claims whilst either batting, bowling, fielding or wicket keeping in both indoor and outdoor forms of the sport. The most common female age group injured was the 15-19 years old age group – consistent with the overall numbers in Figure 36. However the second most common age grouping was the 20-24 years old age group, compared to the 10-14 years old age group in the overall numbers (Figure 36).

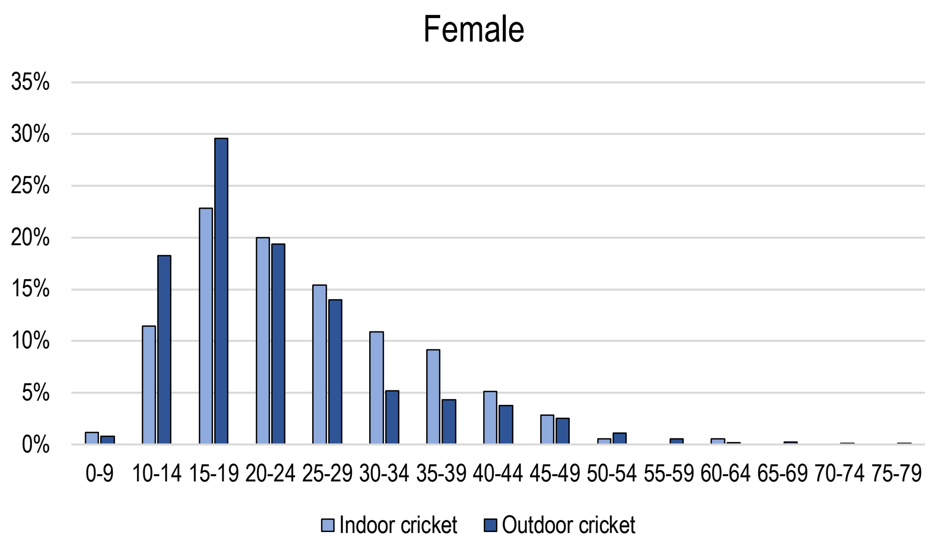

Figure 44. Overall age distribution of ACC claims for females by form of cricket (indoor/outdoor) where activity is known (i.e. batting, bowling, fielding, wicket keeping), subset n = 1,335, (2008 – 2018).

The overall age distribution for males injured whilst batting, bowling, fielding or wicket keeping was fairly consistent with the overall distribution of claims in Figure 36.

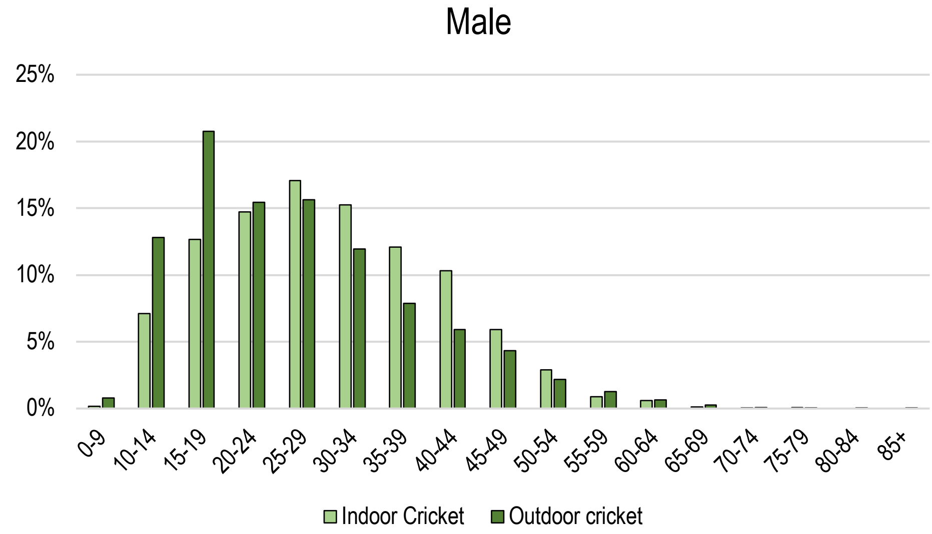

Figure 45. Overall age distribution of ACC claims for males by form of cricket (indoor/outdoor) where activity is known (i.e. batting, bowling, fielding, wicket keeping), subset n = 18.456 (2008 – 2018).

Activity: Batting

There were 3,613 reported batting injury claims, representing 18.6% of the claims that reported the activity at injury.

Figures 46 and 47 show the overall age distribution for female and male injury claims whilst batting in indoor and outdoor cricket forms. For females, the age distribution of batting related injury claims was similar to their overall distribution (Figure 36), with the 15-19 years old age group being the most common in both indoor (19.5%) and outdoor (23.3%) formats. For males, the 25-29 years old age group was the most common age group for batting related injury claims in both indoor (15.3%) and outdoor (16.4%) formats.

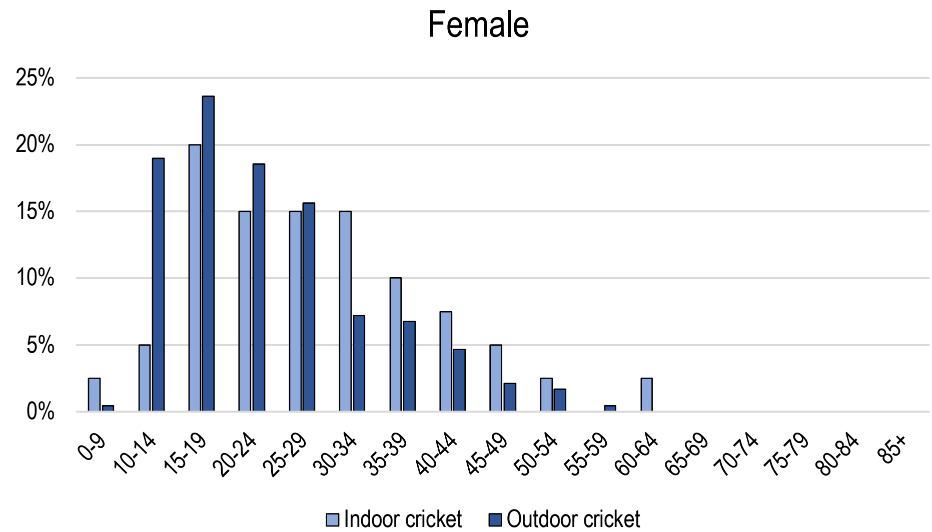

Figure 46. Age distribution of ACC claims for females by form of cricket (indoor/outdoor) where activity is batting, n = 277 (2008 – 2018).

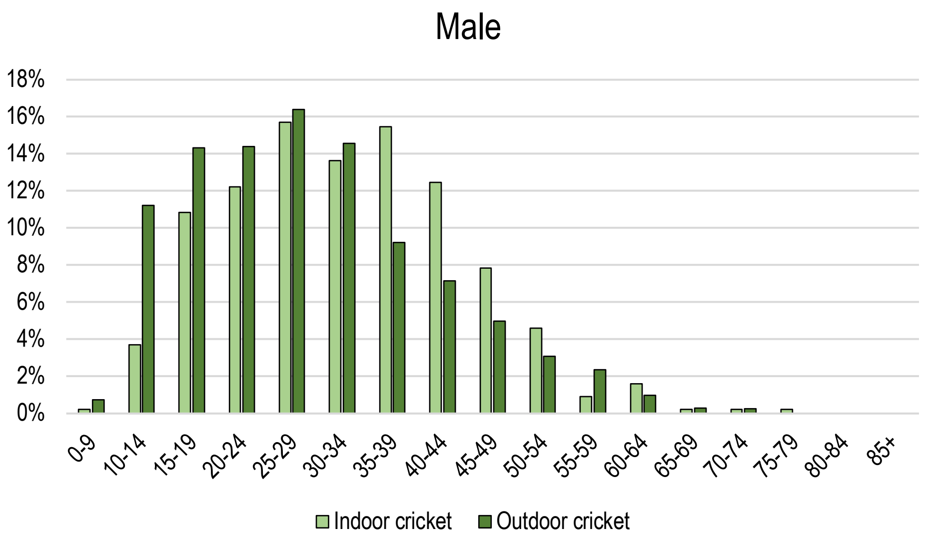

Figure 47. Age distribution of ACC claims for males by form of cricket (indoor/outdoor) where activity is batting n = 3,336 (2008 – 2018).

Activity: Bowling

There were 11,816 bowling related injury claims reported, representing 59.9% of the claims that reported the activity at injury.

Figures 48 and 49 show the overall age distribution for female and male injury claims whilst bowling in indoor and outdoor cricket forms. For females, the age distribution of bowling related injury claims was similar to their overall distribution (Figure 36), with the 15-19 years old age group being the most common in both indoor (28.3%) and outdoor (32.0%) formats. The most common age group for male injury claims whilst bowling in outdoor cricket was the 15-19 years old age group (24.3%). The 25-29 years old age group was the most common for indoor cricket related bowling injury claims (17.3%).

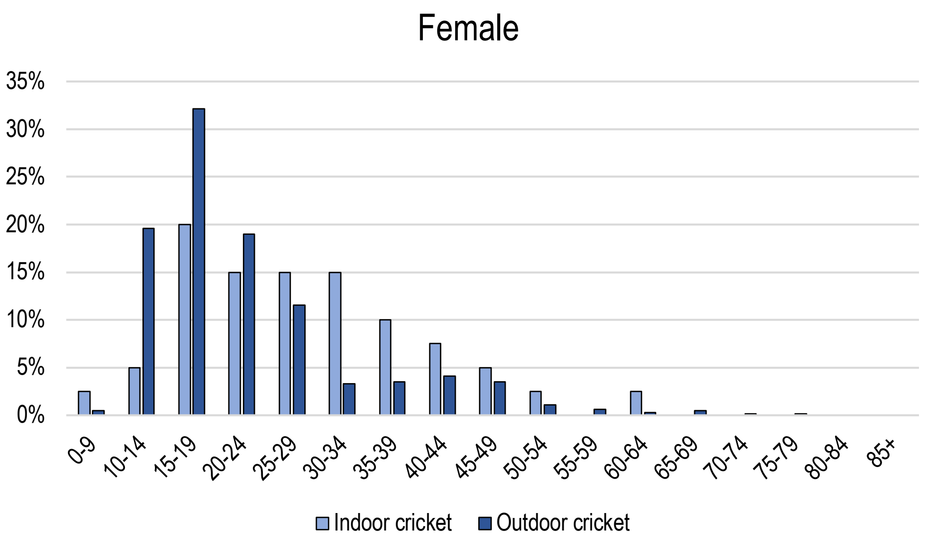

Figure 48. Age distribution of ACC claims for females by form of cricket (indoor/outdoor) where activity is bowling n = 723 (2008 – 2018).

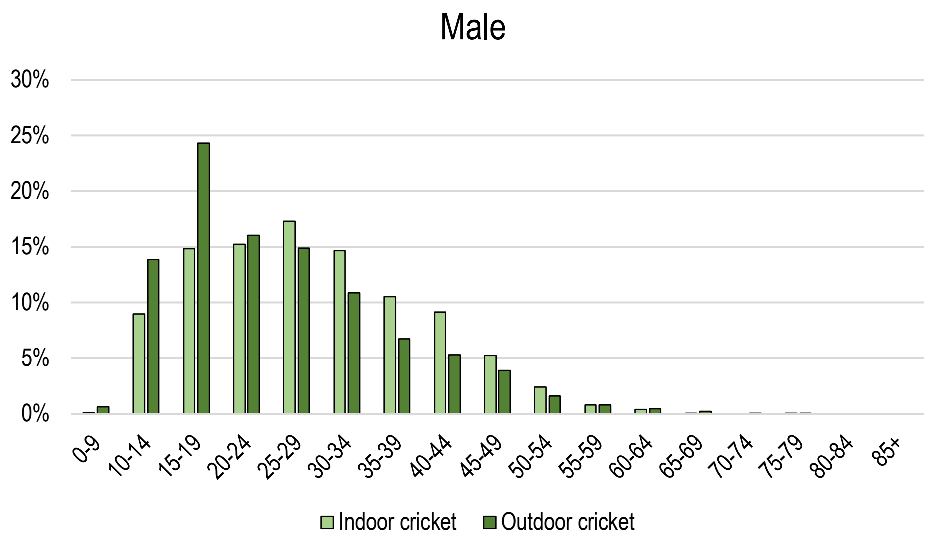

Figure 49. Age distribution of ACC claims for males by form of cricket (indoor/outdoor) where activity is bowling n = 11,093 (2008 – 2018).

Activity: Fielding

There were 3,507 fielding related injury claims reported, representing 18.3% of the claims that reported the activity at injury.

Figures 50 and 51 show the overall age distribution for female and male injury claims whilst fielding in indoor and outdoor cricket forms. For females, the 15-19 years old age group was the most common age group for fielding injuries in the outdoor format (29.7%) with the indoor format having three age groups (20-24, 25-29, 30-34 years old) all recording the same proportion of fielding injuries (18.9%). The most common age group for male injury claims whilst fielding was the 25-29 years old age group for outdoor cricket (18.1%), and indoor cricket (19.9%).

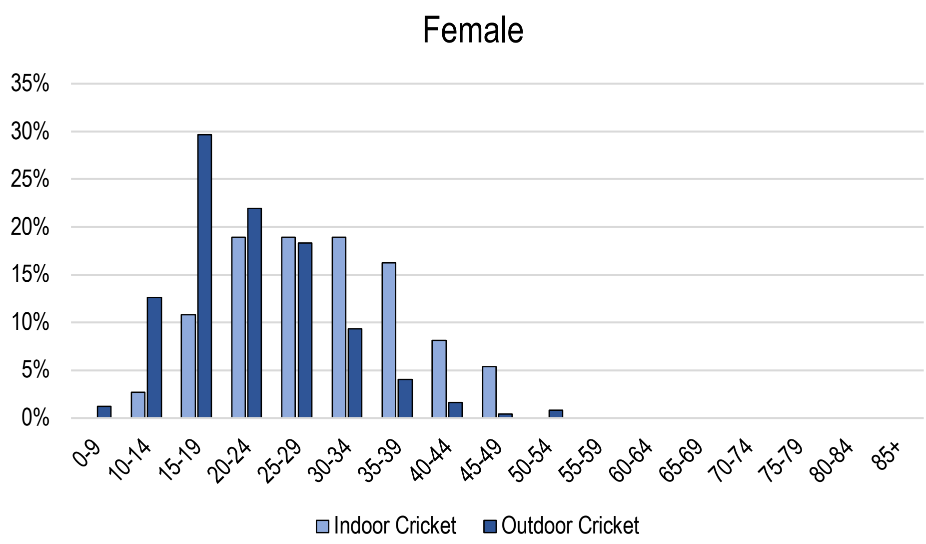

Figure 50. Age distribution of ACC claims for females by form of cricket (indoor/outdoor) where activity is fielding n = 270 (2008 – 2018).

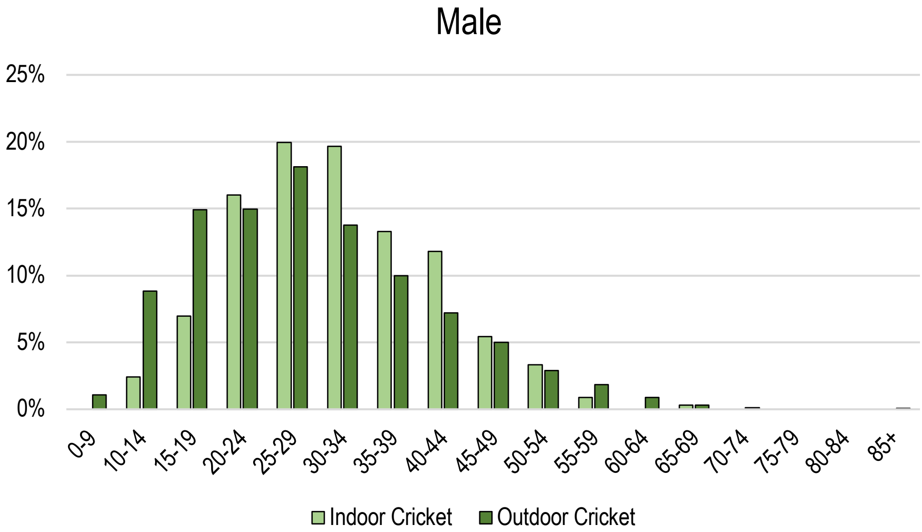

Figure 51. Age distribution of ACC claims for males by form of cricket (indoor/outdoor) where activity is fielding n = 3,237 (2008 – 2018).

Activity: Wicket Keeping

There were 855 wicket keeping related injury claims reported, representing 4.4% of the claims that reported the activity at injury. Figures 52 and 53 show the overall age distribution for female and male injury claims whilst wicket keeping in indoor and outdoor cricket forms. The 15-19 years old age group was the most common age group for wicket keeping injuries in the outdoor format (26.7%) with the indoor format having two age groups (15-19 and 20-24 years old) all recording the same proportion of wicket keeping injuries (28.6%). The most common age group for male injury claims whilst wicket keeping in outdoor cricket was the 15-19 years old age group (23.5%). The 35-39 years old age group recorded the highest proportion of wicket keeping injuries for indoor cricket (18.8%).

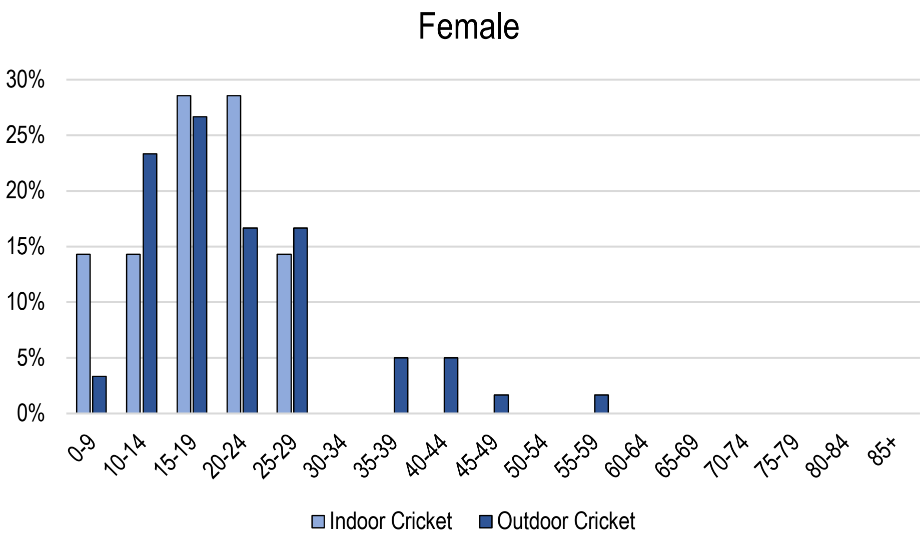

***Figure 52.** Age distribution of ACC claims for females by form of cricket (indoor/outdoor) where activity is wicket keeping n = 65 (2008 – 2018).*

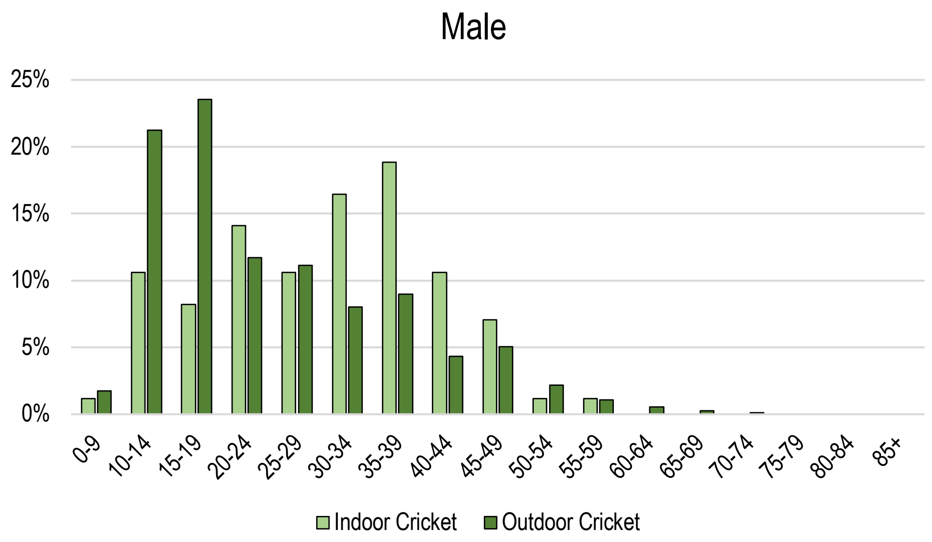

Figure 53. *Age distribution of ACC claims for males by form of cricket (indoor/outdoor) where activity is wicket keeping n = 790 (2008 – 2018).*

Claims by cricket type and month

Of the 62,776 cricket injury claims, there were 8,508 (13.6%) claims for indoor cricket and 54,268 (86.4%) claims for outdoor cricket. Typically, cricket season in NZ begins in October. The monthly distribution of claims for indoor and outdoor cricket followed the expectation of outdoor cricket being played in the late spring, summer and early autumn months (Figure 54). February and November were the most common months for outdoor cricket injury while indoor cricket injuries increased from May through to a peak in September.

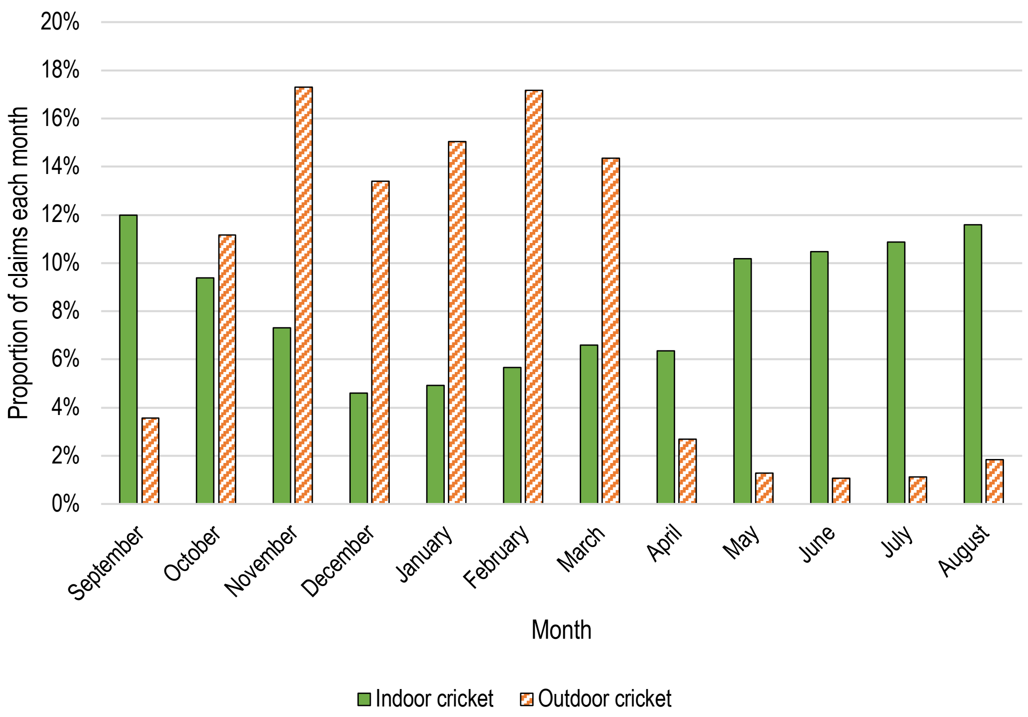

Figure 54. *Cricket-related ACC claims per month for males and females, by form of cricket (indoor/outdoor), relating to a place of recreation or sports (indoor n = 8,508, outdoor n = 54,268) (2008 – 2018).*

5.4.5 Claim trends by activity for all cricket types

All activity

Figure 55 shows the trends for injury claims by the different formats of cricket (indoor and outdoor) by sex. For male outdoor cricket, there was a significant average increase in claims of 2.0% (95% CI 0.8% – 3.3%, p = 0.01, Quasi-Poisson) per year.

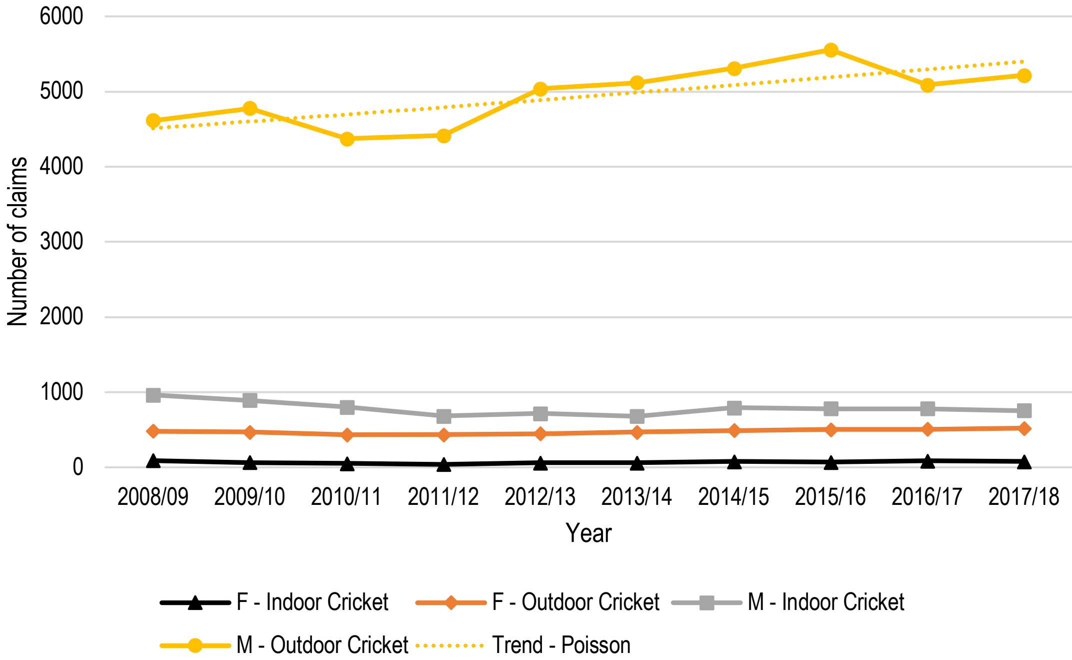

Figure 55. *Overall number of annual cricket-related ACC claims by sex and form of cricket relating to a place of recreation or sports n = 19,791 (2008 – 2018).*

Activity: Batting

Figure 56 shows the yearly injury claims by indoor and outdoor formats for females and males related to batting. There was a non-significant upward trend for male outdoor cricket batting injuries of 0.45% per year (95% CI -1.1% - 2.0%, p = 0.59, Quasi-Poisson).

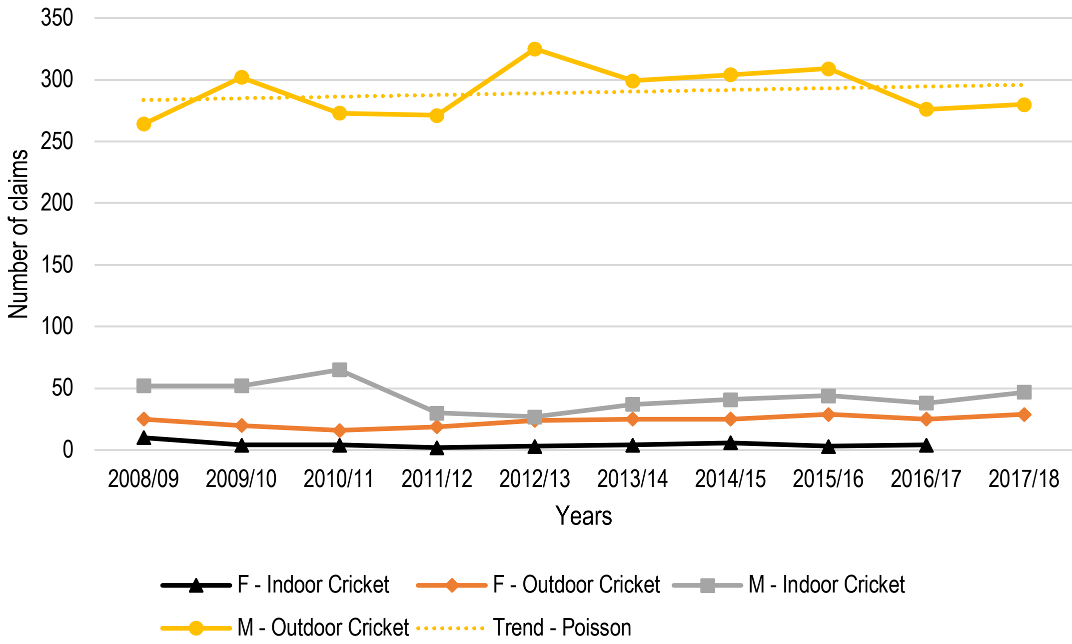

Figure 56. Overall annual cricket-related ACC claims by sex and form of cricket by activity of batting (2008 – 2018) (males n = 3,336, females n = 277).

Activity: Bowling

Figure 57 shows the trends for injury claims related to bowling by sex and format. Male outdoor cricket injury claims related to bowling increased on average by 2.9% (95% CI 1.2 %– 4.7%, p = 0.01, Quasi-Poisson) per year.

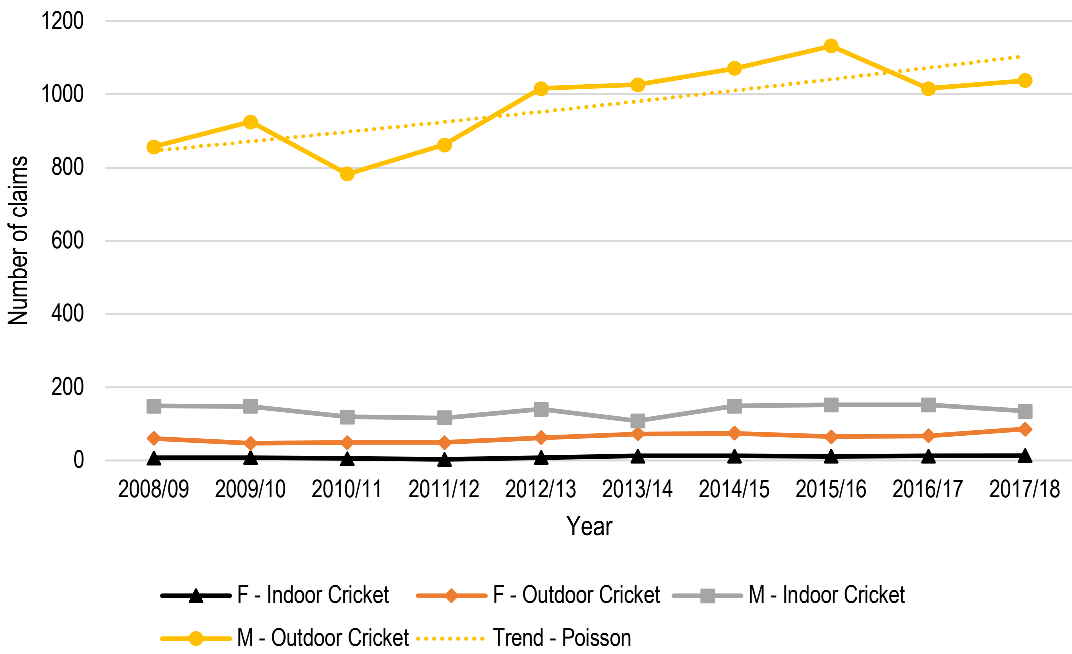

Figure 57. Overall annual cricket-related ACC claims by sex and form of cricket by activity of bowling (2008 – 2018) (males n = 11,093, females n = 723).

Activity: Fielding

Figure 58 shows the trends for injury claims related to fielding by sex and format. Male outdoor cricket injury claims related to fielding increased on average by 2.0% (95% CI 0.1% – 3.8%, p = 0.07, Quasi-Poisson) per year.

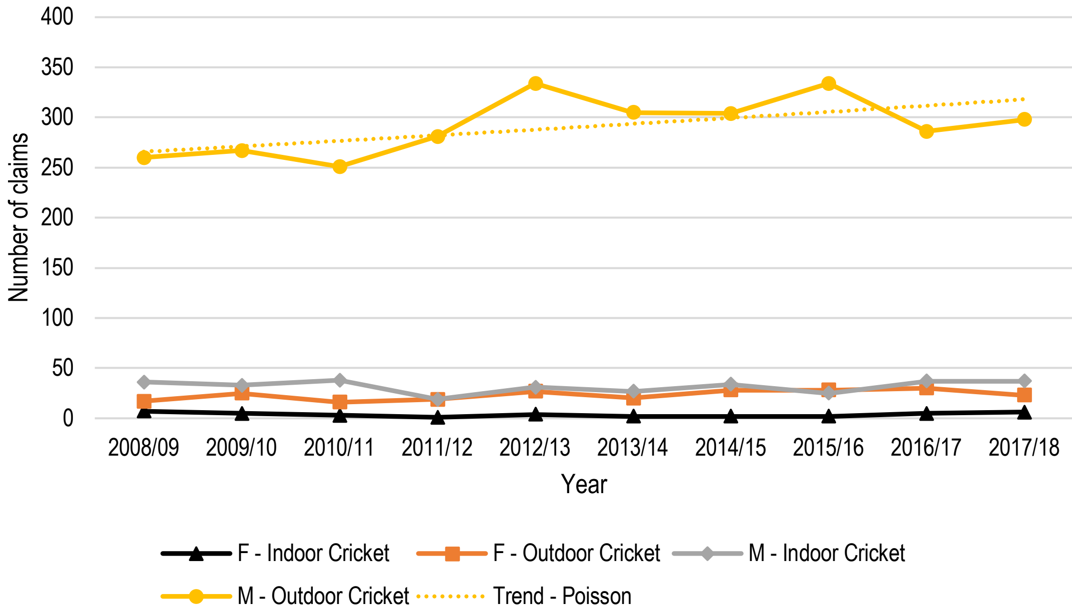

Figure 58. *Overall annual cricket-related ACC claims by sex and form of cricket by activity of fielding (2008 – 2018) (males n = 3,237, females n = 270).*

Activity: Wicket keeping

Figure 59 shows the trends for injury claims related to wicket keeping by sex and format. Male outdoor cricket injury claims related to wicket keeping decreased significantly on average by 2.9% (95% CI 0.3% – 5.3, p = 0.03) per year.

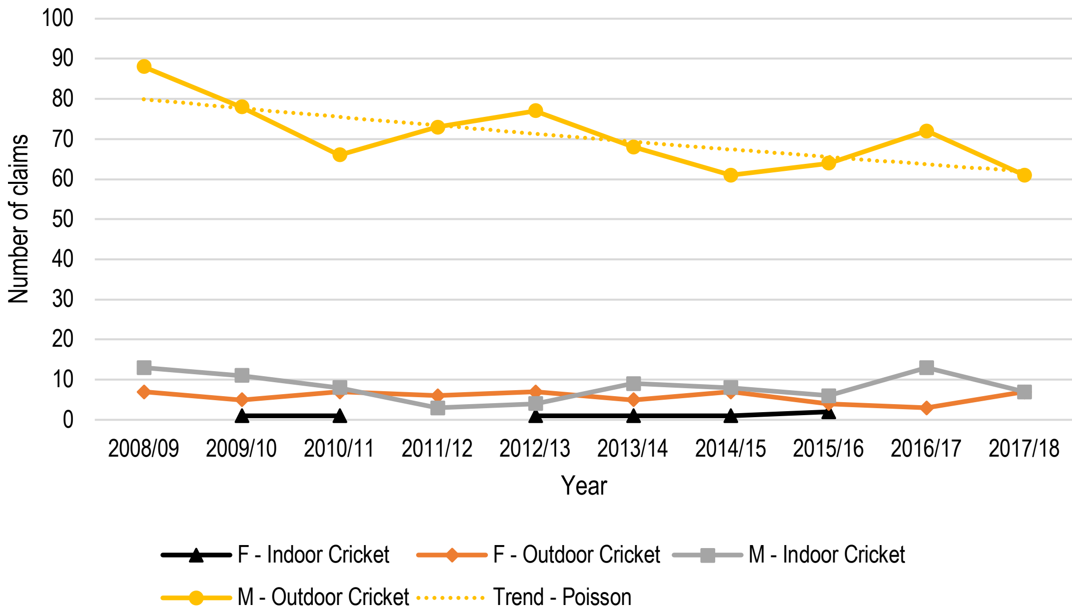

Figure 59. *Overall annual cricket-related ACC claims by sex and form of cricket by activity of wicket keeping (2008 – 2018) (males n = 790, females n = 65).*

5.4.6 Injury Diagnosis – Broad categories

The majority of injury claims were classified as soft tissue injuries (n = 50,604 or 80.6%) (Figure 60). Fracture and dislocation represented 9.6% of the injuries, laceration/puncture/sting 5.6% and dental injuries 1.8%. There was 3.3% of cases that were classified as other or unknown. Concussion represented 0.4% of the injuries.

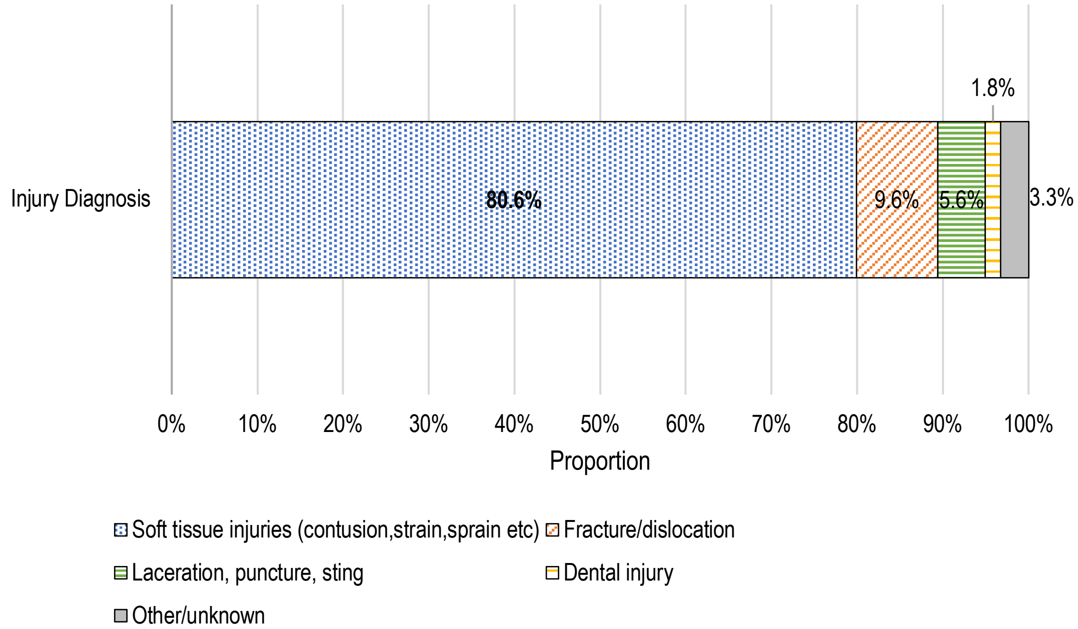

Figure 60. *Proportion of injuries by nature for cricket-related ACC claims (2008 – 2018).*

For the most common broad injury diagnosis, soft tissue injury, there was a higher proportion in females than males (females 82.8% (95% CI 81.8% – 83.8%), males 80.4% (95% CI 80.1% – 80.7%)). Figure 61 shows the other injury diagnosis in broad categories by gender. Injured females were proportionally more likely to have dental injury 2.5% (95% CI 2.1% – 3.0%), compared to males 1.7% (95% CI 1.6% – 1.8%), concussion injury 0.7% (95% CI 0.5% – 0.9%) compared to males 0.4% (95% CI 0.4% – 0.5%). Injured males were proportionally more likely to have fracture/dislocation injuries 9.8% (9.6% – 10.0%) compared to females 7.6% (6.9% – 8.3%) and laceration/puncture/sting injuries 5.7% (5.5% – 5.9%) compared to females 4.5% (4.0% – 5.1%).

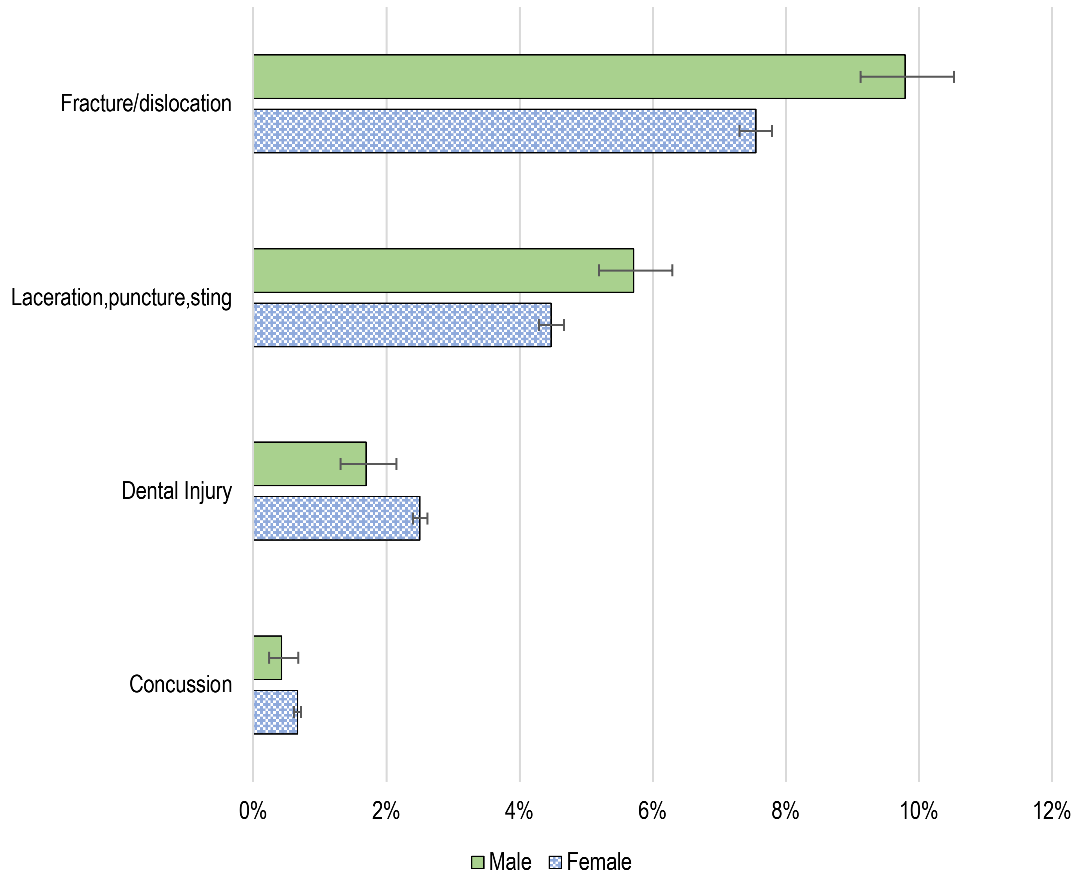

Figure 61. Proportion of other cricket-related ACC claim injury diagnoses by sex n = 62,766 (2008 – 2018).

5.4.7 Injury Diagnosis – Specific

Using the top three broad injury diagnoses (Figure 60), Tables 57 to 59 examine the most common specific injury diagnoses associated with soft tissue, fracture/dislocation and laceration/puncture/sting injuries.

Table 57 lists the top 12 specific soft tissue injuries in females and males of all ages, representing injury claims of proportion greater than 2% of all soft tissue injury. Of the soft tissue injuries, lumbar sprain (14.0% overall) was the most common in both males (14.3%) and females (11.0%). Ankle and neck sprains were proportionally more common in females, while rotator cuff and shoulder and upper arm sprains were proportionally more common in males. When activity of injury onset was included (i.e. batting, bowling, fielding, wicket keeping), the overall soft tissue injury proportion increased to 90.6%. When activity of injury onset was known, the proportion of lumbar sprain was much higher than for all claims (22.8% overall). Other injuries that were of higher proportion when activity was included were sprains of knee and leg, rotator cuff sprain, sprain of shoulder and upper arm, sprain of hip and thigh and neck sprain. Ankle sprain was the only diagnosis that was of lower proportion in the top five.

Table 57. Cricket-related ACC specific soft tissue injury claims by sex representing injury claims of > 2% all soft tissue injury, (2008 – 2018).

Soft tissue injury – female	n	%[1]	Soft tissue injury – male	n	%[1]
Lumbar sprain	493	11.0%	Lumbar sprain	6589	14.3%
Sprain of knee and leg	315	7.0%	Sprain of knee and leg	2814	6.1%
Ankle sprain	295	6.6%	Rotator cuff sprain	2607	5.7%
Neck sprain	227	5.0%	Sprain of shoulder and upper arm	2565	5.6%
Rotator cuff sprain	224	5.0%	Ankle sprain	2520	5.5%
Sprain of shoulder and upper arm	220	4.9%	Sprain of hip and thigh	2349	5.1%
Sprain of hip and thigh	216	4.8%	Neck sprain	1675	3.6%
Sprain finger	195	4.3%	Sprain gastrocnemius	1674	3.6%
Sprain gastrocnemius	178	4.0%	Sprain finger	1527	3.3%
Sprain thumb	114	2.5%	Thoracic sprain	1227	2.7%
Thoracic sprain	106	2.4%	Sprain, hamstring tendon	1183	2.6%
Foot sprain	102	2.3%	Sprain thumb	960	2.1%

1. Proportions based on whole subset populations: female soft tissue n = 4,496, male soft tissue n = 46,108.

Table 58 lists the top 7 specific fracture/dislocation injuries for females and males of all ages, representing injury claims of proportion greater than 2.3% of all fracture/dislocation injury. Fractures to one or more fingers represented nearly one-third of all fracture/dislocation injuries in both females (32.7%) and males (31.9%). Fractures of the nose, distal radius and ulna (wrist) and scaphoid were proportionally more common in females. Scaphoid fractures, in particular, were twice as common in females. Dislocation or subluxation of the shoulder and rib fractures were proportionally more common in males. When the activity of injury onset (i.e. batting, bowling, fielding, wicket keeping) was included, the fracture/dislocation proportion reduced to 4.4% overall. The overall proportions of fracture to one or more phalanges (31.9% to 26.2%) and dislocation/subluxation of finger or thumb dropped (12.3% to 8.8%), while the proportion of shoulder dislocation/subluxations increased (4.0% to 8.3%).

Table 58. Cricket-related ACC specific fracture/dislocation injury claims by sex, representing injury claims of > 2.3% of all fracture/dislocation injuries, (2008 – 2018)

Fracture/dislocation injury – female	n	%[1]	Fracture/dislocation injury – male	n	%[1]
Fracture of one or more phalanges of hand	134	32.7%	Fracture of one or more phalanges of hand	1791	31.9%
Dislocation or subluxation of finger or thumb	43	10.5%	Dislocation or subluxation of finger or thumb	699	12.4%
Fracture of metacarpal bone	32	7.8%	Fracture of metacarpal bone	380	6.8%
Closed fracture nose	17	4.1%	Dislocation or subluxation of shoulder	231	4.1%
Closed fracture of radius and ulna, lower end	13	3.2%	Fracture of one or more phalanges of foot	181	3.2%
Fracture of one or more phalanges of foot	11	2.7%	Closed fracture rib	159	2.8%
Closed fracture of the scaphoid	10	2.4%	Closed fracture nose	144	2.6%

1. Proportions based on whole subset populations: female fracture/dislocation n = 410, male fracture/dislocation n = 5,617.

Table 59 lists the top seven specific injuries under the broad diagnosis category of lacerations/puncture/sting for females and males of all ages, representing injury claims of proportion greater than 3% of all lacerations/puncture/sting injury. Open wound of the hand, excluding the fingers, was the most common injury in the category for females (13.6%) and males (12.6%), followed by in order for both females and males with open wound of finger(s) or thumb, lip and eyebrow.

__Table 59.__ Cricket-related ACC specific laceration/puncture/sting injury claims by sex, representing injury claims of > 3% of all laceration/puncture/sting injuries, (2008 – 2018).

Laceration/puncture/sting injury – female	n	%[1, 2]	Laceration/puncture/sting injury – male	n	%[1, 3]
Open wound of hand, excluding finger(s)	33	13.6%	Open wound of hand, excluding finger(s)	412	12.6%
Open wound of finger(s) or thumb	14	5.8%	Open wound of finger(s) or thumb	251	7.7%
Open wound of lip	14	5.8%	Open wound of lip	246	7.5%
Open wound of eyebrow	11	4.5%	Open wound of eyebrow	203	6.2%
Open wound of leg	11	4.5%	Abrasion/friction burn of lower limb, without infection	102	3.1%
Abrasion, knee	9	3.7%	Abrasion or friction burn of lower limb, infected	99	3.0%
Open wound of knee	9	3.7%	Open wound of face	98	3.0%

1. Proportions based on whole subset populations: female fracture/dislocation n = 243, male fracture/dislocation n = 3,276.
2. 'Blank' field represented 7.4% of female cases.
3. 'Blank' flied represented 6.0% of male cases.

5.4.8 Injury location by activity and sex

Table 60 reports the specific body locations of injury for females and males by activity at time of injury (batting, bowling, fielding and wicket keeping). The most common batting related injury claims for females were to the lower back (13.4%), hip/upper leg/thigh (10.5%), and knee (10.5%), whilst for males the most common injury claims were to the lower back (13.1%), knee (10.3%), and hip/upper leg/thigh (9.8%).

The most common bowling related injury claims for both females and males were to the lower back (female = 24.8%, male = 28.2%), shoulder (including clavicle/scapula) (female = 20.5%, male = 18.7%) and knee (female = 12.0%, male = 11.2%).

The most common fielding related injury claims for females were to the knee (16.3%), finger/thumb (13.0%), followed by ankle (10.7%) and hip/upper leg/thigh (10.4%). For males the most common fielding injury claims were to the knee (16.4%), finger/thumb (13.6%), shoulder (inc. clavicle/scapula) (13.4%), hip/upper leg/thigh just below (10.8%) and lower back (10.1%).

The most common wicket keeping related injury claims for females were to the finger/thumb (33.8%), knee and face equally (10.8%), and lower back (9.2%), whilst for males the most common injury claims were to the finger/thumb (41.5%), face (11.9%) and lower back (10.6%).

Tables 61 and 62 show the relative proportions of broad body regions injured by activity and sex with 95% confidence intervals. Based on non-overlapping confidence intervals, trunk/back injuries were significantly higher proportions for bowling for both males (37.2% (95% CI 36.3% – 38.1%)) and females (33.9% (95% CI 30.5% – 37.4%)) compared to all other activities. Lower limb injury in males whilst fielding was significantly proportionally higher than all other activities. Upper limb injury in males whilst wicket keeping (50.4% (95% CI 46.9% – 53.9%), was significantly higher proportionally to all other activities.

Table 63 shows the diagnoses (as labelled in the ACC dataset) for the top three injury locations by activity. For all activities, where the lower back/spine was involved, almost all were diagnosed as lumbar sprains. For knee injuries, common across all activities, the diagnosis of sprain of knee and leg was the most common, followed by ligament injuries to the major ligaments of the knee (e.g. medial and/or lateral collateral, anterior and/or posterior cruciate ligaments). Similarly, for shoulder injuries across all activities, rotator cuff sprains and/or sprains of the upper arm or shoulder were the most common diagnoses. Where finger/thumb injuries were involved, sprain was around twice as common as fractures in fielding and wicket keeping activities. Although not in the top three injury body locations for batting, finger/thumb fractures were proportionally more common (27%) than similar injuries in fielding. Facial injuries in wicket keeping mostly involved injury to the teeth, followed by open wounds.

Table 60. *Cricket-related ACC claims (n = 19,791) for specific body locations of injury for females and males by activity (batting, bowling, fielding and wicket keeping), (2008 – 2018).*

	Batting				Bowling				Fielding				Wicket Keeping			
Injury Site	**n female**	**%**	**n male**	**%**	**n female**	**%**	**n male**	**%**	**n female**	**%**	**n male**	**%**	**n female**	**%**	**n male**	**%**
Abdomen/pelvis	< 4	< 1.0%	42	1.3%	9	1.2%	132	1.2%	5	1.9%	16	0.5%	< 4	< 3.0%	10	1.3%
Ankle	26	9.4%	186	5.6%	65	9.0%	783	7.1%	29	10.7%	259	8.0%	0	0.0%	17	2.2%
Chest	5	1.8%	94	2.8%	10	1.4%	278	2.5%	5	1.9%	36	1.1%	< 4	< 3.0%	7	0.9%
Ear	< 4	< 1.0%	8	0.2%	0	0.0%	0	0.0%	0	0.0%	< 4	< 1.0%	0	0.0%	0	0.0%
Elbow	7	2.5%	98	2.9%	< 4	< 1.0%	55	0.5%	< 4	< 1.0%	25	0.8%	0	0.0%	< 4	< 1.0%
Eye	< 4	< 1.0%	27	0.8%	0	0.0%	< 4	< 1.0%	< 4	< 1.0%	21	0.6%	< 4	< 3.0%	10	1.3%
Face	13	4.7%	235	7.0%	< 4	< 1.0%	30	0.3%	7	2.6%	152	4.7%	7	10.8%	94	11.9%
Finger/thumb	22	7.9%	227	6.8%	11	1.5%	114	1.0%	35	13.0%	440	13.6%	22	**33.8%**	328	**41.5%**
Foot	8	2.9%	82	2.5%	24	3.3%	213	1.9%	6	2.2%	52	1.6%	< 4	< 3.0%	5	0.6%
Hand/wrist	23	8.3%	259	7.8%	5	0.7%	82	0.7%	17	6.3%	160	4.9%	0	0.0%	26	3.3%
Head (except Face)	< 4	< 1.0%	31	0.9%	< 4	< 1.0%	< 4	< 1.0%	< 4	< 1.0%	23	0.7%	0	0.0%	6	0.8%
Hip, Upper Leg, Thigh	29	10.5%	327	9.8%	46	6.4%	1062	9.6%	28	10.4%	351	10.8%	< 4	< 3.0%	36	4.6%
Knee	29	10.5%	342	10.3%	87	12.0%	1239	11.2%	44	**16.3%**	532	**16.4%**	7	10.8%	50	6.3%
Lower Back/spine	37	**13.4%**	437	**13.1%**	179	**24.8%**	3124	**28.2%**	18	6.7%	327	10.1%	6	9.2%	84	10.6%
Lower Leg	9	3.2%	168	5.0%	21	2.9%	302	2.7%	15	5.6%	139	4.3%	< 4	< 3.0%	14	1.8%
Lung	0	0.0%	0	0.0%	0	0.0%	< 4	< 1.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Multiple Locations	0	0.0%	< 4	< 1.0%	0	0.0%	< 4	< 1.0%	0	0.0%	< 4	< 1.0%	0	0.0%	< 4	< 1.0%
Neck, Back Of Head Vertebrae	16	5.8%	96	2.9%	45	6.2%	622	5.6%	11	4.1%	85	2.6%	< 4	< 3.0%	22	2.8%
Nose	< 4	< 1.0%	25	0.7%	0	0.0%	< 4	< 1.0%	< 4	< 1.0%	11	0.3%	0	0.0%	10	1.3%
Shoulder (incl Clavicle/blade)	23	8.3%	281	8.4%	148	20.5%	2074	18.7%	22	8.1%	432	13.3%	5	7.7%	31	3.9%
Toes	5	1.8%	102	3.1%	< 4	< 1.0%	53	0.5%	< 4	< 1.0%	9	0.3%	< 4	< 3.0%	< 4	< 1.0%
Unknown	< 4	< 1.0%	12	0.4%	5	0.7%	62	0.6%	< 4	< 1.0%	23	0.7%	< 4	< 3.0%	< 4	< 1.0%
Unobtainable	< 4	< 1.0%	31	0.9%	< 4	< 1.0%	107	1.0%	< 4	< 1.0%	44	1.4%	< 4	< 3.0%	6	0.8%
Upper And Lower Arm	9	3.2%	142	4.3%	10	1.4%	162	1.5%	10	3.7%	61	1.9%	< 4	< 3.0%	11	1.4%
Upper Back/spine	6	2.2%	81	2.4%	47	6.5%	588	5.3%	6	2.2%	35	1.1%	0	0.0%	16	2.0%

Proportions highlighting potential prevention priorities by body locations and associated activity 5 – 9% 10-19% 20-29% 30-39% **40%+**

Table 61. Cricket-related ACC claims for broad body locations of injury for females (n = 1,335) by activity (batting, bowling, fielding and wicket keeping), (2008 – 2018).

Female	Batting			Bowling			Fielding			Wicket Keeping		
Injury Site	**n female**	**%**	**95% CI**	**n female**	**%**	**95% CI**	**n female**	**%**	**95% CI**	**n female**	**%**	**95% CI**
Head/neck/face	33	11.9%	(8.6% - 16.3%)	48	6.6%	(5.0% - 8.7%)	23	8.5%	(5.7% - 12.5%)	10	15.4%	(8.6% - 26.1%)
Upper limb	84	30.3%	(25.2% - 36.0%)	176	24.3%	(21.4% - 27.6%)	87	32.2%	(26.9% - 38.0%)	29	44.6%	(33.2% - 56.7%)
Lower limb	106	38.3%	(32.7% - 44.1%)	246	34.0%	(30.7% - 37.6%)	123	**45.6%**	(39.7% - 51.5%)	13	20.0%	(12.1% - 31.3%)
Trunk/back	50	18.1%	(14.0% - 23.0%)	245	**33.9%**	(30.5% - 37.4%)	34	12.6%	(9.2% - 17.1%)	10	15.4%	(8.6% - 26.1%)
Multiple locations	0	0.0%	-	0	0.0%	-	0	0.0%	-	0	0.0%	-
Unknown/unobtainable	4	1.4%	(0.6% - 3.7%)	8	1.1%	(0.6% - 2.2%)	< 4	< 1.5%	-	< 4	< 5.0%	-

Note: shaded numbers represent the activity maximum and bold values represent significant maximum within body region by 95% CI

Table 62. Cricket-related ACC claims for broad body locations of injury for males (n = 18,456) by activity (batting, bowling, fielding and wicket keeping), (2008 – 2018).

Male	Batting			Bowling			Fielding			Wicket Keeping		
Injury Site	**n male**	**%**	**95% CI**	**n male**	**%**	**95% CI**	**n male**	**%**	**95% CI**	**n male**	**%**	**95% CI**
Head/neck/face	422	12.6%	(11.6% - 13.8%)	660	5.9%	(5.5% - 6.4%)	294	9.1%	(8.1% - 10.1%)	142	18.0%	(15.5% - 20.8%)
Upper limb	1007	30.2%	(28.7% - 31.8%)	2487	22.4%	(21.7% - 23.2%)	1118	34.5%	(32.9% - 36.2%)	398	**50.4%**	(46.9% - 53.9%)
Lower limb	1207	36.2%	(34.6% - 37.8%)	3652	32.9%	(32.1% - 33.8%)	1342	**41.5%**	(39.8% - 43.2%)	124	15.7%	(13.3% - 18.4%)
Trunk/back	654	19.6%	(18.3% - 21.0%)	4123	**37.2%**	(36.3% - 38.1%)	414	12.8%	(11.7% - 14.0%)	117	14.8%	(12.5% - 17.5%)
Multiple locations	< 4	< 1.0%	-	< 4	< 1.0%	-	< 4	< 1.0%	-	< 4	< 1.0%	-
Unknown/unobtainable	43	1.3%	(0.3% - 1.7%)	169	1.5%	(1.3% - 1.8%)	67	2.1%	(1.6% - 2.6%)	7	0.9%	(0.4% - 1.8%)

Note: Shaded numbers represent the activity maximum and bold values represent significant maximum within body region by 95% CI

Table 63. *Top three cricket-related ACC claims (n = 19,791) of injury diagnoses (as labelled in the ACC data) for females and males by activity (batting, bowling, fielding and wicket keeping), (2008 – 2018).*

Activity / body region / *diagnosis*	**Male (n)**	**%**	**Female (n)**	**%**	**Total (n)**	**%**
Batting						
Lower back/spine	383		33		416	
Lumbar sprain	*363*	*95%*	*33*	*100%*	*396*	*95%*
Knee	283		27		310	
Sprain of knee and leg	*129*	*46%*	*9*	*33%*	*138*	*45%*
ligament sprain[1]	*63*	*22%*	*7*	*26%*	*70*	*23%*
Hip, upper leg, thigh	281		24		305	
Sprain of hip and thigh	*133*	*47%*	*12*	*50%*	*145*	*48%*
sprain, hamstring tendon	*74*	*26%*	*7*	*29%*	*81*	*27%*
Bowling						
Lower back/spine	2756		150		2906	
Lumbar sprain	*2676*	*97%*	*148*	*99%*	*2824*	*97%*
Shoulder	1733		128		1861	
Sprain of shoulder and upper arm	*678*	*39%*	*63*	*49%*	*741*	*40%*
Rotator cuff sprain	*677*	*39%*	*50*	*39%*	*727*	*39%*
Knee	1098		77		1175	
Sprain of knee and leg	*726*	*66%*	*46*	*60%*	*772*	*66%*
ligament sprain[1]	*178*	*16%*	*12*	*16%*	*190*	*16%*
Fielding						
Knee	481		32		513	
Sprain of knee and leg	*229*	*48%*	*17*	*53%*	*246*	*48%*
ligament sprain[1]	*84*	*17%*	*3*	*9%*	*87*	*17%*
Finger/thumb	395		31		426	
Sprain finger/thumb	*162*	*41%*	*13*	*42%*	*175*	*41%*
Fracture	*81*	*21%*	*8*	*26%*	*89*	*21%*
Shoulder[2]	394		19[2]		413	
Rotator cuff sprain	*149*	*38%*	*5*	*26%*	*154*	*37%*
Sprain of shoulder and upper arm	*120*	*30%*	*6*	*32%*	*126*	*31%*
Wicket Keeping						
Finger/thumb	287		19		306	
Sprain finger/thumb	*128*	*45%*	*11*	*58%*	*139*	*45%*
Fracture	*66*	*23%*	*5*	*26%*	*71*	*23%*
Face	87		6		93	
Teeth (not otherwise specified)	*47*	*54%*	*2*	*33%*	*49*	*53%*
Open wound	*23*	*26%*	*1*	*17%*	*24*	*26%*
Lower back[3]	81		6[3]		87	
Lumbar sprain	*78*	*96%*	*6*	*100%*	*84*	*97%*

[1] Includes medial and/or lateral collateral and/or anterior and/or posterior cruciate ligaments.
[2] For female fielding injuries, ankle injuries (n = 25) were more common, with sprains (75%) being the most common diagnosis.
[3] For female wicket keeping injuries, knee injuries (n = 7) were more common, with sprain of knee and leg (57%) the most common diagnosis.

5.4.9 Injury factors associated with claims by activity

Table 64 presents information on numbers and proportions of injury claims associated with the different activities of cricket by the top four external agencies: ball, equipment, ground and self. Wicket keeping was the activity most associated with injury from the ball (67.3%). Bowling was the second most common activity associated with injury from the ball (47.2%), closely followed by batting (46.6%) and fielding (42.0%). Females (73.8% (95% CI 62.0% - 83.0%)) were more commonly injured by the ball in wicket keeping than males (66.7%, (95% CI 63.3% - 69.9%)), and similarly for fielding, females (47.0%, (95% CI 41.2% - 53.0%)) were more commonly injured by the ball than males (41.6%, 95% CI (39.9% - 43.3%)), although not significantly so.

Injuries associated with equipment, other than the ball, were more common with batting activity (female 24.9% (95% CI 20.2% - 30.3%)), male 23.0% (95% CI 21.6% - 24.5%)). Males were more likely to be injured by equipment while wicket keeping and bowling than females but not significantly.

Injuries associated with the ground were more common in fielding (females 35.2% (95% CI 29.7% - 41.1%)), males 37.0% (95% CI 35.4% - 38.7%)). Females were slightly more represented in batting and bowling whilst males were more represented in fielding and wicket keeping.

For the external agency of self, bowling was the most common activity (females 11.2% (95% CI 9.1% - 13.7%)), males 12.0% (95% CI 11.4% - 12.7%)).

Figures 62 – 65 show the breakdown of injury factors by injury contact and injury cause to help understand the mechanisms of injury by activity for the top two external agents in each activity. Because there was no significant difference in the proportions of injury between sexes associated with external agency, and the relative low number of female injuries compared to male injury, both male and female injuries have been included together.

Recreation/sports equipment-ball was the most common external agency for batting activity (n = 1,648, 46.6%) and wicket keeping (n = 575, 67.3%) with n = 1,106 (65.7%) batting injuries due to contact with the ball and n = 417 (72.5%) wicket keeping injuries being due to contact with the ball. Impact/contact with the ground was the most common injury factor for fielding (n = 967, 27.6%) and contact with the ball second most common (n = 744, 21.2%). A strain or twisting movement with strenuous movement involving the ball accounted for n = 2,571 (21.8%) bowling related injuries, 1,087 (9.2%) claims involved contact with the ball and n = 947 (8.0%) claims occurred from impact with the ground due to a loss of balance or slip/trip/skid.

Table 64. Numbers and proportions of cricket-related ACC injury claims associated with the different activities and forms of cricket by the top four external agencies: ball, equipment, ground and self, (2008 – 2018).

	Recreation/Sports Equip-Ball				Recreation/Sports Equip-Other				Ground/path				Self				Other				
	Female		Male		Female		Male		Female		Male		Female		Male		Female		Male		
Activity & Format	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	**Total**
Batting																					
Indoor Cricket	10	8.3%	174	11.1%	13	18.8%	90	11.7%	9	20.0%	82	16.8%	< 4	10.5%	46	18.5%	-	-	-	-	
Outdoor Cricket	110	91.7%	1390	88.9%	56	81.2%	678	88.3%	36	80.0%	406	83.2%	17	89.5%	202	81.5%	-	-	-	-	
Grand Total	120		1564		69		768		45		488		19		248		24		268		3,613
All batting injuries	**277**	**43.3%**	**3,336**	**46.9%**	**277**	**24.9%**	**3,336**	**23.0%**	**277**	**16.2%**	**3,336**	**14.6%**	**277**	**6.9%**	**3,336**	**7.4%**		**8.7%**		**8.0%**	**100%**
95% CI	**(37.6% - 49.2%)**		**(45.2% - 48.6%)**		**(20.2% - 30.3%)**		**(21.6% - 24.5%)**		**(12.4% - 21.0%)**		**(13.5% - 15.9%)**		**(4.4% - 10.5%)**		**(6.6% - 8.4%)**		**(5.9% - 12.6%)**		**(7.2% - 9.0%)**		
Bowling																					
Indoor Cricket	43	12.8%	726	13.9%	10	15.9%	129	11.3%	18	11.4%	197	8.9%	6	7.4%	167	12.5%	-	-	-	-	
Outdoor Cricket	293	87.2%	4,514	86.1%	53	84.1%	1,009	88.7%	140	88.6%	2,016	91.1%	75	92.6%	1,168	87.5%	-	-	-	-	
Grand Total	336		5,240		63		1,138		158		2,213		81		1,335		85		1167		11,816
All Bowling injuries	**723**	**46.5%**	**11,093**	**47.2%**	**723**	**8.7%**	**11,093**	**10.3%**	**723**	**21.9%**	**11,093**	**19.9%**	**723**	**11.2%**	**11,093**	**12.0%**		**11.8%**		**10.5%**	**100%**
95% CI	**(42.9% - 50.1%)**		**(46.3% - 48.2%)**		**(6.9% - 11.0%)**		**(9.7% - 10.8%)**		**(19.0% - 25.0%)**		**(19.2% - 20.7%)**		**(9.1% - 13.7%)**		**(11.4% - 12.7%)**		**(9.6% - 14.3%)**		**(10.0% - 11.1%)**		
Fielding																					
Indoor Cricket	15	11.8%	122	9.1%	< 4	18.8%	33	17.2%	11	11.6%	92	7.7%	< 4	13.3%	20	9.8%	-	-	-	-	
Outdoor Cricket	112	88.2%	1,225	90.9%	13	81.3%	159	82.8%	84	88.4%	1,107	92.3%	13	86.7%	184	90.2%	-	-	-	-	
Grand Total	127		1,347		16		192		95		1,199		15		204		17		295		3,507
All Fielding injuries	**270**	**47.0%**	**3,237**	**41.6%**	**270**	**5.9%**	**3,237**	**5.9%**	**270**	**35.2%**	**3,237**	**37.0%**	**270**	**5.6%**	**3,237**	**6.3%**		**6.3%**		**9.1%**	**100%**
95% CI	**(41.2% - 53.0%)**		**(39.9% - 43.3%)**		**(3.7% - 9.4%)**		**(5.2% - 6.8%)**		**(29.7% - 41.1%)**		**(35.4% - 38.7%)**		**(3.4% - 9.0%)**		**(5.5% - 7.2%)**		**(4.0% - 9.9%)**		**(8.2% - 10.2%)**		
Wicket Keeping																					
Indoor Cricket	5	10.4%	59	11.2%	< 4	33.3%	10	16.1%	0	0.0%	5	4.9%	0	0.0%	5	12.2%	-	-	-	-	
Outdoor Cricket	43	89.6%	468	88.8%	< 4	66.7%	52	83.9%	5	100.0%	97	95.1%	5	100.0%	36	87.8%	-	-	-	-	
Grand Total	48		527		< 4		62		5		102		5		41		4		58		855
All W-Keeping injuries	**65**	**73.8%**	**790**	**66.7%**	**65**	**4.6%**	**790**	**7.8%**	**65**	**7.7%**	**790**	**12.9%**	**65**	**7.7%**	**790**	**5.2%**		**6.2%**		**7.3%**	**100%**
95% CI	**(62.0% - 83.0%)**		**(63.3% - 69.9%)**		**(1.6% - 12.7%)**		**(6.2% - 9.9%)**		**(4.4% - 9.1%)**		**(10.8% - 15.4%)**		**(3.3% - 16.8%)**		**(3.8% - 7.0%)**		**(2.4% - 14.8%)**		**(5.7% - 9.4%)**		
Total Indoor Cricket	73	11.3%	1,081	12.4%	27	18.2%	262	12.3%	38	12.4%	376	9.3%	10	8.1%	238	13.0%					
Total Outdoor Cricket	558	88.7%	7,597	87.6%	124	81.8%	1,898	87.7%	265	87.6%	3,626	90.7%	110	91.9%	1,590	87.0%					
Overall Total	**631**	**47.3%**	**8,678**	**47.0%**	**151**	**11.3%**	**2,160**	**11.7%**	**303**	**22.7%**	**4,002**	**21.7%**	**120**	**9.0%**	**1,828**	**9.9%**	**130**	**9.7%**	**1788**	**9.7%**	**19,791**

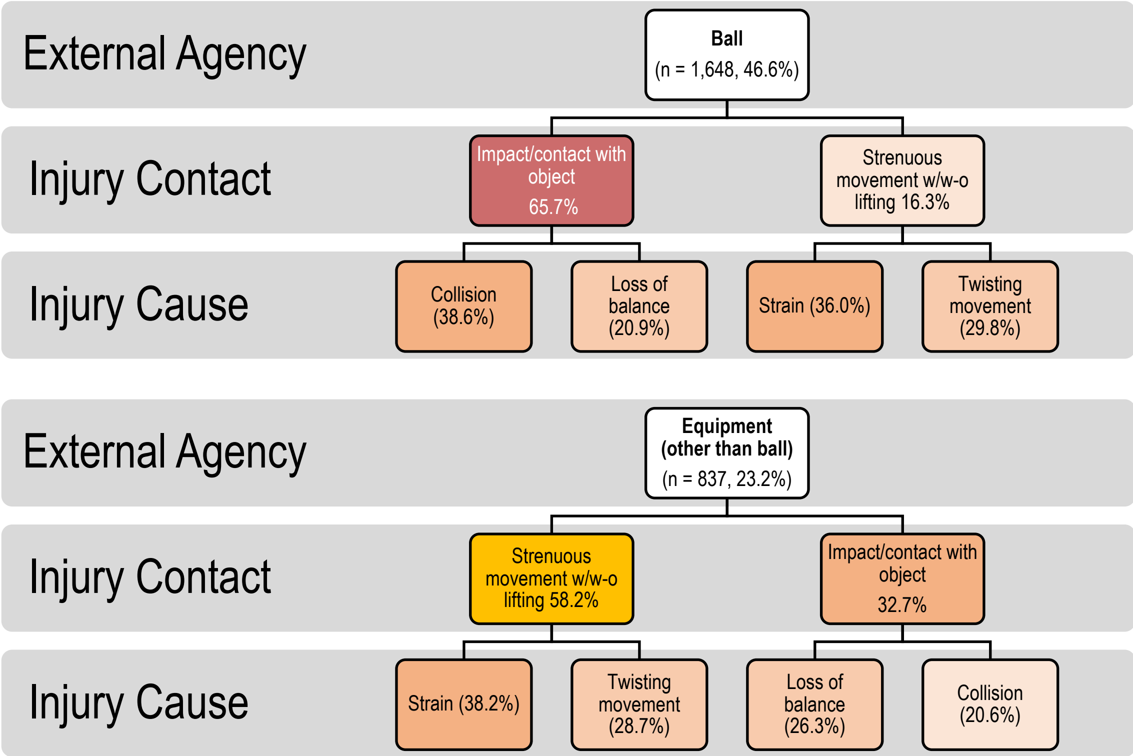

Figure 62. *Top two injury factors for cricket-related ACC claims associated with activity of batting (2008 – 2018).*

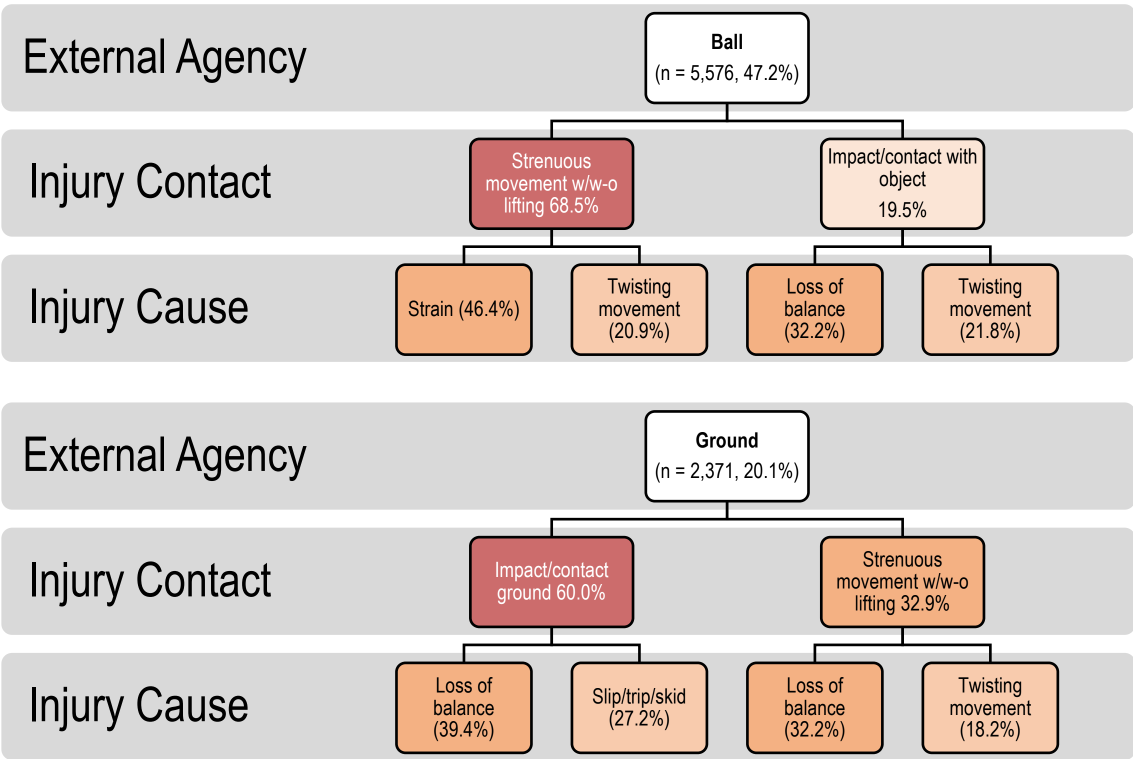

Figure 63. *Top two injury factors for cricket-related ACC claims associated with activity of bowling (2008 – 2018).*

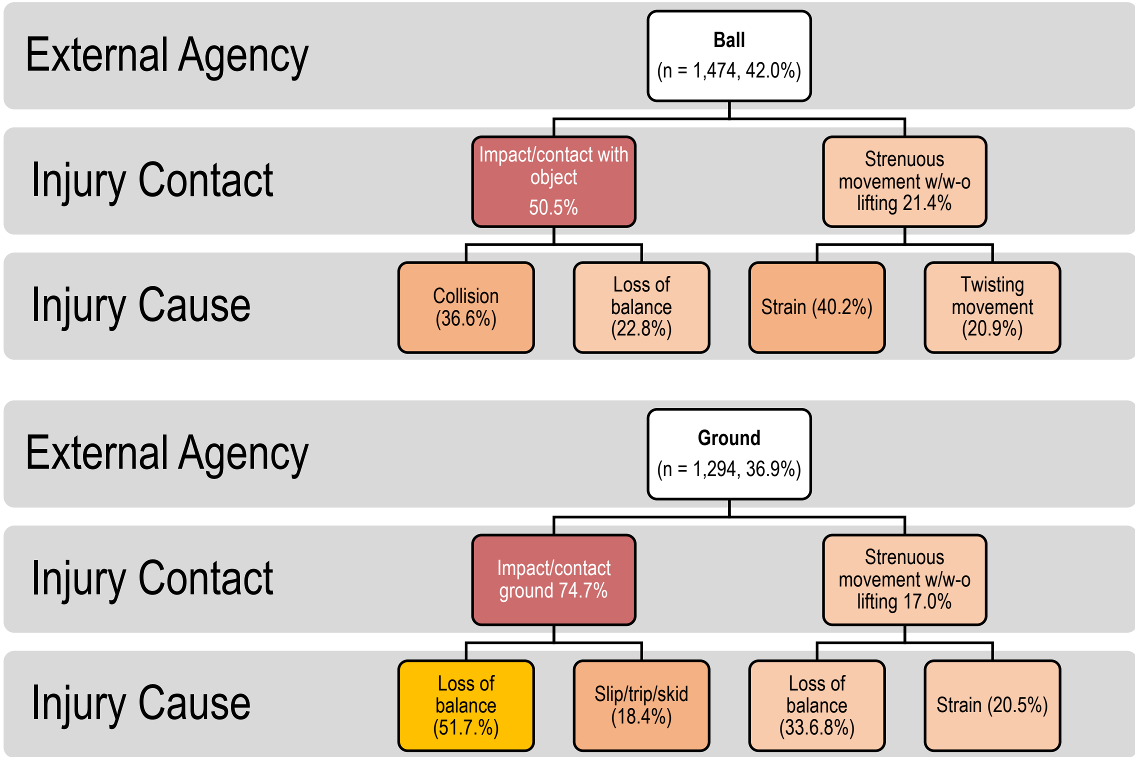

__Figure 64.__ Top two injury factors for cricket-related ACC claims associated with activity of fielding (2008 – 2018).

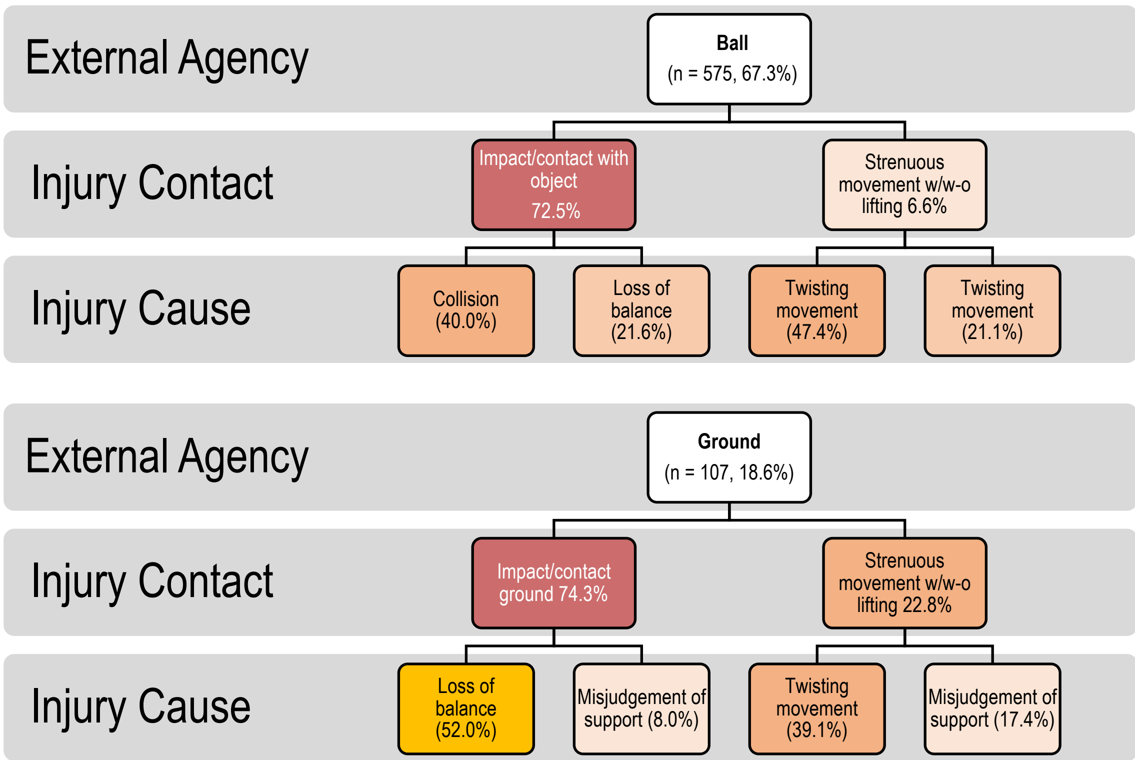

__Figure 65.__ Top two injury factors for cricket-related ACC claims associated with activity of wicket keeping (2008 – 2018).

5.4.10 Activity of injury onset by age

Figure 66 shows the proportion of male injury claims by activity of injury onset and age group. For bowling the peak proportion occurred at the 15-19 years old age group, with lower back sprains the most common injury diagnosis (36%, n = 840). Bowling related claims decrease from that age group. Batting related injury claims increase with increasing age group. In the 0-9 years old age group, finger/thumb contusions account for 24% of the batting injury claims. For the 30-34 years old age group, lower back sprains (14%) account for the most injury claims and for the later spike in the 55-59 years old age group, calf and Achilles sprains or ruptures account for 17% of the claims. Fielding injury claim proportions follow a similar trajectory to batting. An early peak in the 0-9 years old age group involved mostly facial injuries (23%), being contusions, open wounds and eye injuries. The 35-39 years old age group were associated mostly with knee injuries (16%), with the majority of these sprains/strains. The later spike in the fielding claim proportions associated with the 55-59 years old age group had a variety of equally common injuries: knee sprain/strains (13%), hamstring sprain (11%), shoulder sprains (11%) and lumbar sprains (10%).

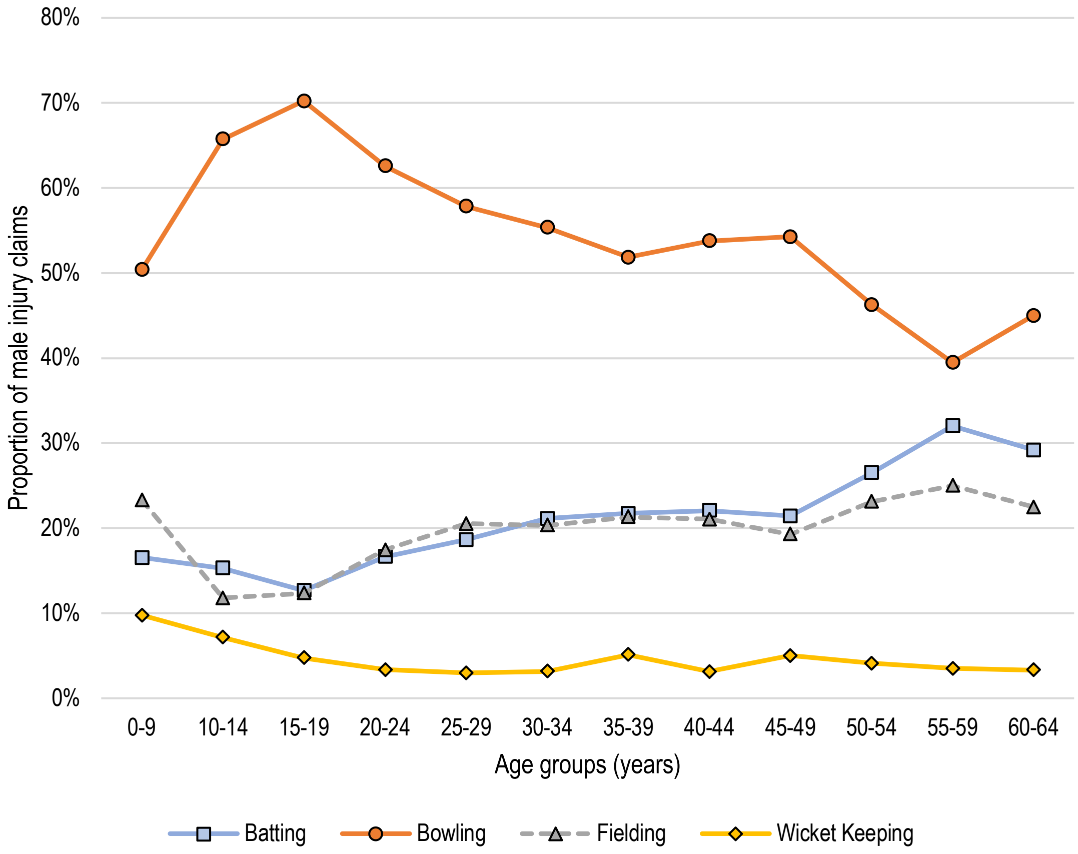

Figure 66. *Proportion of male cricket-related ACC claims by activity of injury onset and age group n = 18,456 (2008 – 2018).*

Figure 67 shows the proportion of claims for females by activity of injury onset and age groups. The proportion of bowling related claims was similar to the male pattern initially, with juniors having the highest proportions, but after an initial decrease, the proportions began to rise again in the 35-39 years old age group. Similarly, for batting and fielding, claims proportions increased with age groups until the 35-39 and 30-34 years old age groups respectively, where the proportions began to drop. Between the ages of 10-19 years inclusive, lower back sprains were the most common injury claim associated with bowling (27%), with shoulder sprains/strains second most common (18%). Between the ages of 35-49 years inclusive, for bowling, shoulder sprains/strains were the most common injury claim (40%). Batting injuries claims in the 10-14 years old age group were mostly contusions (44%) and of those, 55% were to the upper limb.

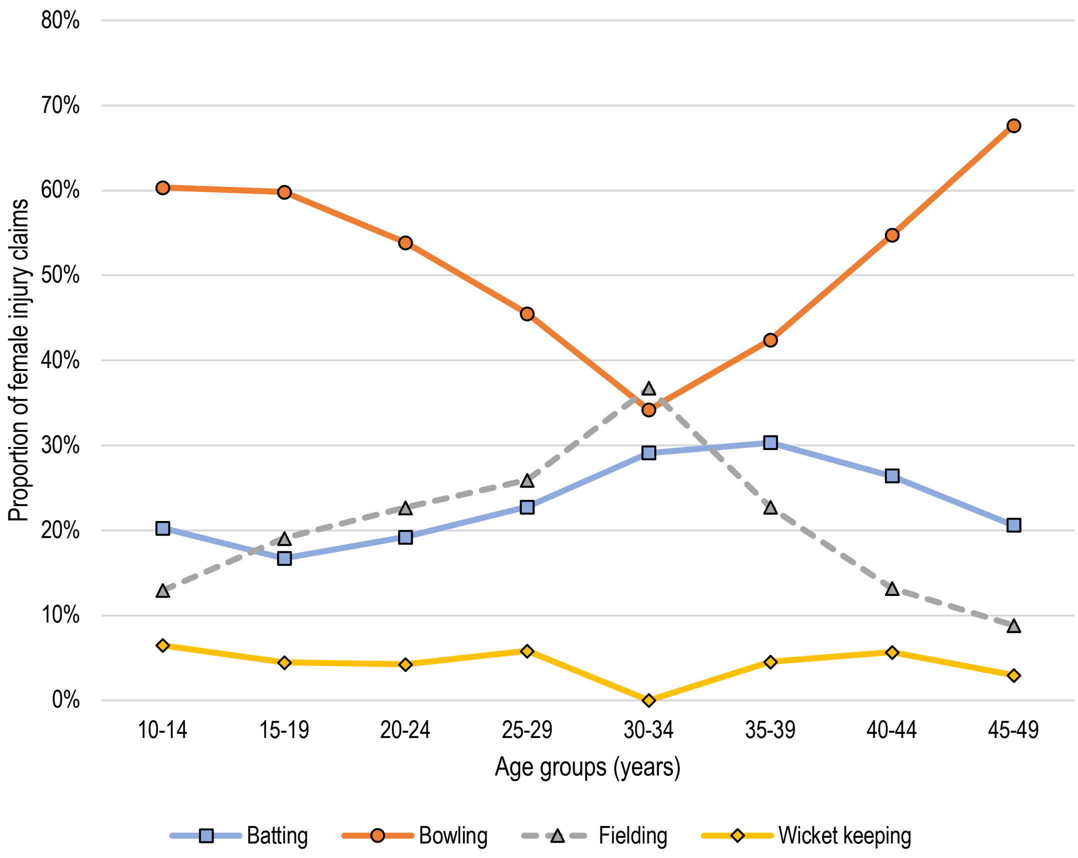

Figure 67. *Proportion of female cricket-related ACC claims by activity of injury onset and age group n = 1,335 (2008 – 2018).*

5.4.11 Injury claim provider

Table 65 shows the numbers and proportions of claims seen by different types of health providers. The majority of claimants sought treatment initially at either a General Practitioner (43.6%) or Physiotherapist (41.2%). There were 6,557 claims that required acute level care (taken as hospital, nurse, surgeon, and ambulance officer), which represented 10.4% of claims.

Table 65. Number and proportion of cricket-related ACC claims (n = 62,776) seen by various initial claim providers (2008 – 2018).

Claim Provider	n	%
General Practitioner	27,373	43.6%
Physiotherapist	25,852	41.2%
Hospital	5,114	8.1%
Chiropractor	1,483	2.4%
Osteopath	1,195	1.9%
Dental Surgeon	1,029	1.6%
Nurse	339	0.5%
Podiatrist	205	0.3%
Sports Medicine Specialist	74	0.1%
Ambulance Officer	62	0.1%
Occupational Therapist	13	< 0.1%
Orthopaedic Surgeon	12	< 0.1%
Acupuncturist	9	< 0.1%
Optometrist	6	< 0.1%
Ophthalmologist	≤ 4	< 0.1%
Musculoskeletal Medicine Specialist	≤ 4	< 0.1%
Otolaryngologist/Head & Neck Surgeon	≤ 4	< 0.1%
Paediatrician	≤ 4	< 0.1%
Psychiatrist	≤ 4	< 0.1%
Unknown	≤ 4	< 0.1%

Table 66 shows the top six claim providers by gender. Males (43.8% (95 CI 43.4% – 44.2%)) proportionally saw General Practitioners more often than females (41.3% (95% CI 40.0% – 41.6%)) and females (42.5% (95% CI 41.2% – 43.8%)) saw physiotherapists proportionally more than males (41.0 (95% CI 40.6% – 41.4%)).

Table 66. Number, proportion and relative rank of cricket-related ACC claims (n = 62,776) seen by various claim providers by sex (2008 – 2018).

Claim Provider	n, female	%	Rank	n, male	%	Rank
General Practitioner	2,243	41.3%	2	25,130	43.8%	1
Physiotherapist	2,308	42.5%	1	23,544	41.0%	2
Hospital	442	8.0%	3	4,672	8.3%	3
Chiropractor	110	2.0%	6	1,373	2.4%	4
Osteopath	117	2.2%	5	1,078	1.9%	5
Dental Surgeon	127	2.3%	4	902	1.6%	6

On the assumption that knowing the activity of onset increases the likelihood of the injury claim being associated with an organised level of cricket, Table 67 shows the numbers and proportions of claims seen by health providers where the activity of injury onset was derived from the injury description. The proportion of claims seen by GPs and physiotherapists is similar to the overall proportion from Table 66, however, physiotherapy now has the vast majority of those. Claims involving hospital treatment have dropped from 8.1% to 4.4% and allied health practitioners such as osteopaths and chiropractors increased their proportions.

Table 67. *Number and proportion of cricket-related ACC claims (n = 19.791) seen by various claim providers where activity of injury onset was known (i.e. batting, bowling, fielding or wicket keeping).*

Claim Provider	**(n)**	**%**
Physiotherapist	12,176	61.5%
General Practitioner	4,918	24.8%
Hospital	872	4.4%
Chiropractor	745	3.8%
Osteopath	597	3.0%
Dental Surgeon	287	1.5%
Podiatrist	86	0.4%
Nurse	52	0.3%
Sports Medicine Specialist	35	0.2%
Ambulance Officer	7	0.0%
Orthopaedic Surgeon	5	0.0%
Occupational Therapist	< 4	0.0%
Acupuncturist	< 4	0.0%
Ophthalmologist	< 4	0.0%
Optometrist	< 4	0.0%
Otolaryngologist/Head & Neck Surgeon	< 4	0.0%
Sub-total	**19,791**	

Table 68 shows the relative proportions of the injured body location attended to by hospitals, GPs and physiotherapists. Finger/thumb, hand/wrist, head, face, and eye injuries were significantly more common in the hospital system, with the finger/thumb being the most common injury treated. Physiotherapists assessed lower and upper back, neck, hip/upper leg and thigh and lower leg significantly more commonly than did GPs or hospitals, with the lower back being the most common injury treated. By proportion, GPs attended to more shoulders injury claims than physiotherapists and hospitals but not significantly more than physiotherapists. General practitioners did attend to significantly more chest injuries than physiotherapists and hospitals.

Table 68. Proportions cricket-related ACC claims attended to by hospitals, GPs and physiotherapists, by the body location, where the activity of injury onset was known (batting, bowling, fielding, wicket keeping).

	Hospital			GPs			Physiotherapist		
Body Location	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**
Abdomen/pelvis	8	0.9%	(0.5% - 1.8%)	58	1.2%	(0.9% - 1.5%)	41	0.3%	(0.2% - 0.5%)
Ankle	75	8.6%	(6.9% - 10.6%)	335	6.8%	(6.1% - 7.6%)	898	7.4%	(6.9% - 7.9%)
Chest	13	1.5%	(0.9% - 2.5%)	174	3.5%	(3.1% - 4.1%)	232	1.9%	(1.7% - 2.2%)
Ear	< 4	< 1.0%	-	7	0.1%	(0.1% - 0.3%)	0	0.0%	-
Elbow	21	2.4%	(1.6% - 3.7%)	85	1.7%	(1.4% - 2.1%)	81	0.7%	(0.5% - 0.8%)
Eye	19	2.2%	(1.4% - 3.4%)	43	0.9%	(0.6% - 1.2%)	< 4	< 1.0%	-
Face	89	10.2%	(8.4% - 12.4%)	160	3.3%	(2.8% - 3.8%)	4	0.0%	(0.0% - 0.1%)
Finger/thumb	**174**	**20.0%**	**(17.4% - 22.7%)**	678	13.8%	(12.9% - 14.8%)	333	2.7%	(2.5% - 3.0%)
Foot	38	4.4%	(3.2% - 5.9%)	147	3.0%	(2.5% - 3.5%)	166	1.4%	(1.2% - 1.6%)
Hand/wrist	70	8.0%	(6.4% - 10.0%)	273	5.6%	(4.9% - 6.2%)	224	1.8%	(1.6% - 2.1%)
Head (except Face)	31	3.6%	(2.5% - 5.0%)	31	0.6%	(0.4% - 0.9%)	4	0.0%	(0.0% - 0.1%)
Hip, Upper Leg, Thigh	27	3.1%	(2.1% - 4.5%)	221	4.5%	(3.9% - 5.1%)	1588	13.0%	(12.5% - 13.7%)
Knee	111	12.7%	(10.7% - 15.1%)	593	12.1%	(11.2% - 13.0%)	1562	12.8%	(12.2% - 13.4%)
Lower Back/spine	15	1.7%	(1.0% - 2.8%)	556	11.3%	(10.5% - 12.2%)	**3080**	**25.3%**	**(24.5% - 26.1%)**
Lower Leg	17	1.9%	(1.2% - 3.1%)	129	2.6%	(2.2% - 3.1%)	503	4.1%	(3.8% - 4.5%)
Multiple Locations	< 4	< 1.0%	-	6	0.1%	(0.1% - 0.3%)	< 4	< 1.0%	-
Neck, Back Of Head Vertebrae	5	0.6%	(0.2% - 1.3%)	98	2.0%	(1.6% - 2.4%)	587	4.8%	(4.5% - 5.2%)
Nose	14	1.6%	(1.0% - 2.7%)	36	0.7%	(0.5% - 1.0%)	0	0.0%	-
Shoulder (incl Clavicle/blade)	61	7.0%	(5.5% - 8.9%)	**748**	**15.2%**	**(14.2% - 16.2%)**	2055	16.9%	(16.2% - 17.6%)
Toes	20	2.3%	(1.5% - 3.5%)	122	2.5%	(2.1% - 3.0%)	18	0.1%	(0.1% - 0.2%)
Unknown	12	1.4%	(0.8% - 2.4%)	42	0.9%	(0.6% - 1.2%)	13	0.1%	(0.1% - 0.2%)
Unobtainable	22	2.5%	(1.7% - 3.8%)	131	2.7%	(2.2% - 3.2%)	38	0.3%	(0.2% - 0.4%)
Upper And Lower Arm	22	2.5%	(1.7% - 3.8%)	133	2.7%	(2.3% - 3.2%)	240	2.0%	(1.7% - 2.2%)
Upper Back/spine	4	0.5%	(0.2% - 1.2%)	112	2.3%	(1.9% - 2.7%)	507	4.2%	(3.8% - 4.5%)

Legend	**Bold text** are most common injury	Significant difference to other providers	Significant difference to adjacent provider not shaded

Hospital attended injuries

There were 5,114 claims associated with hospital attended injuries. Males represented 91.4% (n = 4,672) of these claims. Figure 68 shows the proportions by age group and sex of hospital attended claims. The most common age groups for females was skewed toward the younger age brackets, with the 10 to 14 years old age group the most common. For males, the 25 to 29 years age group was the most common.

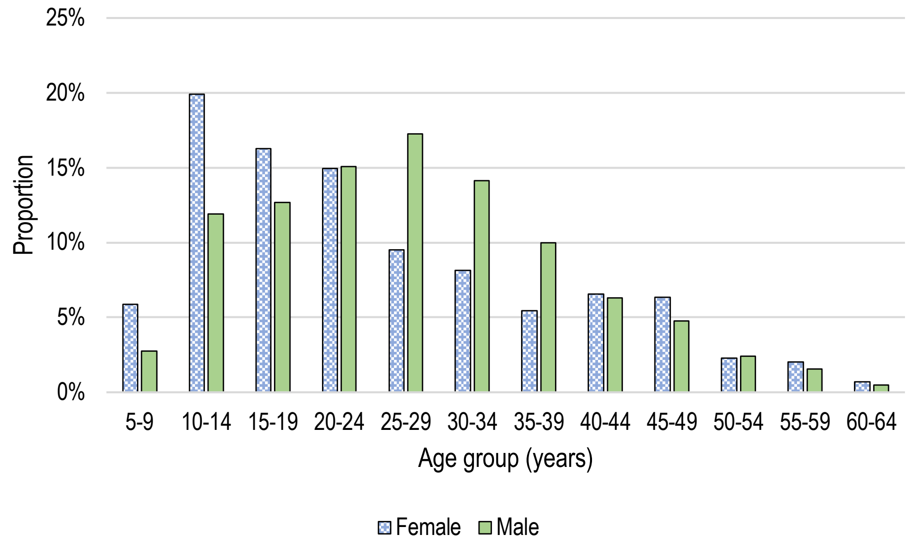

__Figure 68.__ Proportion of cricket-related ACC claims for males (n = 4,672) and females (n = 442) by age group for injuries treated at hospitals (2008 – 2018).

The majority of hospital treated claims related to injuries occurring in outdoor cricket (84.8%, n = 4,337). Indoor cricket injuries requiring hospital treatment were slightly more common in males (15.6%) compared to females (11.3%).

The annual number of claims for hospital treated injuries was relatively steady over the time period investigated, except for a spike in claims in outdoor cricket injury claims in males between 2012/13 and 2014/15 (Figure 69).

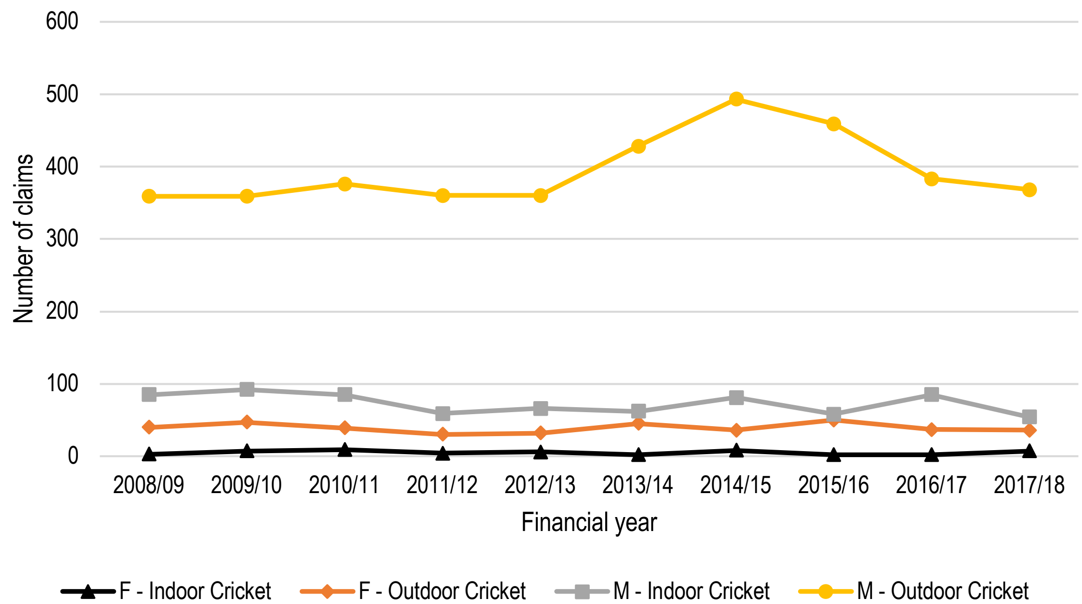

__Figure 69.__ Annual number of cricket-related ACC claims for males and females by age group and form of cricket for injuries treated at hospitals n = 5,114 (2008 – 2018).

The finger/thumb was the most commonly injured body part in males (27.8%) and females (21.7%) requiring hospital treatment, followed by the hand/wrist (8.7% overall) and knee (8.6% overall). Table 69 shows the relative proportions of broad body regions injured requiring hospital treatment. Males had a significantly higher proportion of upper limb injuries compared to females.

Table 69. *Proportions of cricket-related ACC claims by sex for broad body regions injured requiring hospital treatment (2008 – 2018).*

Body region	n (female)	%	95% CI	n (male)	%	95% CI
Head, neck & face	86	19.5%	(16.0% - 23.4%)	787	16.8%	(15.8% - 17.9%)
Upper limb	170	38.5%	(34.0% - 43.1%)	2,247	**48.1%**	(46.7% - 49.5%)
Trunk/pelvis	16	3.6%	(2.2% - 5.8%)	205	4.4%	(3.8% - 5.0%)
Lower limb	145	32.8%	(28.6% - 37.3%)	1,225	26.2%	(25.0% - 27.5%)
Other[1]	25	5.7%	(3.9% - 8.2%)	208	4.5%	(3.9% - 5.1%)
Totals	**442**			**4671**		

[1] includes multiple locations, internal organ, unknown and unobtainable.
Shaded values represent significant differences based on non-overlapping 95% CI.

Table 70 shows the numbers and proportions of injury by diagnosis for hospital treated injury claims. Soft tissue injury was still the most common injury diagnosis and significantly more common in females than males. Fracture and dislocation the second most common injury diagnosis and was significantly more common in males.

Table 70. *Proportions of cricket-related ACC claims by broad diagnosis (nature) for males and females requiring hospital treatment (2008 – 2018).*

Diagnosis	n (female)	%	95% CI	n (male)	%	95% CI	Total	%
Soft Tissue Injury	253	**57.2%**	(52.6% - 61.8%)	2360	50.5%	(49.1% - 52.0%)	2613	51.1%
Fracture/dislocation	91	20.6%	(17.1% - 24.6%)	1394	**29.8%**	(28.5% - 31.2%)	1485	29.0%
Laceration, puncture, sting	60	13.6%	(10.7% - 17.1%)	604	12.9%	(12.0% - 13.9%)	664	13.0%
Other	21	4.8%	(3.1% - 7.2%)	198	4.2%	(3.7% - 4.9%)	220	4.3%
Concussion	11	2.5%	(1.4% - 4.4%)	71	1.5%	(1.2% - 1.9%)	82	1.6%
Dental Injury	6	1.4%	(0.6% - 2.9%)	44	0.9%	(0.7% - 1.3%)	50	1.0%
Totals	**442**			**4671**			**5114**	

Shaded values represent significant differences based on non-overlapping 95% CI.

Because the ACC data has information on the activity of injury onset, it can be used to identify the most common activities associated with hospital treated claims, something lacking from the VISU data in Chapter 4. Analysis of hospital treated claims where activity was known, showed that batting (n = 343) was, overall, the most common activity resulting in hospital treatment claims, followed by fielding (n = 258). For males, batting was the most common activity, whilst fielding was the most common activity involved for females (Table 71). Bowling and fielding were more common causes of hospital treated claims in females, however, the low number of claims resulted in non-significant differences.

Table 71. *Proportion of cricket-related ACC claims requiring hospital treatment where activity of onset was known (batting, bowling, fielding, wicket keeping).*

Activity	n (female)	%	95% CI	n (male)	%	95% CI
Batting	12	30.8%	(18.6% - 46.4%)	331	39.7%	(36.5% - 43.1%)
Bowling	11	28.2%	(16.5% - 43.8%)	180	21.6%	(18.9% - 24.5%)
Fielding	13	33.3%	(20.6% - 49.0%)	245	29.4%	(26.4% - 32.6%)
Wicket Keeping	< 4	-	(2.7% - 20.3%)	77	9.2%	(7.5% - 11.4%)
Totals	**39**			**833**		

The most common mechanism of injury for batting was impact/contact with the ball (all ages, male 59.8% (95% CI 54.5% – 65.0%)). When assessed for ages less than 15 years, the proportion of injuries due to impact/contact with the ball was higher, but not significantly so (66.7% (95% CI 49.6% – 80.3%)). Impact with the ball accounted for 81% of the wicket keeping injuries in males and 36% of fielding injuries. For batting injuries occurring due to impact/contact with equipment, the proportions were similar for adults (7%) and children less than 15 years old (6%). The proportion of impact/contact with equipment for males aged 5 to 14 years for all hospital cases (i.e. not filtered for activity) was 11%.

5.4.12 Injury severity/burden

In order to gain understanding of the severity of injuries occurring to cricketers in New Zealand, the number of work days paid by the ACC has been used as a proxy. There were 2,491 (4.0%) claims that were approved for work days paid, with males representing 95.7% of these claims. The highest number of claims that resulted in work days paid for males occurred in the 25-29 years old age group (n = 558, or 23.4% (95% CI 21.8% - 25.2%)), whilst for females it was the 30-34 years old age group (n = 19, or 47.2% (95% CI 38.1% - 56.6%)). The proportions of work days paid by sex and severity is shown in Figure 70.

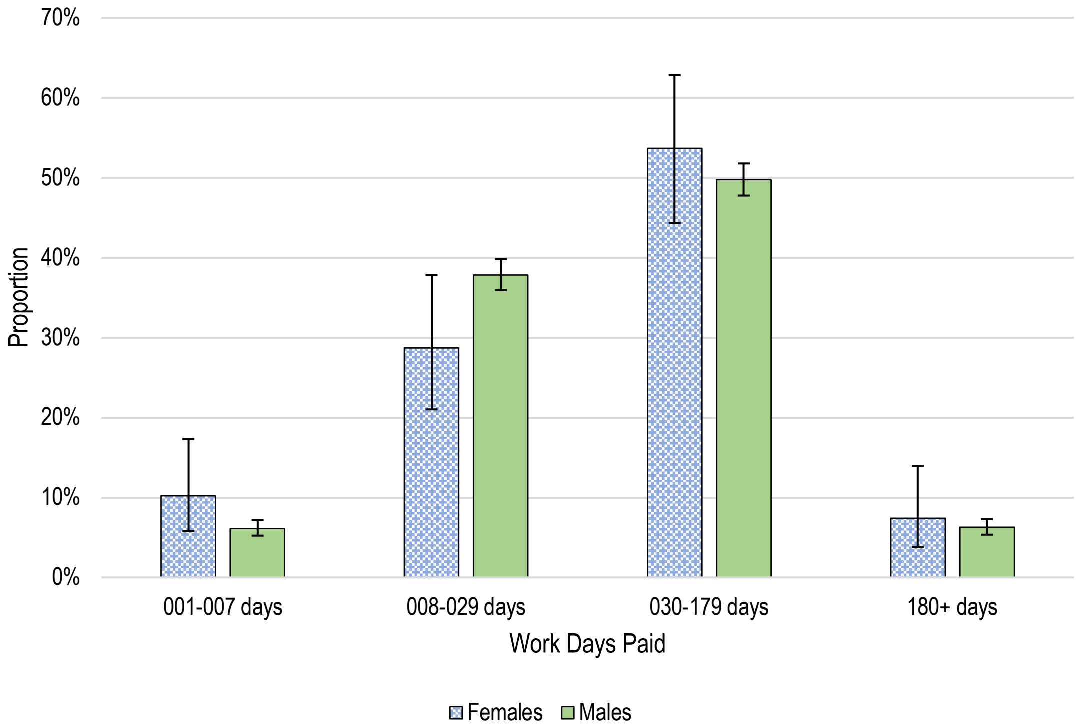

Figure 70. Proportion of cricket-related ACC claims, that resulted in work days paid (WDP), by sex and severity category (females n = 108, males n = 2,383).

When investigating differences between females and males, female claimants had an odds ratio of 0.468 (95% CI 0.385 – 0.569) compared to males when receiving a claim for work days paid as a result of a cricket related injury. Table 72 shows the odds ratios (OR) for females and males by WDP.

Table 72. Female:Male odds ratios for cricket-related ACC claims resulting in work days paid (2008 – 2018).

Work Days Paid	Proxy severity measure	Odds Ratio (F:M) (95% CI)	Significance to 5% level (p)
1 – 7 days	Mild	0.80 (0.43 – 1.47)	> 0.05
8 – 29 days	Moderate	0.36 (0.25 – 0.52)	**< 0.05**
30 – 180 days	Major	0.51 (0.39 – 0.67)	**< 0.05**
180 + days	Severe	0.54 (0.26 – 1.09)	> 0.05

Analysing severity by activity, 2.9% of claims (n = 577) required WDP. Table 73 shows the relative proportions of work days paid by claims that reported either batting, bowling, fielding or wicket keeping as the activity when injured. Bowling was the most common activity associated with work days paid. Batting and fielding recorded similar numbers of claims that required work days paid.

Table 73. Proportion of cricket-related ACC claims that resulted in work days paid by activity (batting, bowling, fielding, wicket keeping) (2008 – 2018).

Activity	n claims	%	(95% CI)
Batting	135	23.4%	(20.1 -27.0)
Bowling	281	48.7%	(44.6 – 52.8)
Fielding	134	23.2%	(20.0 – 26.8)
Wicket Keeping	27	4.7%	(3.2 – 6.7)

Figure 71 shows the proportions of claims receiving work days paid by activity. Bowling was the most common activity associated with such claims across all severities. Bowling was significantly more common by proportion than batting, fielding or wicket keeping for moderate and major severity measures.

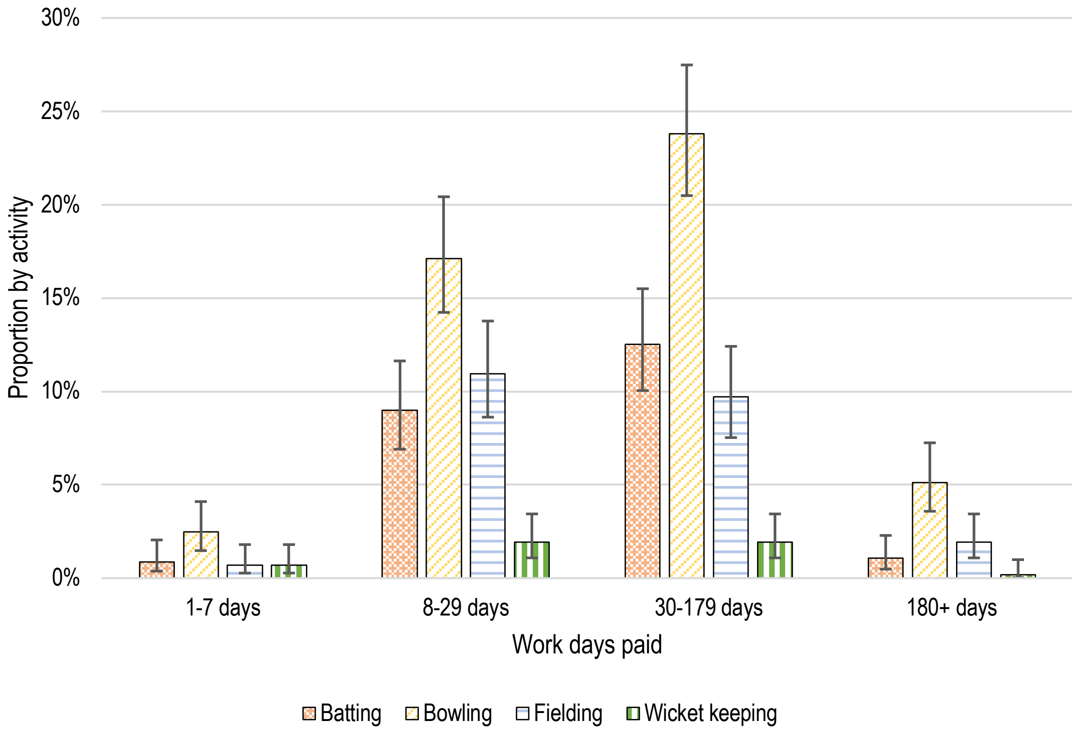

Figure 71. Proportion of cricket-related ACC claims that resulted in work days paid by activity (batting, bowling, fielding, wicket keeping) and severity category n = 577 (2008 – 2019).

5.4.13 Proportion of work days paid by provider

Table 74 shows the proportions of the top three attended health providers for claims that resulted in work days paid. General practitioners had significantly higher proportions of WDP cases than physiotherapists across all categories. Hospitals had significantly higher proportions of WDP cases than both GPs and physiotherapists across all categories.

Table 74. *Proportions of cricket-related ACC claims that resulting in work days paid by the top three attended health providers (2008 – 2018).*

Work Days Paid	General Practitioner		Physiotherapist		Hospital	
	(n)	% (95% CI)	(n)	% (95% CI)	(n)	% (95% CI)
001-007 days	100	**0.4%** (0.3% - 0.4%)	18	0.1% (0.0% - 0.1%)	35	**0.7%** (0.5% - 1.0%)
008-029 days	533	**1.9%** (1.8% - 2.1%)	172	0.7% (0.6% - 0.8%)	214	**4.2%** (3.7% - 4.8%)
030-179 days	664	**2.4%** (2.2% - 2.6%)	261	1.0% (0.9% - 1.1%)	290	**5.7%** (5.1% - 6.3%)
180+ days	79	**0.3%** (0.2% - 0.4%)	35	0.1% (0.1% - 0.2%)	33	**0.6%** (0.5% - 0.9%)
> 1 week (all)	1,376	**5.0%** (4.8% - 5.3%)	486	1.9% (1.7% - 2.1%)	572	**11.2%** (10.4% - 12.1%)
None	25,998	95.0% (94.7% - 95.2%)	25,366	98.1% (97.9% - 98.3%)	4,542	88.8% (87.9% - 89.6%)
Total (less all)	**27,374**		**25,852**		**5,114**	

When WDP were examined using the data where the activity of onset was known (Table 75), there was no significant difference found to that of the overall data. The only major difference was the shift in proportions in hospital treated cases toward the 8 to 29 days.

Table 75. *Proportions of cricket-related ACC claims that resulting in work days paid by the top three attended health providers where the activity of onset was known (batting, bowling, fielding, wicket keeping) (2008 – 2018).*

Work Days Paid	General Practitioner		Physiotherapist		Hospitals	
	(n)	% (95% CI)	(n)	% (95% CI)	(n)	% (95% CI)
001-007 days	13	**0.3%** (0.2% - 0.5%)	6	0.1% (0.0% - 0.1%)	6	**0.7%** (0.3% - 1.5%)
008-029 days	95	**1.9%** (1.6% - 2.2%)	75	0.6% (0.5% - 0.8%)	46	**5.3%** (4.0% - 7.0%)
030-179 days	115	**2.3%** (2.0% - 2.8%)	113	0.9% (0.8% - 1.1%)	38	**4.4%** (3.2% - 5.6%)
180+ days	18	**0.4%** (0.2% - 0.6%)	16	0.1% (0.0% - 0.2%)	6	**0.7%** (0.3% - 1.5%)
> 1 week (all)	241	**4.9%** (4.6% - 5.5%)	210	1.7% (1.6% - 2.1%)	96	**11.0%** (9.1% - 13.3%)
None	4,677	95.1% (94.5% - 95.7%)	11,966	98.3% (98.0% - 98.5%)	776	89.0% (86.7% - 90.9%)
Total (less all)	**4,918**		**12,176**		**872**	

5.4.14 Injury type and diagnosis by severity

Table 76 shows the top four body locations, and injury diagnosis by severity (WDP) for injuries occurring where the activity was reported (n = 577). Knee injuries made up 18.2% of WDP claims, with knee ligament injuries alone accounting for 8.3%. Shoulder injuries accounted for 13.9% of WDP injury claims, with 3.8% being made up of general strains to the shoulder or upper arm and 3.6% being rotator cuff sprains. Lower back injuries accounted for 12.8% of WDP claims, of which lower back sprains made up 4.2%. Finger/thumb injuries were the fourth most common WDP claim injury (10.4%), with fractures accounting for 6.1%.

Table 76. Proportions of cricket-related ACC claims for top four body locations, and injury diagnosis by severity (WDP) for injuries occurring where the activity was reported – all activities (n = 577) (2008 – 2018).

Body Region and Diagnosis by Work Days Paid – All activities				
Rank	**1 - 7 days (n =28)**	**8 - 29 days (n = 223)**	**30 - 179 days (n = 277)**	**180 + days (n = 49)**
1	**Lower back 28.6%** [1]	**Knee 18.4%**	**Knee 17.7%**	**Lower back 26.5%**
	Sprain 100%	Sprain 56.1%	Acute MCL tear 18.4%	Sprain 46.2%
		Meniscal tear 24.4%	Complete/partial ACL tear 16.3%	Closed fracture of vertebra 23.1%
		ACL tear 7.3%	Acute LCL tear 14.3%	Disc prolapse & radiculopathy 15.4%
2	**Knee 21.4%**	**Finger/thumb 13.0%**	**Shoulder 15.9%**	**Knee 18.6%**
	MCL/LCL tear/sprain 50.0%	Fracture of phalanges 58.6%	Sprain of upper arm/shoulder 29.5%	ACL rupture 33.3%
	Meniscal tear 50.0%	Dislocation 17.2%	Rotator cuff sprain 20.5%	MCL/LCL tear 22.2%
			Dislocation/subluxation 11.4%	
3	**Hip/upper leg/thigh 14.3%**	**Shoulder 12.6%**	**Lower back 14.4%**	**Shoulder 12.2%**
	Strain hamstring tendon 75.0%	Sprain upper arm/shoulder 32.1%	Sprain 29.5%	Rotator cuff sprain 50.0%
	Strain quadriceps tendon 25.0%	Rotator cuff strain 28.6%	Disc prolapse & radiculopathy 22.5%	Labral tear 33.3%
4	**Shoulder & ankle 7.1% each**	**Hip/upper leg/thigh 10.3%**	**Finger/thumb 10.8%**	**Hand/wrist 6.1%**
	Rotator cuff sprain 50.0%	Hip strain 52.2%	Fracture of phalanges 60.0%	Fracture metacarpal 66.7%
	Ankle sprain 100%	Hip/thigh sprain 34.8%	Contusion 13.3%	Sprain tendon wrist/hand 33.3%
			Thumb sprain 10.0%	

[1] includes 2 sacroiliac ligament sprains, MCL = Medial Collateral Ligament, LCL = Lateral Collateral Ligament, ACL = Anterior Cruciate Ligament

Table 77 shows the top four body locations, and injury diagnosis by severity (WDP) for injuries occurring where the activity was batting (n = 135). Knee injuries made up 17.8% of batting related WDP claims with knee meniscus tears accounting for 5.9% and ligament injuries 5.2%. Finger/thumb injuries accounted for 12.6% of batting related WDP injury claims, with 9.6% being made up of fractures to the phalanges. Ankle injuries accounted for 11.9% of batting related WDP claims, of which Achilles tendon ruptures made up 4.4% and Achilles tendon sprains 3.7%. Lower back injuries were the fourth most common batting related WDP claim injury (10.4%), with sprains accounting for 8.1% and disc injury 2.2%. Facial injuries, specifically eye injuries, were as common as lower back injuries in the 180+ days WDP category.

Table 77. *Proportions of cricket-related ACC claims for top four body locations, and injury diagnosis by severity (WDP) for injuries occurring where the activity was reported – batting (n = 135) (2008 – 2018).*

Body Region & Diagnoses by Work Days Paid - Batting				
Rank	**1 - 7 days (n =6)**	**8 - 29 days (n = 51)**	**30 - 179 days (n = 72)**	**180 + days (n = 6)**
1	**Lower back 66.7%[1]**	**Knee 23.5%**	**Ankle 15.3%**	**Face 33.3%**
	Sprain 100%	Meniscal tear 41.7%	Rupture Achilles tendon 54.5%	Retinal detachment 50%
		MCL/other sprain 25.0%	Sprain Achilles tendon 45.5%	Fracture of orbital floor 50%
		Cruciate ligament sprain 16.7%		
		Patella dislocation 16.7%		
2	**Ankle 33.3%**	**Wrist/hand 17.6%**	**Finger/thumb 15.3%**	**Lower back 33.3%**
	Sprain 100%	Fracture of wrist bones 77.8%	Fracture of phalanges 72.7%	Sprain 100%
		Sprain 22.3%	Contusion 17.3%%	
3	**-**	**Finger/thumb 11.8%**	**Knee 15.3%**	**Knee 16.7%**
		Fracture of phalanges 83.3%	ACL tear 18.2%	Acute meniscal tear 100%
		Crush injury 16.7%	Acute meniscal tear 18.2%	
			Sprain/other 18.2%	
			Fracture/dislocation 9.1%	
4	**-**	**Shoulder 7.8%**	**Shoulder 7.8%**	**Ankle 16.7%**
		Sprain 25.0%	Sprain 25.0%	Unknown 100%
		Rotator cuff tear 25.0%	Rotator cuff tear 25.0%	
		Dislocation 25.0%	Dislocation 25.0%	

[1] includes sacroiliac ligament sprain.

Table 78 shows the top four body locations, and injury diagnosis by severity (WDP) for injuries occurring where the activity was bowling (n = 281). Knee injuries made up 19.6% of bowling related WDP claims with knee ligament injuries accounting for 6.1% and meniscus tears 5.0%. Shoulder injuries accounted for 18.9% of bowling related WDP injury claims, with 7.8% being rotator cuff sprains/tears and 6.4% general sprains. Lower back injuries accounted for 18.6% of bowling related WDP claims, of which lower back sprains accounting for 14.2%, disc injury 2.8% and closed fracture of vertebrae 1.4%. Hip/thigh and upper leg injuries were the fourth most common bowling related WDP claim injury (11.0%), with hamstring sprains/ruptures accounting for 4.2%.

There were seven stress fractures diagnosed in outdoor male cricketers, with four associated with bowling, however, the body location was unobtainable.

Table 78. Proportions of cricket-related ACC claims for top four body locations, and injury diagnosis by severity (WDP) for injuries occurring where the activity was reported – bowling (n = 281) (2008 – 2018).

Body Region & Diagnoses by Work Days Paid - Bowling				
Rank	**1 - 7 days (n =14)**	**8 - 29 days (n = 98)**	**30 - 179 days (n = 138)**	**180 + days (n = 31)**
1	**Knee 28.6%**	**Knee 17.3%**	**Lower back 21.0%**	**Lower back 29.0%**
	Meniscal tear 50.0%	Meniscal tear 29.4%	Sprain 72.4%	Sprain 44.4%
	ACL tear 25.0%	ACL tear 23.5%	Disc prolapse with radiculopathy 20.7%	Closed vertebra fracture 33.3%
	LCL sprain 25.0%	Sprain cruciate ligament 17.6%	Closed vertebra fracture 3.4%	Disc prolapse with radiculopathy 22.2%
		LCL sprain/tear 11.8%		
2	**Hip/upper leg/thigh 33.3%**	**Hip/upper leg/thigh 16.3%**	**Shoulder 21.0%**	**Knee 19.4%**
	Sprain hamstring tendon 100%	Sprain of hip/thigh 43.8%	Sprain 37.9%	ACL tear 33.3%
		Sprain hamstring tendon 37.5%	Rotator cuff tear/sprain 34.5%	Acute meniscus tear 16.7%
		Rupture hamstring tendon 6.3%	Dislocation 10.3%	MCL sprain 16.7%
			Labral tear 10.3%	Sprain 16.7%
3	**Lower back 14.3%**	**Shoulder 16.3%**	**Knee 20.3%**	**Shoulder 19.4%**
	Sprain 100%[1]	Sprain of shoulder 37.5%	Acute meniscal tear 28.6%	Rotator cuff tear/sprain 83.3%
		Rotator cuff sprain/tear 37.5%	MCL/LCL tear/sprain 21.4%	
		Dislocation 12.5%	Sprain 21.4%	
			Fracture tibial condyle 3.6%	
4	**Shoulder 14.3%**	**Lower back 13.3%**	**Ankle 8.7%**	**Unknown 12.9%**
	Rotator cuff sprain 50.0%	Sprain 100%[1]	Sprain 58.3%	
	Other sprain 50.0%		Rupture Achilles tendon 25.0%	
			Sprain Achilles tendon 25.0%	

[1] includes sacroiliac ligament sprain.

Table 79 shows the top four body locations, and injury diagnosis by severity (WDP) for injuries occurring where the activity was fielding (n = 134). Finger/thumb injuries accounted for 19.4% of fielding related WDP injury claims, with 9.7% being made up of fractures to the phalanges and 5.2% dislocations or sprains. Knee injuries made up 18.7% of fielding related WDP claims with knee meniscus tears and knee ligament injuries accounting for 5.0% each. Shoulder injuries accounted for 9.7% of fielding related WDP claims, of which rotator cuff sprains/tears and dislocations made up 2.2% each. Hand/wrist injuries were the fourth most common fielding related WDP claim injury (9.0%), with fractures accounting for 6.0%. Hip/thigh and upper leg injuries were as common as hand/wrist injuries (9.0%), however hand/wrist injuries tended to create longer WDP claims.

Table 79. Proportions of cricket-related ACC claims for top four body locations, and injury diagnosis by severity (WDP) for injuries occurring where the activity was reported – fielding (n = 134) (2008 – 2018).

Body Region & Diagnoses by Work Days Paid - Fielding				
Rank	**1 - 7 days (n =4)**	**8 - 29 days (n = 63)**	**30 - 179 days (n = 56)**	**180 + days (n = 11)**
1	**Knee 50.0%**	**Finger/thumb 23.8%**	**Finger/thumb 19.6%**	**Unknown 36.4%**
	Meniscal tear 50.0%	Fracture of phalanges 60.0%	Fracture of phalanges 36.4%	
	MCL tear 50.0%	Dislocation 20.0%	Sprain 36.4%	
		Volar plate injury 6.7%		
		Open wound 6.7%		
2	**Hip/upper leg/thigh 50.0%**	**Knee 17.5%**	**Knee 17.9%**	**Hand/wrist 33.3%**
	Sprain hamstring tendon 50.0%	Sprain 27.2%	Acute meniscal tear 30.0%	Fracture 66.7%
	Sprain quadriceps tendon 50.0%	MCL sprain 18.2%	Sprain 20.0%	Sprain 33.3%
		Prepatellar bursitis 18.2%	MCL sprain 10.0%	
		Contusion 18.2%	Patellar tendinitis 10.0%	
3	**-**	**Ankle 11.1%**	**Hand/wrist 12.5%**	**Knee 18.2%**
		Sprain 85.7%	Fracture wrist bones 85.7%	Acute meniscal tear 50.0%
			Sprain 14.3%	ACL tear 50.0%
4	**-**	**Shoulder 11.1%**	**Shoulder 10.7%**	**Head or Lower back 18.2%%**
		Sprain 28.6%	Dislocation 33.3%	Closed skull fracture 50.0%
		Rotator cuff tear/sprain 28.6%	Rotator cuff tear 16.7%	Lumbar sprain 50.0%
		Dislocation 14.2%		

There were 27 injuries that required WDP where the activity was wicket keeping. Finger/thumb injuries accounted for 44.4% of wicket keeping related WDP injury claims, with 25.9% being made up of fractures to the phalanges and 11.1% dislocations or sprains. Lower back injuries made up 14.8% of wicket keeping related WDP claims with disc injuries and sprains accounting for 7.4% each. Finger/thumb injuries were equally most commonly associated with 8 to 29 and 30 to 179 WDP. The majority (75%) of lower back injuries associated with wicket keeping resulted in WDP of 30 to 179 days or more.

5.5 Summary of key findings

This chapter presents a detailed analysis of ACC data, specifically for cricket-related injury. This is important because the ACC dataset is a longstanding, well managed, collection of injury data across all accidental injury in NZ. The opportunity to explore the dataset in detail for community level cricket injury is useful to advance the knowledge base on the patterns of injury within this cohort. Key findings include:

- There were 62,776 cricket injury claims relating to a place of recreation or sports, 5,430 (8.6%) were in females and 57,346 (91.4%) were in males.
- The 15 to 19 years old age group was the most commonly injured in both male and females claimants.

- Overall the number of claims per year increased on average by 1.5% (95% CI 0.3% – 2.7%, $p = 0.006$). The male and female annual IIR, by 100,000 population, for ages 5 to 64 increased non-significantly 0.2% and 0.3% respectively.
- There was a sharp rise in the number of 10 to 14 years old female claims from 2012/13.
- 32% (n = 19,791) of claims occurring in a place of recreation or sports were identifiable by the cricket activity of injury onset (batting, bowling, fielding or wicket keeping), 88% of which were due to the outdoor cricket form of the game.
- The majority of injury claims were for soft tissue related injury (81%).
- Bowling was the most common activity resulting in injury claims (60%) with lower back and shoulder sprains the most common injury location and nature.
- Lower back and knee sprains were the most common injury associated with batting.
- Sprains to the knee and fingers/thumb sprains and fracture/dislocations were the most common injury claim associated with fielding.
- Sprains or fractures/dislocation to the fingers/thumb were the most common wicket keeping injury claim.
- Females had a significantly higher proportion of dental injury claims than males and non-significantly higher proportion of concussion claims.
- Male wicket keepers, by proportion, were significantly more commonly injured in the head/face/neck than for other activities.
- Wicket keeping and batting were the most common activities associated with injury due to contact with the ball. Contact with the ground was the most common injury factor for fielders, primarily due to a loss of balance.
- Overall general practitioners (GPs) and physiotherapists were almost equally the most common claim providers accounting for 44% and 41% respectively. Hospital treatment accounted for 8% of injury claims.
- When activity of onset was included, physiotherapists were by far the most common provider of injury claims treatment (62%). Hospital treated claims dropped to 4%.
- For hospital treated claims, males had a significantly higher proportion of fractures/dislocations than females. For males, wrist/hand and head injuries were the most common hospital treated claims, similar to Chapter 4 (Hospital injury in Victoria, Australia).
- Batting was the activity most commonly associated with hospital attended injury in males, but not significantly different to fielding when wicket keeping injury was included.
- 4% of claims required WDP and this dropped to 3% when activity of onset was included.

- Males accounted for 96% of WDP claims and were most commonly in the 25 to 29 years old age group. Females claiming WDP were most commonly in the 30 to 34 years old age group.
- The 30 to 179 days WDP category was the most common for both males and females.
- Bowling accounted for 48% of WDP and was significantly more common across the moderate, major and severe injury categories than batting, fielding, and wicket keeping.
- Knee injuries were the most common batting injury requiring WDP, with over half of those being meniscal or ligamentous injury.
- Knee, shoulder and lower back injuries were similarly common injuries due to bowling that required WDP, with lower back sprains being the most common specific injury.
- Finger and thumb injuries were the most common WDP claims for fielding and wicket keeping with over half being due to fractures.

Analysis of the ACC data in this chapter highlights the potential value of insurance data to understand how, and to whom, cricket injuries occur. However, despite the large amount of information available within the ACC dataset, it is still limited in its ability to inform cricket injury prevention in so much as the level of organisation of the sport cannot be accurately identified, the precise mechanism of injury is difficult to elicit, the setting of the injury occurrence (i.e. match or training) and a level of severity measure that is not only based on cost or time off work.

Chapter 6. An assessment of data validity and completeness of reported data in published prospective studies, hospital data and ACC insurance data.

6.1 Chapter rationale

Chapters 3, 4 and 5 have addressed aim 1 and research question 1 quantitatively. However, knowing the injury outcomes alone can be misleading if the data quality and completeness is unknown or unclear. This Chapter looks at the quality of the information provided and extracted from the existing literature, specifically in relation to the prospectively collected cricket injury studies, and data from the existing databases of the VISU and ACC. Validity and completeness of the data extracted is compared against the core data items of the ASIDD (11) and data items from the cricket injury consensus statements (13, 14).

6.2 Aim

The aim of this Chapter was to investigate the quality of the injury data summarised and presented through Chapters 3, 4 and 5. Specifically, there is an assessment of:

- The completeness of data reporting in studies using prospectively collected injury data on community cricket injury.
- The data collection validity and collected data completeness of hospital (VISU) and ACC insurance claims data.

6.3 Methods

Each of the sources of injury data looked at in Chapters 3 (prospectively collected data studies), 4 (VISU hospital data) and 5 (ACC insurance claims data) are assessed against the core items from the ASIDD, with the player age and sex combined into one item (Table 80). Also, the same data were assessed against 10 items from the initial (2005) and one item from the updated consensus statements on injury surveillance in cricket (13, 14) (Table 81).

A completeness rating (consensus completeness and ASIDD completeness) was given, based on similar data assessment processes in other studies (88), with items that completely fulfilled the criteria given 1 point, items that partially fulfilled the criteria 0.5 point and 0 points were assigned where items were not covered. Each source of data is assessed against slightly different criteria due to the nature of the data source, as outlined below.

The study was approved by the Edith Cowan University Human Research Ethics Committee (2019-01144-FORTINGTON). Refer to Appendix D for a copy of the ethics approval.

Table 80. ASIDD core data items used to compare existing studies, hospital and insurance data.

Item	ASIDD core data item	Item number within the ASIDD
1	Date of injury[1]	3
2	Player details: Age, Gender	6, 7
3	Activity at onset (broad areas)	13
4	Mechanism of injury	18
5	Body region	20
6	Nature of injury	22

[1] Date is assumed to be collected for this analysis

6.3.1 Prospectively collected injury data studies

There were 15 studies found in the systematic review in Chapter 3 that prospectively collected injury data related to community cricket. One of those studies (183) included cricket amongst other sports and only gave injury numbers and, as such, has been excluded from this analysis. The data item collection of each cricket specific study was assessed against 10 of the cricket injury consensus items (including nine of the 11 suggested to be collected for injury surveillance and one on injury rates, Table 81).

6.3.2 Hospital and insurance data

Hospital and insurance data were assessed against the cricket injury consensus items as per the prospectively collected data studies, excluding the injury rates item as exposure data is not routinely part of these services collection processes (i.e. VISU and ACC). For the hospital data, the ED presentations and admission data from the VISU were considered one dataset for the purposes of this analysis.

Table 81. Items of cricket injury consensus statement used for completeness check against various forms of data sources.

No.	Cricket consensus item/intent	Prospectively collected injury data studies	Hospital data (VISU)	Insurance data (ACC)
1	Player name[1]	N	N	N
2	Player details (Age., bowler type)	Y	Y	Y
3	Injury diagnosis including body region.	Y	Y	Y
4	Injury side (left, Right, Bilateral, NA)	Y	Y	Y
5	New Injury/Recurrent injury	Y	Y	Y
6	Time of onset (match/training/other/gradual) including match details	Y	Y	Y
7	Activity at onset (batting/bowling/fielding/gradual) including fielding position	Y	Y	Y
8	Date of onset[1]	N	N	N
9	Mechanism description	Y	Y	Y
10	Qualification as a significant injury	Y	Y	Y
11	Details of surgery or other major treatment (if relevant)	Y	Y	Y
12	Injury rates calculated as per consensus methods	Y	N	N

[1] Player name and date of onset are assumed to be collected.

The completeness of the insurance data is assessed based on missing or inaccurate data associated with the data items supplied by the ACC, shown in Table 82. The total proportion of missing data is calculated by dividing the number of missing data points (n) by the total possible data points (total = 21 × 84,942 = 1,783,782)

Table 82. Data items supplied by ACC for cricket-related claims.

Item	ACC data item supplied
1	Accident financial year
2	Accident month
3	Work days paid
4	Age group
5	Sport (indoor or outdoor cricket)
6	Activity prior to injury (recreation/sporting activity)
7	Injury contact (Accident contact)
8	External agency (Off road agency)
9	Injury scene
10	Injury site (body location)
11	Injury diagnosis
12	Injury read code
13	Injury ICD-10 code
14	Injury cause (Accident cause)
15	Sex
16	Batting, bowling, fielding, wicket keeping (from narrative text)
20	Health provider
21	Claim count (for claimant's with multiple claims)

6.4 Results

6.4.1 Prospectively collected injury data studies

Table 83, Section A displays the cricket specific studies assessed against the cricket injury surveillance consensus guidelines (13). Across all studies, 28 of the possible 140 items were fully covered (20%). In terms of individual consensus items, player details such as age and bowling type recorded the highest proportion of yes answers (64%). This was partly due to there being seven studies investigating only bowlers. Injury diagnosis, including body region, was complete in four studies (29%), with the remainder partially covering either body region or nature of injury but not both. Injury side (i.e. left/right), was reported in two studies (14%). One study reported the time of onset of injury (174), while another study implied all injuries occurred during matches as they were only observing matches (172). Activity at onset was recorded sufficiently by two studies (14%) (51, 174), while most other studies had missing or unidentified results for the proportion of injury by activity. The mechanism description was reported in full for four studies, partially in five studies, and at broad level or not at all for five studies. Two studies specified significant injury (51, 174) and one study indicated the level of medical attention for all injuries (174). No study followed the consensus recommended method for calculating injury rates.

The consensus completeness rating score for studies ranged from 2.5-6.0 with a mean of 3.4 (95% C.I. 2.7–4.1). There were four studies where the data were collected prior to the consensus publication and their ratings ranged from 3.5-5.5 with a mean 4.3 (95% C.I. 3.5–5.0) and ten studies where the data were collected after the consensus with a range of 2.5-6.0 with a mean of 3.4 (95% C.I. 2.5–4.4).

Table 83, Section B, shows an assessment of the studies which prospectively collected data against the ASIDD core items. The date of injury was assumed available in three studies (21%) on the basis that medical personnel were used in the diagnosis of the injury. Whilst it may not guarantee a date was recorded, it is typical practice for medical records to contain this information. It is possible that other studies would have dates recorded but were not explicit in reporting this. Player details and broad activity at onset were fully reported by all studies. Injuries reported by body region were recorded in all but one study. Fewer than half of the studies reported the mechanism of injury (36%) and nature of the injury (43%). Seven studies did not report any injury nature. The overall mean ASIDD completeness rating achieved was 4.4 (95% C.I. 3.9–5.0).

Table 83. *Data completeness of prospectively collected injury data studies compared to (A) cricket injury consensus statements and (B) the ASIDD.*

		Data collected pre-2005 consensus statement (first author, year)				Data collected post-2005 consensus statement (first author, year)										
A	**Consensus Item**	Foster 1989 (175)	Dennis 2005 (51)	Kountouris 2012 (173)	Shaw 2008 (46)	Finch 2010 (174)	Twomey 2012 (172)	Olivier 2013 (181)	Martin 2017 (177)	Olivier 2015 (180)	Olivier 2016 (179)	Soomro 2018 (171)	Gamage 2019	Martin 2017 (178)	Pote 2019	% of yes by item
	Data collection period	1986/87	2002/03	2002/03	2003/05	2007/08	2007/08	Before 2013	2014	Before 2015	Before 2016	2015/16	2016	Before 2017	2017	
1	Player details (age., bowler type)	Y	Y	Y	P[6]	P[6]	P[6]	Y	Y	Y	Y	P[6]	P[6]	Y	Y	64%
2	Injury diagnosis including body region	Y	Y	Y	P[7]	P[10]	P[10]	N	P[13]	P[7]	P[7]	P[7]	Y	P[13]	P[7]	29%
3	Injury side (left, right, bilateral, NA)	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	14%
4	New Injury/recurrent injury	N	P[2]	P[5]	N	N	N	P[14]	P[14]	P[14]	N	Y	N	N	N	7%
5	Time of onset [b] including match details	N	P[3]	N	P[8]	Y	P[11]	N	N	N	N	N	N	N	N	7%
6	Activity at onset [c] including fielding position	P[1]	Y	N	P[9]	Y	N	Y	P[15]	P[15]	P[15]	N	Y	P[15]	N	29%
7	Mechanism description	P[1]	P[4]	N	Y	Y	Y	N	P[16]	P[17]	N	N	Y	P[16]	N	29%
8	Qualification as a significant injury	Y	N	N	N	Y	P[12]	N	N	N	N	P[18]	P[18]	N	N	14%
9	Details of surgery or other major treatment (if relevant)	N	N	N	N	Y	P[12]	N	N	N	N	N	N	N	N	7%
10	Injury rates calculated as per consensus methods	N	N	N	N	N	N	N	N	N	N	N	N	N	N	0%
	Consensus completeness rating [a]	4.0	5.5	3.5	4.0	6.0	3.5	2.5	3.0	3.0	2.0	2.5	4.0	2.5	1.5	20%

		Pre-ASIDD	Post-ASIDD (first author, year)													
B	**ASIDD Item**	Foster 1989 (175)	Dennis 2005 (51)	Kountouris 2012 (173)	Shaw 2008 (46)	Finch 2010 (174)	Twomey 2012 (172)	Olivier 2013 (181)	Martin 2017 (177)	Olivier 2015 (180)	Olivier 2016 (179)	Soomro 2018 (171)	Gamage 2019	Martin 2017 (178)	Pote 2019	% of yes by item
	Data collection period	1986/87	2002/03	2002/03	2003/05	2007/08	2007/08	< 2013	2014	< 2015	< 2016	2015/16	2016	< 2017	2017	
1	Date of injury	Y	Y	Y	P[2]	P[2]	P[2]	P[3]	P[3]	P[3]	P[3]	P[7]	P	P[3]	P[9]	21%
2	Player details (age, gender)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%
3	Activity at onset (broad areas)[b]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%
4	Mechanism	P[1]	Y	N	Y	Y	Y	N	P[4]	P[5]	N	N	Y	P[4]	N	36%
5	Body region	Y	Y	Y	Y	Y	Y	N	Y	Y	P[6]	Y	Y	Y	Y	86%
6	Nature	Y	Y	Y	N	Y	Y	N	N	N	N	N	Y	P[8]	N	43%
	ASIDD completeness rating [a]	5.5	6.0	5.0	4.0	5.5	5.5	2.5	4.0	4.0	3.0	3.5	5.5	4.5	3.5	64%

Notes (A):
a. Score 1 for Y, 0.5 for P = Partial, and 0 for N, b. (match/training/other/gradual), c. (batting/bowling/fielding/gradual)
1. Stress fractures found deemed to be probably the result of repetitive bowling.
2. Recurrent injuries in the season of interest were not recorded as only workload prior to original injury noted.
3. Study focused only on injuries of gradual onset.
4. 100% of injuries were reported as bowling related overuse.
5. Participants had baseline MRI which indicated whether there was pre-existing lumbar soft tissue, bone stress or no injury on radiological examination. All participants were reported injury free and had no pain at the start of the trial.
6. Age groups provided, but no specific bowler types (e.g. spin/pace) were differentiated.
7. Body regions injured provided but no injury diagnosis.
8. Some proportions referenced to training injuries.
9. Ranges of proportions of injury by player position given.
10. General injury diagnosis provided (i.e. nature/type) and body regions provided, but not collated.
11. Injuries were recorded at matches only.
12. Reported single injury required hospitalisation.
13. Broad terms for nature of injury (contact / non-contact).
14. Reference to previous season injury amongst cohort, but not within surveillance period.
15. Activity at onset recorded, but not all proportions identified.
16. Contact injuries defined as those where an injury was sustained from collision with the ball, another player or object.
17. Only 'non-contact' injuries included.
18. Significance proportioned to number of weeks missed (match time loss).

Notes (B):
a. Score 1 for Y, 0.5 for P = Partial, and 0 for N, b. In reference to organised or recreational cricket in this case.
1. Bowling assumed to be the causal factor, but not specific mechanism provided.
2. Personal Data Collectors (PDCs) used, so in theory date was recorded but no specific mention of it.
3. Questionnaires used to collect injury data, likely date of injury is included but not stated, and also injury definition was not wholly dependent on medical attention.
4. Contact injuries defined as those where an injury was sustained from collision with the ball, another player or object.
5. Only 'non-contact' injuries included.
6. Only reported lower back injuries (76% not reported).
7. Injury investigated through proxy, so unclear if actual date of injury was recorded.
8. Non-contact injuries grouped as overuse, acute ligament sprain, or muscle strain.
9. Week of injury occurrence reported but not specific date (likely known, but not reported).

6.4.2 Hospital and insurance data

Hospital data

When comparing the data from the VISU with the cricket injury consensus, the completeness rating was 3.5/9 (39%), with two (22%) items fully available (Table 84). In terms of data completeness, the activity at onset was largely missing from the ED presentation with only 1.3% of cases being identified as associated with batting, 1.5% with bowling and 0.8% with fielding. This leaves 96.4% of ED presentations with no activity at onset documented. There was no activity at onset reported in the admissions data. The injury mechanism was largely available through broad classification, however in ED presentations, there was 33.8% of cases where the specific cause or injury factors were not reported.

Table 84. *Completeness of the VISU supplied hospital data compared to cricket injury consensus items.*

No.	Consensus item/intent	Availability	Remarks
1	Player details (Age., bowler type)	P	Bowler type not available
2	Injury diagnosis including body region	Y	
3	Injury side (left, Right, Bilateral, NA)	N	Injury side not reported
4	New Injury/Recurrent injury	P	Assumed new injury, no detail on recurrent injuries
5	Time of onset (match/training/other/gradual) including match details	N	Not routinely collected
6	Activity at onset (batting/bowling/fielding/gradual) including fielding position	N	Sporadically collected in narrative text (<4% cases)
7	Mechanism description	P	33.8% of specific cause missing in ED presentations
8	Qualification as a significant injury	Y	Assumed all significant injuries due to hospital attendance
9	Details of surgery or other major treatment (if relevant)	N	Not recorded in data
	Consensus completeness rating	**3.5 / 9**	

When examining the hospital data in relation to the ASIDD core items, the completeness rating was 5.5/6 (92%) (Table 85), with five (83%) items fully available. The one item that did not fully align to the ASIDD recommendations was the activity at onset. This is because there is no way to fully identify the distribution of organised versus recreational forms of cricket injury in the ICD-10-AM coded data.

Table 85. *Completeness of the VISU supplied hospital data compared to the core ASIDD items.*

No.	ASIDD core item	Availability	Remarks
1	Date of injury	Y	
2	Player details (Age., Gender)	Y	
3	Activity at onset (broad areas)[b]	P	Cannot accurately assess whether sport is organised or recreational, but can exclude obvious recreational cases
4	Mechanism	Y	
5	Body region	Y	
6	Nature	Y	
	ASIDD completeness rating [a]	**5.5 / 6**	

In terms of data completeness, the initial data supplied by the VISU had 60.6% of admitted cases occurring at a school, sports and athletic area, 2.6% occurring at home/residential institution, 0.9% at other specified places, 0.1% on road, street, highway or farm and 35.7% were unspecified places. Analysis in Chapter 4 used the admitted cases occurring at school, sports and athletic areas and the unspecified places, making up 96.3% of the available data. The ED presentation data excluded cases where the description of event variable indicated the injury occurred at home, the beach or street, however, no proportions were given for the excluded data.

Insurance data

The ACC insurance data supplied had a cricket injury consensus completeness rating of 4.0/9 (44%), with 22.0% of items fully available (Table 86). Injury side and time of onset (setting) were not specifically collected. It is possible that the injury setting could be obtained in some cases from the description of injury event variable. In terms of data completeness, the activity of onset was found in 23.9% of all claims or 32.3% of claims where the injury scene was a place or recreation or sports. Subsequent analysis of the activity at injury onset (batting, bowling, fielding, wicket keeping) variable indicated there were claims where several activities were noted against the one claim (n = 324 claims). Excluding these claims resulted in the activity at injury onset proportion being 23.2% of all claims or 31.5% of claims where the injury scene was a place or recreation or sports.

Table 86. *Completeness of ACC supplied claims data compared to cricket injury consensus items.*

No.	Consensus item/intent	Availability	Remarks
1	Player details (Age., bowler type)	P	Bowler type not available
2	Injury diagnosis including body region.	Y	
3	Injury side (left, Right, Bilateral, NA)	N	Injury side not reported
4	New Injury/Recurrent injury	P	Assumed new injury, no detail on recurrent injuries
5	Time of onset (match/training/other/gradual) including match details	N	Not routinely collected
6	Activity at onset (batting/bowling/fielding/gradual) including fielding position	P	Can be extracted in narrative text (24% of cases)
7	Mechanism description	P	Description not always reported, but injury factors are.
8	Qualification as a significant injury	Y	Those requiring work days paid by ACC
9	Details of surgery or other major treatment (if relevant)	N	Not recorded in supplied data
	Consensus completeness rating	**4.0 / 9**	

When comparing the ACC data with the ASIDD core items, the completeness rating was 5.0/6 (83%), with 67% of items fully available (Table 87). As was the case for the hospital data, in terms of data completeness, there was no accurate way to assess whether each claim was specifically related to organised or recreational forms of cricket. There were 73.9% of claims that occurred at a place of recreation or sports, 12.6% at home, 7.6% at school. The injury mechanism was also only able to be inferred through the injury factor variables injury contact, external agent and injury cause.

Table 87. *Completeness of ACC supplied claims data compared to the ASIDD items*

No.	ASIDD core item	Availability	Remarks
1	Date of injury	Y	
2	Player details (Age., Gender)	Y	
3	Activity at onset (broad areas)[b]	P	Cannot accurately assess whether sport is organised or recreational, but can exclude obvious recreational cases
4	Mechanism	P	Not directly available but may be inferred from injury factor variables
5	Body region	Y	
6	Nature	Y	
	ASIDD completeness rating	**5.0 / 6**	

Data completeness of the variables supplied by ACC was very high (Table 88). As noted previously, the cricket activity (i.e. batting, bowling, fielding or wicket keeping) at injury was the only variable with notable missing data.

Table 88. *Data completeness of ACC claims data supplied.*

Item	ACC data item supplied	Missing or inaccurate data
1	Accident financial year	0.0%
2	Accident month	0.0%
3	Work days paid	0.0%
4	Age group	0.0%
5	Sport (indoor or outdoor cricket)	0.0%
6	Activity prior to injury (recreation/sporting activity)	0.0%
7	Injury contact (Accident contact)	0.08%
8	External agency (Off road agency)	0.01%
9	Injury scene	0.0%
10	Injury site (body location)	0.0%
11	Injury diagnosis	0.45%
12	Injury read code[1]	0.0%
13	Injury ICD-10 code[1]	0.0%
14	Injury cause (Accident cause)	0.19%
15	Sex	0.0%
16	Batting, bowling, fielding, wicket keeping[4]	76.9%[2]
20	Health provider	0.0%[3]
21	Claim count	0.0%
	Total missing data	**0.05% (95% CI 0.05% - 0.06%)**

[1] Where there was no read code, an ICD-10 code was provided.
[2] Combined missing or inaccurate data from description of event text searches.
[3] There were two (n = 2) claims missing health provider information (0.002%).
[4] As extracted and supplied by ACC.

6.5 Summary of key findings

This Chapter presents a novel analysis of the assessment of the validity and completeness of prospectively collected injury data from published studies and existing injury data from a large public hospital and national insurance databases. The injury data were compared for validity and completeness against the ASIDD and the cricket injury surveillance consensus statements. The key findings include:

- Studies prospectively collecting injury data in community cricket were found to be lacking reporting completeness in the specific items of injury diagnosis, the player role or activity when injured, and injury mechanism.
- Studies that collected data after the original cricket injury consensus statement was published had a lower average comparison rating than studies that collected data prior to the consensus.
- Hospital (VISU) and insurance (ACC) data were well aligned with the ASIDD core items, but lacked completeness when assessed against the cricket injury consensus statements.
- Both hospital and insurance datasets were lacking information on formality (organised or recreational) and setting (match or practice) of the cricket activity.
- The major key area lacking in detail across all data sources was information on injury mechanism, especially where associated with specific cricket activity. This gap limits these data sources direct value in identifying specific opportunities for injury prevention.

Chapter 7. Validity assessment of the National Club Risk Protection Program data collection forms against the ASIDD and cricket injury surveillance consensus statement.

7.1 Chapter rationale

Chapter 6 examined the completeness and validity of the data collection items in the VISU, ACC and prospectively collected data studies investigated thus far for injury in community cricket. The chapter highlighted that there was a lack of prospectively collected injury data studies of sufficient validity and completeness in comparison with the ASIDD (11) surveillance standards and the internationally agreed cricket injury surveillance statements (13, 14) to accurately quantify the extent and profile of the injury problem within community level cricket. Hospital data gave rich detail in terms of injury profiles when it came to the type, nature and body location, but lacked accurate actionable information on the mechanism of injury in association with the cricketing activity at onset. The ACC insurance data provided greater detail of the injury profile in NZ, but still lacked clarity on the mechanism of injury. The ACC insurance data also lacked clear demarcation in the level of formality of the cricket, i.e. whether it was organised or informal sport. The latter point reflects the fact that, for most sports, injury surveillance needs to be specific to the sport and the context in which it is played. For cricket, the various activities within the sport make this requirement more pertinent because of the different injury risks, outcomes and mechanisms associated with each role.

In line with aim 2 and research question 2 of this thesis, Chapters 7 through 9 focus on the National Club Risk Protection Program (NCRPP), a cricket specific, community level, insurance scheme within Australia, which has not been previously explored in research. Because the scheme is not foremost an injury surveillance system, it shall first be assessed in a similar manner to the methods used in Chapter 6. In Chapter 7, the scheme is analysed, using the insurance claims forms, for its potential to collect injury data to a level considered appropriate for sports injury surveillance as per the ASIDD (11) and cricket injury consensus statements (13, 14). Secondly, in Chapter 8, the data collected, stored and provided by the insurance scheme is analysed for validity and completeness against the ASIDD and cricket injury consensus. Thirdly, in Chapter 9, a sample of the NCRPP data is analysed and described.

7.2 Aim

The aim of this Chapter was to identify the potential information collected by the NCRPP and compare it against the industry standards of the ASIDD (11) and cricket injury consensus statements (13, 14). Understanding the validity of injury data potentially collected by an injury surveillance system is necessary to ensure the system is able to efficiently identify important injury problems (210).

7.3 Methods

The NCRPP provides accidental injury insurance and benefits for community cricket associations, club members and volunteers. The system was set up between Cricket Australia and JLT-Sport, a subsidiary of Jardine Lloyd Thompson, in 2002. Claimants are required to notify the insurer of their injury through submission of a claim form, typically within 270 days of the injury date.

Variations in JLT-Sport insurance claims forms since the inception of the NCRPP system were sought from JLT-Sport (personal correspondence: A. Weir, JLT-Sport). Six paper versions of the claims form were provided by JLT-Sport. The versions of claims forms dated back to 2003, 2004/05, 2005/06, 2008/09, 2009/10, and 2010/11, which is still the current form. The 2003 and 2004/05 forms were essentially identical in information collected, with variations in layout only. The same applied to the 2009/10 and 2010/11 forms. An online version of the claims form was also commenced in October 2016 (personal correspondence: J. Taylor, JLT-Sport). Refer to Appendix F for form details.

All the paper versions of the JLT-Sport cricket injury insurance claim form come in four sections, which have remained relatively consistent, with variations in title only:

1. Section A – Claimant's details. To be completed by the player/claimant/legal guardian.
2. Section B – Club declaration. To be completed by a club representative.
3. Section C – Loss of income. To be completed by the claimant.
4. Section D – Physician's report. To be completed by an appropriate health professional.

Sections A, B, and D are relevant to the ASIDD, while Section C may be useful for injury burden assessment.

The online version of the form has three sections, the claimant information (similar to Section A), the club declaration (similar to Section B) and the physician's report (similar to Section D). The loss of income (Section C) is incorporated into the claimant information form.

Data items were transcribed from the JLT-Sport claims forms into an Excel spreadsheet and compared against the 31 data items from the ASIDD. A data agreement scoring system was adopted, similar to Finch 2003 (88), to assess the amount of information on the JLT-Sport insurance forms compared to the ASIDD (11) guidelines and cricket injury consensus statements (13, 14):

1 Data item fully present (could be coded according to ASSID or consensus statements) and denoted in tables with a Y.

0.5 Data item partially present (some, but not all, of the details specified in ASIDD or consensus statements was on the form or could be derived from similar fields) and denoted in tables with a P.

0 Data item totally absent (item was in ASIDD or consensus statements but not on form) and denoted in tables with a N.

A total score was determined by the sum of each item's score. Although there are 31 possible items listed in Table 89, overall a possible 30 points could be scored for the ASIDD comparison. As item 24 (provisional diagnosis text) was considered as optional in the ASSID it was not included in the overall scoring. The availability of data items within the insurance forms is also reported in terms of percentage completeness. This refers to the number of items recording a yes answer as a ratio to the total number of items (n = 31), which in this case includes item 24.

A similar process was performed for the most recent versions of the JLT insurance (from 2009/10-10/11) form against 11 items from the cricket consensus statements. The injury data collection items from the original injury consensus statement were still considered relevant in the updated consensus statement (14). Therefore, 10 items from the original consensus statement (excluding 'players name' - refer to Section 1.5.3 of Chapter 1) and an additional injury data item derived from the 2016 update in regard to the mode of onset of injury were adopted for this chapter. The study was approved by the Edith Cowan University Human Research Ethics Committee (2019-01144-FORTINGTON).

7.4 Results

Overall, the insurance forms covered the ASIDD items in some part (either Y or P) ranging from 27 (87%) to 30 (97%) items. One hundred percent of the core items were covered fully or in some part.

In terms of completely addressing all items within the ASIDD document, the insurance forms varied from 12 (39%) to 13 (42%) of complete item agreement. Core items were constant over time at 43%, while strongly recommended items increased from 33% to the current level of 47% agreement. Recommended items dropped from 27% to 20%.

In terms of agreement scores, the core items were constant at 5 out of a possible 7 points. The strongly recommended items increased from 8.5 to 10.5 out of a possible 15 points and the recommended items varied from 4 to 5 points out of a possible 8 points, with the current form rating 4.5 points. Overall, the total agreement score varied from 18.0 (2008/09 version) to 20.5 points (2010/11 version) out of a possible 30 points.

The major injury factors (ASIDD items 17 and 18 relating to injury factors and protective equipment usage) and injury site (ASIDD items 21 and 22 relating to body region and specific structure) sections were proportionally the sections with the least agreement (25%). Table 89 summarises all the different versions of the forms in relation to the ASIDD specifications. Additional notes on each ASIDD item are then provided for further explanation.

Table 89. *Comparability of JLT-Sport/Marsh claims forms (historical and current) against the ASIDD.*

No	Data Item	Category	2003 & 2004/05	2005/06	2008/09	2009/10 & 2010/11	Online Oct 2016
	Administrative Items						
1	Person recording case information	SR	P	P	P	P	P
2	Immediate source of injury record	SR	N	N	N	Y	Y
3	Date of injury	C	Y	Y	Y	Y	Y
4	Time of injury	R	Y	Y	Y	Y	Y
5	Date of injury record	R	Y	Y	Y	Y	Y
	Demographics						
6	Age	C	Y	Y	Y	Y	Y
7	Gender	C	Y	Y	Y	Y	Y
8	Area of usual residence	SR	P	P	P	P	P
	Place of Injury Occurrence						
9	Name of injury place – text	SR	Y	Y	Y	Y	Y
10	Place of injury – type	SR	P	P	P	P	P
11	Sport and recreational places - specific	SR	P	P	P	P	P
12	Part of specific injury place	R	P	P	P	P	P
	Activity When Injured						
13	Activity when injured – broad areas	C	P	P	P	P	P
14	Activity when injured – name of sport/activity	SR	Y	Y	Y	Y	Y
15	Phase or aspect of involvement in activity or event	R	P	P	P	P	P
16	Activity when injured – grade or level	R	Y	Y	N	P	P
	Major Injury Factors						
17	Injury factors	SR	P	P	P	P	P
18	Equipment used with intent to protect against injury	SR	N	N	N	N	P
	Mechanism of injury						
19	Mechanism of injury	C	P	P	P	P	P
20	Narrative of mechanism of injury	SR	Y	Y	Y	Y	Y
	Injury Site						
21	Body region and body chart	C	P	P	P	P	P
22	Specific structure injured	R	P	P	P	P	P
	Nature of Injury – Pathology						
23	Nature of injury	C	P	P	P	P	P
24	Provisional diagnosis text	O	Y	Y	Y	Y	Y
	Treatment Factors						
25	Date of presentation	SR	Y	Y	Y	Y	Y
26	Time of presentation	R	N	N	N	N	N
27	Reason for presentation	R	Y	Y	Y	Y	Y
	Treatment						
28	Treatment	SR	P	P	P	P	P
29	Advice given to injured person	SR	Y	Y	Y	Y	Y
30	Referral	SR	P	P	P	P	P
31	Treating person	SR	P	P	P	P	P
	Overall ASIDD data items covered in some part		**28 (90%)**	**28 (90%)**	**27 (87%)**	**29 (94%)**	**30 (97%)**
	Overall ASIDD data items covered fully		**13 (42%)**	**13 (42%)**	**12 (39%)**	**13 (42%)**	**13 (42%)**
	Core items covered fully		3 (43%)	3 (43%)	3 (43%)	3 (43%)	3 (43%)
	Strongly recommended items covered fully		5 (33%)	5 (33%)	5 (33%)	6 (40%)	6 (40%)
	Recommended items covered fully		4 (50%)	4 (50%)	3 (38%)	3 (38%)	3 (38%)
	Optional items covered fully		1 (100%)	1 (100%)	1 (100%)	1 (100%)	1 (100%)
	Core items agreement score	(Max = 7)	5.0	5.0	5.0	5.0	5.0
	Strongly recommended items agreement score	(Max = 15)	9.0	9.0	9.0	10.0	10.5
	Recommended items agreement score	(Max = 8)	5.5	5.5	4.5	5.0	5.0
	Total agreement score		**19.5**	**19.5**	**18.5**	**20**	**20.5**
	Maximum score possible		30	30	30	30	30

C = Core item, SR = Strongly Recommended item, R = Recommended item, O = Optional item (not included in total agreement scores)

7.4.1 Explanation of compliance with the ASIDD

The items numbers listed in bold in this section relate to data items within the ASIDD.

Item 1 - Person recording case information

There are potentially three people involved in recording the information on the form – the injured player, a club representative, and a doctor. The injured player is most likely to be the person conveying this information to the other two. However, there may be circumstances where the injured player is unable to do so (e.g. if concussed or unconscious at the time of injury, and or cannot recall the events), and the current form lacks the option to allow for a third party to be noted as witness. The original form (2003 and 2004/05 version) had a space for witness to the injury – however this was removed in the next iteration (2005/06). Ideally, as per the ASIDD, there should be identification of the person completing the forms, which may be a proxy in the case of claimant disability or death. This is also true for children, whose parents are most likely to be filling out the forms.

Item 2 – Immediate source of injury record

Technically, according to the ASIDD, this would default to an insurance record. However, this was only checked as positive when there was a reference to the club having appropriate insurance coverage in Section B of the form. This was only the case in the 2009/10 and 2010/11 versions.

Item 3 - Date of injury (core item)

This was covered fully in three sections of the form and so should match with all persons (in sections A, B, and D) recording this information. A question to be asked here is if there is a discrepancy in the dates across sections, then which one is adopted? To address this would require an analysis on a subset of claims to determine if this is an issue for data completeness and accuracy.

Item 4 – Time of injury

This is covered fully in Section A – in 12 hour time with am/pm selection.

Item 5 – Date of injury record

This item is taken as the date at which either the claimant, club representative or doctor has signed the form, allowing it to be submitted. This, similar to item 3, may have issues around the potential for up to three separate dates being entered.

Item 6 – Age (core item)

This is recorded on all versions in Section A by the date of birth item. Age, at the time of injury, can therefore be determined from the date of injury (item 3) and date of birth.

Item 7 – Gender (core item)

This is recorded on all versions in Section A.

Item 8 – Area of usual residence

Up to 2005/06, the address with state and postcode was recorded. The presumption here would be that this is the claimant's usual residential address, although it is not specifically identified as such. In 2008/09, the mailing address was used, which may be different from usual residence. In 2009/10, this term was changed to postal address which could still be different from usual residence. These possible variations may impact on profiles based on postcode.

Item 9 – Name of injury place – text

This item was introduced in 2005/06 in section B.

Item 10 – Place of injury – type

This was not specifically addressed, but could be inferred from other sources such as Item 9.

Item 11 – Sport and recreation places – specific

This was not specifically addressed, but some information could be taken from Section A of the form regarding where the injury occurred, such as indoor/outdoor, or through items 9 and 10.

Item 12 – Part of specific injury place

This was not specifically addressed, but could be partially addressed as per item 11.

Item 13 – Activity when injured – broad areas (core item)

This was not specifically covered as per the ASIDD coding recommendations but could be addressed to varying degrees in Section A of the form. The insurance scheme, being applicable to club members of an insured club or association, effectively means the injuries are, in general, occurring in an organised setting. The 2003 and 2004/05 forms had distinctions around the circumstances under which the injury occurred such as organised playing or training, or social or private competition or practice. These distinctions were removed in subsequent forms, however there was still the coding options of 'playing' or 'other' available.

Item 14 – Activity when injured – name of sport or activity

Defaults to cricket, being a sport specific insurance form.

Item 15 – Phase or aspect of involvement in activity or event

This item referred to options such as warm up, training, competition etc. This was partially covered in Section A of the form when compared to the coding options provided in ASIDD. Refer to Table 90 for detail.

Item 16 – Activity when injured – grade or level

This item was specifically included in 2003 and 2004/05 forms, excluded in the 2005/06 and 2008/09 versions. In the 2009/10 form versions some distinction was reintroduced, however, it only allowed the option junior and senior level.

Item 17 – Injury factors

This item was partially covered when compared to the ASIDD guidelines. Table 90 summarises the change in injury factor items over the years.

Item 18 – Equipment used with intent to protect against injury

This item is of particular use for assessing the effectiveness of protective equipment in reducing or preventing injury (11). This item was available only on the online version of the form from October 2016, and relied on user input in text form rather than specific check items. Given the strong relationship of cricket injury and protective equipment use (194), and the recommendations for universal helmet wearing policy at all community levels for batting, keeping and close in fielding (211), this item would be recommended for future inclusion on paper based forms with allowance for specific check box items such as helmet, gloves, pads, groin protector and so forth. It may also be useful to ascertain the manufacturer/model/brand of the equipment to help understand if equipment used meets recommended standards.

Item 19 – Mechanism of injury (core item)

Only the forms in 2004/05, 2008/09 and the online form from October 2016 had items available in Section A to record injury mechanism (refer to Table 90). The items available were limited when compared to the extensive options in the ASIDD. Conceivably, this item may be partially or fully extracted from the text narratives available in the forms in either section A or D. However, the instructions for section A are to “Describe your injury and how it happened” and for the physician in section D the instructions are “Diagnosis/history of injury”. The subtle, but crucial differences here are that section A requires the claimant to describe the mechanism of the injury – assuming they know and are able to articulate it in a reliable manner. Also, it may not be possible to rely on the physician’s report as they are instructed to record the diagnosis and history of the injury, not specifically the mechanism. However, it is recognised that many sports medicine diagnoses are linked to specific known mechanisms of tissue (212). In cricket, for example, lumbar bone stress and stress fractures are particularly associated with the act of fast bowling (213).

Information about the mechanism of injury is necessary to inform injury prevention strategies and this is especially true in cricket where there are distinct positions or specialities within the game. For example: If a claimant has an injury cause of being hit by the ball, then it would be useful to know in which context and facet/position of the game this occurred. Figure 72 shows an event diagram of possibilities for action of injury onset within the batting speciality. In this example, because there are two batters on the field in a match situation, then it would be useful to know if the batter hit by the ball whilst on strike (i.e. facing the bowler) or at the non-strikers end, and if on strike then was it during the act of playing a shot or evading the ball and so forth. Similar action of injury onset trees can be derived for bowling, fielding and wicket keeping and umpiring. The level of detail required is dependent on the context in which the surveillance is intended and the preventative measures hoped to be employed (81, 214).

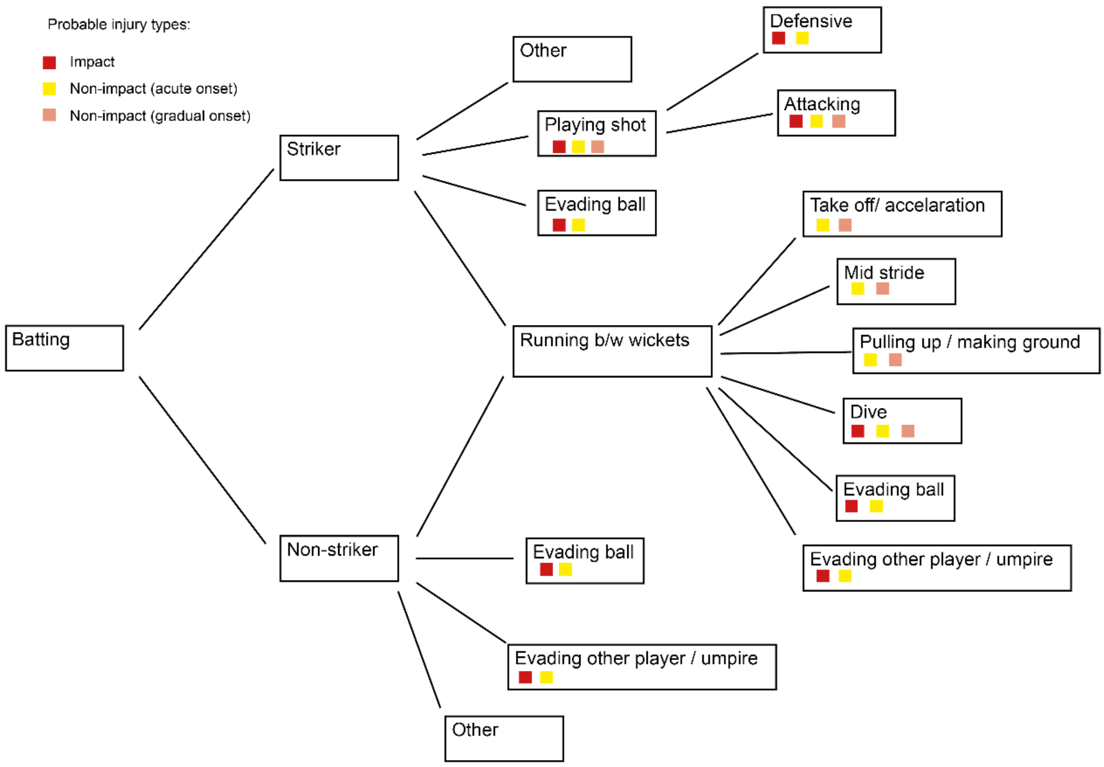

Figure 72. Example of a possible actions of onset event diagram for cricket injury whilst batting with possible injury modes of onset associated. Event diagram derived from the author of this thesis knowledge of cricket with modes of injury onset from the international cricket injury consensus statement update (14).

Table 90. Summary of variations in claim form items in relation to Items 15 and 17 of the ASIDD: Phase or aspect of involvement in activity or event and Injury Factors. (***Italic titles*** reflect sub-headings on the JLT form, non-italic text refer to options within the sub-headings).

2003 & 2004/05	2005/06	2008/09	2009/10	2010/11	Online form (October 2016)
	Where did injury occur	***Where did injury occur***	***Location***	***Location***	***Where was the session held***
	Indoor[1]	Indoor[1]	Indoor[1]	Indoor[1]	Indoor
	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor
Playing surface	***Surface at point of injury[2]***	***Surface type[2]***	***Surface type[2]***	***Surface type[2]***	***Playing surface at time of injury***
Indoor[1]	Grass	Grass	Grass	Grass	Grass
Turf[2]	Indoor area[1]	Indoor area[1]	Indoor[1]	Indoor[1]	Synthetic Grass
Synthetic	Concrete (pitch)	Concrete (pitch)	Concrete	Concrete	Asphalt
Matting	Matting (pitch)	Matting (pitch)	Timber	Timber	Concrete
Other	Synthetic (pitch)	Synthetic (pitch)	Synthetic grass	Synthetic grass	Timber
	Other	Other			Other
Weather conditions	***Weather conditions***	***Weather conditions***	***Weather conditions***	***Weather conditions***	***What was the weather conditions during the session***
Dry	Fine	Fine	Fine	Fine	Fine
Wet	Showers	Showers	Showers	Showers	Hot
	Extreme heat	Extreme heat	Extreme heat	Extreme heat	Cold
	Extreme cold	Extreme cold	Extreme cold	Extreme cold	Light Rain
		Other			Heavy Rain
					Extreme Heat
					Extreme Cold
					Overcast
					Windy
	Surface conditions[3]	***Surface conditions[3]***	***Surface conditions[3]***	***Surface conditions[3]***	***What was the condition of the playing surface***
	Dry	Dry	Dry	Dry	Wet
	Wet	Wet	Wet	Wet	Dry
	Other	Muddy	Muddy	Muddy	Muddy
		Hard	Indoor	Indoor	Indoor
		Other	Other	Other	Other
Playing position[4]	***Playing position[4]***	***Playing position[4]***	***Playing position[4]***	***Playing position[4]***	***What was the position/involvement of the person injured***
Fielding	Fielding	Fielding	Fielding	Fielding	Batting
Batting	Batting	Batting	Batting	Batting	Bowling
Wicket keeping	Wicket keeping	Wicket keeping	Wicket keeping	Wicket keeping	Fielding
Bowling	Bowling	Bowling	Bowling	Bowling	Wicket Keeping
Umpiring	Umpiring	Umpiring	Umpiring	Umpiring	Umpiring
Other	Other	Other			Other

Table 90 (cont).

2003 & 2004/05	2005/06	2008/09	2009/10	2010/11	Online form (October 2016)
			Injured person	***Injured person***	***Who was the injured person?***
			Player	Player	Player
			Umpire	Umpire	Umpire/Referee
			Trainer	Trainer	Official
			Other	Other	Trainer
					Volunteer
					Other
Circumstances	***Injury session***	***Circumstances***	***Session[5]***	***Session[5]***	***Which session did the injury occur?***
Officially recognised competition	Playing (match)	Playing (match)	Playing	Playing	Playing
Officially organised practice	Training	Training	Training	Training	Training
Social or private competition	Travelling	Travelling	Travelling	Travelling	Travelling
Social or private practice	Other	Other	Event	Event	Event
Travelling			Other	Other	Warm up/down
Other (please state what you were doing)			Warm up/down	Warm up/down	Social Game/Match
					Other
	Injury circumstances[6]	***How did injury occur?[6]***			***What was the action/movement that led to the injury?[7]***
	Struck by ball	Trip/fall			Running
	Surface impact	Hit by ball			Jumping
	Other	Collision			Landing
		Overuse			Twisting/turning
		Other			Side stepping
					Stopping
					Other

Notes:
1. Indoor is included in both location and surface options on the forms.
2. Turf wicket and synthetic/concrete wicket would need to be identified in surfaces. Also, the centre wicket area (where pitches are rolled) could be identified in the case of turf wickets, as this can be variable compared with the rest of the infield and outfield.
3. There is no option for ground or surface hardness – known to be a potential injury factor in cricket (172). Also there is no allowance for surface quality – i.e. pot holes, bare patches, debris etc. This information is able to be documented in a smart phone application (JLT risk App) prior to games.
4. Possible scope for additional data from the playing position depending on level of detail required in surveillance – refer to Item 19 notes and Figure 72.
5. Sessions include 'warm up/down' but this could occur at either training or a match. Query if claimants are required to tick both if appropriate? In terms of the training session, was it in the nets, cricket ground or other?
6. Injury cause could include struck by bat, especially for junior level cricket, as this has been shown to be an issue in younger populations in hospital data (Chapters 3 and 4). Twisting movement is known to be a dominant injury cause for cricket in ACC data from NZ.
7. Actions listed in online form appear generic and associated with other sports covered in other schemes (e.g. side stepping for Australian rules football).

Item 20 – Narrative of mechanism of injury

All forms had this item in Section A – filled in by the claimant and Section D – filled in by a health professional, but presumably (but not necessarily) conveyed by the claimant. The same issues as indicated in item 3 apply here in regards to which text field is adopted given they may differ and not represent the same information.

Item 21 – Body region and body chart (core item)

All versions, except the online form[2], had a body chart available in Section D. The body chart provided did not fully match the suggested body region listed in the ASIDD. A face region was added in 2008/09. Body region text was added from 2009/10 which included only 14 items (compared with 22 from ASIDD): ankle, arm, dental, facial, foot, hand, head, internal, knee, lower leg, shoulder, spinal, torso, and upper leg.

Item 22 – Specific structure injured

There is no item on the forms relating to a specific structure injured (e.g. gleno-humeral versus acromioclavicular joint of the shoulder). From 2009/10, the forms did include a body region selection (refer to Item 21). This could be gleaned from the text field 'diagnosis/history of injury' in section D if the physician described it.

Item 23 – Nature of injury – pathology (core item)

The number of injury types available to select increased over the years as outlined in Table 91. At its most detailed, in forms from 2009/10, there were 12 items to select from compared to a possible 31 suggested in ASIDD.

There are some inconsistencies with injury nature definition over time. In both the 2003 and 2004/05 forms, the use of twist and impact are not strictly injury natures rather they relate to cause. In 2005/06, sprain and strain are defined where previously they were not. The definition was dropped again in 2009/10. Variations such as these may lead to inconsistencies in injury nature classifications over time for sprain and strain injuries. Rupture was initially defined for internal organs in 2005/06, but later this definition was dropped (2009/10). It is unclear if rupture still refers to internal organ injury only. Again, this may lead to inaccuracies in injury nature around the term rupture. For example: if an Achilles tendon is completely torn (i.e. grade III strain or rupture) then is it a rupture injury or a strain?

Death was introduced as an option in 2009/10, however this is technically a sequelae or measure of severity of injury. From an injury prevention point of view it is necessary to identify the cause of death (215). For example, it is important to distinguish between if a player died after

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[2] With online submissions, claimant's are still required to use a paper form of section D when obtaining the physician/health practitioner (personal correspondence: J. Taylor, JLT Sport).

being struck on the head by the ball but was later identified as having suffered a cardiac event related to cardiovascular disease rather than the traumatic injury.

Identifying individual injuries in a claim where several (or multiple) injuries have occurred is important from and injury surveillance point of view. Where several injuries are recorded under a ‘multiple injuries’ item then it may obscure information on a particular injury type, such as concussion being obscured by ‘multiple injuries’ to the head. Multiple injuries were only available as an option on the 2008/09 form. Therefore it is possible that injury types may be obscured in that year of data collection. Hence, there should be an allowance for more than one injury nature/pathology on the form and in the database as per the ASIDD recommendations.

Additionally, given outdoor cricket is a summer sport, heat illness is also an important and preventable injury nature missing (216). The option of ‘fatigue/debilitation’ may fit this category, although it is not explicit.

Table 91. *Injury types listed by insurance claims form version (Italic titles reflect sub-headings on the JLT form, non-italic text refer to options within the sub-headings).*

2003 & 2004/05	2005/06	2008/09	2009/10	2010/11	Online form October 2016
-	-	***Injury type***	***Injury type***	***Injury type***	***Injury type***
Concussion	Concussion	Bruising	Amputation	Amputation	Amputation
Cut or abrasion	Cut or abrasion	Concussion	Bruising	Bruising	Bruising
Dislocation	Dislocation	Cut	Concussion	Concussion	Concussion
Fracture	Dental	Dental	Cut	Cut	Cut
Twist	Fracture	Dislocation	Death	Death	Death
Sprain	Sprain (ligament)	Fracture	Dental	Dental	Dental
Strain	Rupture (internal organs)	Multiple	Dislocation	Dislocation	Dislocation
Impact contusion	Strain (muscle/tendons)	Rupture (internal organs)	Fracture/break	Fracture/break	Fracture/break
Other	Bruise	Sprain (ligament)	Rupture	Rupture	Rupture
	Other	Strain (muscle/tendon)	Sprain	Sprain	Sprain
			Strain	Strain	Strain
			Fatigue/debilitation	Fatigue/debilitation	Fatigue/debilitation

Item 24 – Provisional diagnosis

This item is provided in free text in Section D of all versions of the form and should be provided by a medically trained person. Given that the form is to be presented to JLT within 270 days of the injury, there may be some accuracy issues in terms of recall bias on the claimant’s part.

Item 25 – Date of presentation

This item was present in all versions.

Item 26 – Time of presentation for treatment

This item was not present in any version of the form.

Item 27 – Reason for presentation

This item relates to whether the injury is new distinct injury, a recurrence or an exacerbation of a previous injury. This item was available to be coded for in all forms with questions around whether the health professional considered the injury to be a new or recurrent injury (Section D).

Item 28 – Treatment

This item was partially covered in the 2009/10 and 2010/11 forms with identification of the date of the first medical treatment was carried out and the name of the attending physician.

Item 29 – Advice given to injured person

This item is covered in all versions with regard to a nominal return to work/sport date provided by the doctor in Section D.

Item 30 – Referral

All forms have referring details but no information on when the claimant should be seeing the medical professional and/or receiving the treatments.

Item 31 – Treating person

All forms indicate the doctor responsible for completing Section D and any referral to other professionals, but not necessarily identifying those persons. This may not be the initial person treating the injury as there is an allowance of 270 days to notify the insurer.

7.4.2 Cricket injury consensus compliance

Table 92 summarises the latest version of the forms against the cricket consensus statement. The overall rating achieved was 7.0/11 (64%). Three of the 11 items (27%) were fully covered in the latest version of the form. There were no items that were not covered in some manner.

Table 92. *Summary of items on current JLT-Sport cricket injury insurance form (2009/10 & 20010/11) corresponding to cricket consensus statement items*

	Consensus Item/Intent	2009/10 & 2010/11 Forms
1	Player details (Age, bowler type)	P
2	Injury diagnosis including body region.	P
3	Injury side (left, right, bilateral, NA)	P
4	New Injury/Recurrent injury	Y
5	Time of onset (match/training/other/gradual) including match details	Y
6	Activity at onset (batting/bowling/fielding/gradual) including fielding position	P
7	Date of onset	Y
8	Mode of onset [a] (impact, non-contact (acute, identifiable gradual, non-identifiable insidious), illness)	P
9	Mechanism description	P
10	Qualification as a significant injury	P
11	Details of surgery or other major treatment (if relevant)	P
	Consensus completeness rating [b]	**7.0 / 11 (64%)**

[a] adopted from 2016 update, [b] out of a possible 11. N = not covered at all, P = partially covered, Y = fully covered

7.4.3 Explanation of compliance with cricket injury consensus

Items refer to consensus items in Table 92.

Item 1: Player details (age, bowler type)

The bowler type is not specifically requested in the insurance forms, although it may be noted in text fields.

Item 2: Injury diagnosis including body region

The injury diagnosis and body region are part of the physician report in section D of the form. The forms do not use the same categorisation of the body region adopted in the consensus, although it is much better approximated than in the case of the ASIDD.

Item 3: Injury side (left, right, bilateral, not applicable)

This may be recorded in the diagnosis part of the form, but not specifically.

Item 4: New Injury/Recurrent injury

This item is found in section D, requiring an opinion from the physician.

Item 5: Time of onset (match/training/other/gradual) including match details

This information is collected in section A of the form. It is not fully detailed as to what is meant by match details within the cricket injury consensus statement, however, it is assumed it refers to the match type, such as test match, first class match (i.e. 3 or more days) or limited over matches (one day or 20/20). It does provide some scope for match details definition for lower levels, but does not guide what constitutes a major match. The JLT form provides details on where and when the match was played, but does not differentiate between season matches, pre-season practice matches, representative matches or match type (e.g. long format or limited over format) etc.

Item 6: Activity at onset (batting/bowling/fielding/gradual) including fielding position

This item is covered except for the fielding position, other than wicket keeping.

Item 7: Date of onset

This is covered in sections A, B and D of the form.

Item 8: Mode of onset (impact, non-contact (acute, identifiable gradual, non-identifiable insidious), illness)

This may be partially answered in the text fields and from physician's diagnosis.

Item 9: Mechanism description

Text fields are available for the claimant and the physician for this which may or may not provide adequate detail.

Item 10: Qualification as a significant injury

This item is, by admission in the consensus statement, open to subjective bias. The consensus statement provides a definition as being an injury that prevents a player from batting, bowling or wicket keeping, but not fielding (13). From the JLT form, significant injury is not specifically outlined, other than by the proxy of income loss claim requirement and or perhaps surgical referral from the physician.

Item 11: Details of surgery or other major treatment (if relevant)

The details of surgery or other treatment are not specifically provided for on the form, however, referral for other treatment is.

7.5 Summary of key findings

Chapter 7 investigated the NCRPP insurance scheme claim data collection forms for validity against the injury surveillance standards of the ASIDD and the cricket injury consensus statements. In part, the most recent NCRPP claim forms allow for the collection at least 94% of the data items recommended in the ASIDD (94% in paper forms, 97% for online & paper). All of the core data items of the ASIDD could be derived, at least partially from information potentially available in the claim forms. Information relating to all the cricket injury consensus data items were available, at least in part, from the insurance claim forms. Key findings include:

- An average of 92% of the ASIDD data items were covered, at least in part, by the paper and online forms over time.
- An average of 41% of the ASIDD items were completely covered by the paper and online forms over time.
- An average of 43% of the core ASIDD items were completely covered by the paper and online forms over time.
- Core items that were only partially available were: activity when injured – broad areas, mechanism of injury, body region and body chart, and nature of injury.
- The average overall ASIDD completeness score was 19.6 out of a maximum of 30 (65%). The latest paper (completeness score = 20 (67%)) and online/paper (completeness score = 20.5, (68%)) forms were slightly higher than the overall average.
- The cricket injury consensus completeness score was 7 out of 11 (64%), for paper forms since 2005. Items such as the injury diagnosis including body region, mode of onset and mechanism of injury were only partially available.

The overall validity of the injury data items potentially collected by the NCRPP claim forms could be considered of a moderate level, with regard to the ASIDD, when compared to other schemes analysed in a similar manner, identified in Chapter 2 (87, 88). Whilst in principle the validity of the NCRPP data injury collection form may be considered moderate, there is the potential for actual data collected by the system to be highly useful in community cricket injury surveillance. However, the usefulness of data collected relies on its completeness. Therefore the next step in this thesis is to analyse the data collected by the NCRPP for completeness.

Chapter 8. Assessment of data completeness in National Club Risk Protection Program against the ASIDD and cricket injury surveillance consensus statement.

8.1 Chapter rationale

In terms of understanding data quality, it is important to assess the validity and completeness of the data (72). Chapter 7 assessed the potential for and validity of relevant data to be collected by the NCRPP scheme from an examination of the insurance claims forms. This Chapter continues the evaluation of the NCRPP by assessing the data captured by the NCRPP system for completeness.

8.2 Aim

The aim of this Chapter was to investigate the usefulness of the data collected by NCRPP system for injury surveillance in community cricket.

8.3 Methods

This Chapter compares collected injury information by the insurers to that recommended in the Australian Sports Injury Data Dictionary (ASIDD) (11) and the cricket injury surveillance consensus statements (13, 14). The ASIDD is considered a gold standard for a standardised approach for the systematic collection of sports injury data in both elite and community based settings and has been used to help design or assess injury surveillance systems for 20 years (15). The consensus statements on cricket injury surveillance were originally targeted at elite levels of the sport, but do contain relevant and fundamental injury data items specific to cricket at all levels.

The study was approved by the Edith Cowan University Human Research Ethics Committee (2019-01144-FORTINGTON). Injury data items collected by the insurer were derived from the paper and online forms available from the insurer since the inception of the NCRPP as per Chapter 7. The initial NCRPP was based on a standard sports insurance scheme and operated as such until 9th July 2007, after which the system became a discretionary trust arrangement with an insurance scheme. The discretionary trust arrangement allows the trustee discretion over claims approvals. Because of the different systems used and variation in data collected before and after this change, two sets of data were supplied by JLT-Sport/Marsh (the insurer) reflecting this. As such, results have been split to pre-July 2007, representing data collected prior from September 2003 to the 9th July, 2007, and post-July 2007, representing data collected from the

9th July, 2007, to July 2019, to better reflect the variations in data collected under the differing insurance arrangements. The injury related data items for each dataset are listed in Table 93.

Table 93. *Injury related data items from the JLT-Sport/Marsh insurance claims data (Pre- and Post-July 2007).*

Pre-July 2007 injury data items	Post-July 2007 injury data items
State	League
Association	Club
Club	State
Team Grade	Grade
Sex	Age at time of loss
Accident Date	Gender
Age at Injury	Claimant Post Code
Date JLT received claim	Incident Date
Injury Session	Date JLT Notified
Playing Position	Playing Position
Playing Surface	Injury Session
Body Location	Location
Nature of Injury	Injured Person
Similar Injury	Body Location
Description of Injury Event	Nature of Injury
Ceased Play/Training	Description of Injury Event
Accident Location	Location of incident
Weather	Incident Post Code
	Weather
	Surface[1]

[1] Surface variable relates to playing surface (i.e. grass, synthetic etc).

Data quality was assessed at two levels. Firstly, the level of missing data within the injury data fields supplied by JLT-Sport/Marsh (Table 93) and secondly, data completeness as compared to the ASIDD and injury consensus statements about what data should be collected.

Missing data within extracted data supplied by JLT-Sport/Marsh

Missing or inaccurate data were determined for the data items relating to injury supplied by JLT-Sport/Marsh. There were 18 separate injury-related data items in the pre-July 2007 data fields, and 20 in the post-July 2007 data fields. Missing data were defined as 'a blank field associated with the particular data item'. Inaccurate data included fields where the information present did not correspond to valid values for the field involved, e.g. Age = 0 or > 100.

Data completeness compared with ASIDD and consensus statements

Of the 15 strongly recommended ASIDD data items, two items were not included: item 1 person recording case information, as the data were de-identified and item 2, the immediate source of injury record, as this defaults to insurance claims in this case. One of the eight recommended items (item 26 of the ASIDD, relating to time of presentation for treatment) was also not included as this item was more targeted at medical coverage or sports events settings. Item 24 of the ASIDD (provisional diagnosis text) was considered as optional in insurance claims and so it was not included in the overall scoring. A total score was determined by the sum of each item's score (i.e. item fully present = 1, some aspect present = 0.5 and item absent

= 0) with an overall possible score of 27 points; seven for core items, 13 for strongly recommended items and seven for recommended items. Data is also reported in terms of percentage completeness, referring to the number of items recording a yes answer divided by the total number of items (n = 27).

A similar process was performed for the most recent versions of the insurance forms (post-July 2007) against the cricket consensus statements. Eleven items were selected, 10 from the original consensus statement and one from the 2016 update regarding to the mode of onset of injury.

Missing data were assessed on the basis of whether data fields relating to each data item were present and if so, how many cases were incomplete or missing from the insurer's database as a proportion of all claimants (including items that were 'to be advised', 'not yet advised', 'other' and 'unspecified'). In the case of data items that were partially available compared to the ASIDD and the consensus statement, the proportion of missing data were assessed on the available data, with the main examples of injury factors and mechanism described below. Where no data were available from the provided insurer's dataset it was marked with '-'. The overall fidelity of the data, being the amount of data that was actually provided in the insurance claims data compared to what could theoretically be collected by the insurance claims forms, was calculated by the following equation:

$$Fidelity\ of\ data = 100\% - \frac{\sum(\%)\ missing\ data}{(n_{items}\ \times 100\%)}$$

Where n_{items} represents the number of items in each section of the ASIDD (i.e. core n = 7, strongly recommended n = 13 and recommended n = 7), or consensus statement (n = 11). Where an item has no available data in the insurance data supplied it is assumed to be 100% missing for this calculation.

Injury factors

The completeness of the injury factors item was calculated based on the injury factor items available from the pre- and post-July 2007 data. The factors included from the pre-July 2007 data were injury session, playing position, playing surface and weather, while for the post-July 2007 data the factors included were playing position, injury session, location, injured person, weather and surface.

Injury diagnosis accuracy

The representativeness of the injury data, such as body location of injury and injury nature, were examined by assessing the body location and injury nature coded against the description of injury event variable from a randomly selected sample of 280 claims (~ 5% of all claims) from the post-July 2007 data. Where a coded item was clearly representative of the description of injury event it was labelled 'yes', where it was unclear it was labelled 'unclear' and when the item was clearly not represented the it was labelled ‘no’. A calculation of a representative sample size was derived by assessing the relative proportions of claim numbers in each of the years of the post-July 2007 dataset and taking the average as the proportion used in the sample size calculator on the Australian Bureau of Statistics (ABS) website sample size calculator (https://www.abs.gov.au/websitedbs/D3310114.nsf/home/Sample+Size+Calculator). A sample of n = 116 was required for representativeness within 95% CI, which was lower than the sample size adopted.

Injury mechanism

The mechanism of injury was coded by the author of this thesis, from the description of injury event in the supplied data. An adaption of injury mechanisms within the ASIDD was used to code for the broad mechanism of injury and specific mechanism of injury (Table 94). Data completeness for injury mechanism was derived from the broad and specific mechanism coding. A third level of detail was adopted to ascertain if cricket specific actions could be coded for in the injury mechanism (Table 95) and was also used to determine data completeness compared to the consensus statement. Also, for the consensus statement comparison, the mode of onset (impact, non-impact) was mapped from the broad mechanism of injury coding, where impact equated with ‘struck, hit, contact with or by object, person or ground’ and non-impact was all others.

Table 94. *Broad and specific mechanisms used for coding injury mechanisms from the injury description data field (adapted from ASIDD).*

Broad Mechanism	Specific Mechanism (agent)
Struck, hit, contact with or by object, person or ground	Ball
	Bat
	Stumps
	Bails
	Ground. Additional causative factors for impact with ground include: fall, slip, or trip; deliberate dive.
	Person (e.g. other player)
	Fixture (e.g. fence, sprinkler)
	Other
Acute overexertion	Sudden or rapid change of speed
	Sudden or rapid change in direction
	Other
Gradual or chronic overexertion	Repetitive trauma or overuse
	Unspecified/insidious
Crushing, piercing, abrading	Pinching, crushing
	Cutting, tearing
	Puncture
	Bite/sting
	Abrading, rubbing, friction
	Other
Thermal Effect	Whole body heating
	Whole body cooling
	Other
Electric, radiation effect	Sun light
	Other

Table 95. *Cricket-specific action coding for injury mechanism from the injury description data field.*

Cricket Specific Action	Action within role
Batting	Playing a shot
	Evading ball
	Setting off for a run
	Running between wickets (including making ground)
	Non-striker
Bowling	Run up
	Delivery stride
	Follow through
	Attempting caught and bowled
Fielding/Wicket keeping	Catching
	Throwing
	Attempting to field ball (other than catching)
	Chasing ball in field
	Receiving a return from field
Umpiring	Officiating end
	Square leg
Other	Grounds work
	Other

In order to assess the usability of this injury mechanism coding system (Tables 94 & 95), a sample of 10% post-July 2007 claims data were analysed independently by an additional coder. Where there was no agreement between the two codes reported, a third coder was used. A Cohen's Kappa score was calculated, using the Real Statistics add-in package (http://www.real-statistics.com/) for Microsoft Excel 2016, for each of the broad, specific and cricket specific mechanisms to help identify the usability of the proposed coding system with the data available.

8.4 Results

A total of 1,774 claims from pre-July 2007 and 5,251 claims from post-July 2007 were inspected from the insurer's database.

8.4.1 Overall missing or inaccurate data

Table 96 shows the overall availability of data items within the supplied insurance claims data pre-July 2007. Overall 1.1% (95% CI 1.0% – 1.3%) of the data fields were found to be missing information or have inaccurate information. The items with the most missing information were nature of injury (4.7%), accident location (3.7%), playing position (3.3%), weather (2.3%) and playing surface (2.0%).

Table 97 shows the overall availability of the data items within the supplied insurance claims data post-July 2007. Overall, 9.2% (95% CI 9.0% – 9.4%) of the data fields were found to be missing information or have inaccurate information. The items with the most missing information were Incident Post Code (59.3%), Weather (48.9%) and Surface (48.8%), Playing Position (9.3%) and Nature of injury (4.5%). If it is assumed that Incident Post Code could be derived from the Location of Incident item then the overall missing data reduces to 6.4%.

Table 96. *Data items related to injury supplied by JLT Sport/Marsh for cricket-related injury pre-July 2007 (n = 1,703 claims).*

Item	JLT data item supplied	% of missing or inaccurate data
1	State	0.0%
2	Association	0.1%
3	Club	0.6%
4	Team grade	0.6%
5	Sex	0.0%
6	Accident date	0.0%
7	Age at injury	1.2%[1]
8	Date JLT received claim	0.1%
9	Injury session	0.6%
10	Playing position	3.3%
11	Playing surface	2.0%
12	Body location	1.3%
13	Nature of injury	4.7%
14	Similar injury	0.0%
15	Description of injury event	0.1%
16	Ceased play/training	0.0%
17	Accident location	3.7%
18	Weather	2.3%
	Total missing or inaccurate data	**1.1% (95% CI 1.0 – 1.3)**

[1] 0.5% due to age reported as 0 years, 0.7% due to age reported as > 100 years

Table 97. Data items related to injury supplied by JLT Sport/Marsh for cricket-related injury post-July 2007 (n = 5,249 claims).

Item	JLT data item supplied	% of missing or inaccurate data
1	League	0.1%
2	Club	2.6%
3	State	0.0%
4	Grade[1]	0.9%
5	Age at time of loss[1]	1.0%[2]
6	Gender	0.1%
7	Claimant post code	0.1%
8	Incident date	0.0%
9	Date JLT notified	0.0%
10	Playing position	9.3%
11	Injury session	1.6%
12	Location	0.2%
13	Injured person	0.2%
14	Body location	1.0%
15	Nature of injury	4.5%
16	Description of injury event	0.8%
17	Location of incident	4.2%
18	Incident post code	59.3%
19	Weather	48.9%
20	Surface	48.8%
	Total missing or inaccurate data	**9.2% (95% CI 9.0 – 9.4)**

[1] 0.91% of cases where grade reported as junior but age reported as > 18 years.

[2] 0.93% due to age reported as > 100 years, 0.07% due to age reported as 0 years

8.4.2 Data completeness with the ASIDD and consensus statements

Overall, 96% (26/27) of the ASIDD data items investigated were available to some extent from the insurer's data collection forms. The overall agreement score was 18.5 out of a possible 27.

Table 98 shows the results for the ASIDD core data items. The insurance forms contain at least some information on all (100%) of the ASIDD core items, both pre and post July 2007, with category agreement scores of 5 out of 7. The amount of missing data were under 2% for all available items in both pre and post July 2007 data. There was 0.1% and 0.8% of fields missing data from the description of injury event, where it was asserted that mechanism of injury could be at least partially extracted. When mechanism of injury was coded for, using the description of injury event and the ASIDD coding options, 14.0% of claims could not be coded for broad and specific mechanisms pre July 2007 and 17.8% of claims post 2007. The item Activity when injured – broad areas was unavailable in the pre-July 2007 data provided.

The overall fidelity of the data for the ASIDD core data items was 83.6% for the pre-July 2007 data and 97.1% for the post-July 2007 data.

Table 98. Insurance claim form comparison with ASIDD core data items and % of missing data from available data from insurer's database.

No.	Core ASIDD data item	Pre-July 2007 forms: Presence on Insurance form	Pre-July 2007 forms: Missing Data	Post-July 2007 forms: Presence on Insurance form	Post-July 2007 forms: Missing Data
3	Date of injury	Y	0.0%	Y	0.1%
6	Age	Y	0.7%	Y	1.0%
7	Gender	Y	0.0%	Y	0.0%
13	Activity when injured – broad areas	P	-	P	0.2%
19	Mechanism of injury	P	0.1% (14.0%) [1]	P	0.8% (17.8%) [1]
21	Body region and body chart	P	0.1%	P	0.5%
23	Nature of injury	P	0.0%	P	1.6%
	Category Agreement Score (7.0 maximum)	**5.0**	**Fidelity of data provided**	**5.0**	**Fidelity of data provided**
	Proportion of ASIDD items present on form	**100%**	**83.6%**	**100%**	**97.1%**

1 When injury mechanism was coded from injury claims description of event, using ASIDD coding options, 14.0% of claims could not be coded (10.9% of claims could not be coded for broad mechanism of injury and 17.0% could not be coded for specific mechanism of injury) for pre July 2007 data and 17.8% of claims could not be coded (15.4% and 20.2% for broad and specific mechanisms respectively) for post July 2007 data.

Table 99 shows the results for the ASIDD strongly recommended data items. The insurance forms contained at least some information on 92% of the ASIDD strongly recommended items, both pre and post July 2007, with category agreement scores of 8.5 out of 13. The amount of missing data for available items was largest for injury factors in the post-July 2007 data at 18%, and 2% for the pre-July 2007 data. Eight of the 13 strongly recommended items were not available from the insurance data provided for the pre-July 2007 period and seven for the post-July 2007 period. Two of these items, Date of presentation and Advice given to injured person, were available from the forms for both periods.

The overall fidelity of the data for the ASIDD strongly recommended data items was 38.0% for the pre-July 2007 data and 44.0% for the post-July 2007 data.

Table 99. Insurance claim form comparison with ASIDD strongly recommended data items and % of missing data from available data from insurer's database.

No.	Strongly Recommended ASIDD data item	Pre-July 2007 forms: Presence on Insurance form	Pre-July 2007 forms: Missing Data	Post-July 2007 forms: Presence on Insurance form	Post-July 2007 forms: Missing Data
8	Area of usual residence	P	-	P	0.1%
9	Name of injury place – text	Y	3.7%	Y	4.2%
10	Place of injury – type	P	-	P	-
11	Sport and recreational places - specific	P	-	P	-
14	Activity when injured – name of sport/activity	Y	0.0%	Y	0.0%
17	Injury factors	P	2.0%	P	18.2%
18	Equipment used with intent to protect against injury	N	-	N-P[1]	-
20	Narrative of mechanism of injury	Y	0.1%	Y	0.8%
25	Date of presentation	Y	-	Y	-
28	Treatment	P	-	P	-
29	Advice given to injured person	Y	-	Y	-
30	Referral	P	-	P	-
31	Treating person	P	-	P	-
	Category Agreement Score (13.0 maximum)	**8.5**	**Fidelity of data provided**	**8.5**	**Fidelity of data provided**
	Proportion of ASIDD items present on form	**92%**	**30.3%**	**92%**	**36.7%**

1 Partially available on online forms, but only since October 2016

Table 100 shows the results for the ASIDD recommended data items. The insurance forms contained at least some information on all (100%) of the ASIDD recommended items, both pre and post July 2007, with category agreement scores of 5 out of 7. The amount of missing data were under 1% for all available items in both pre and post July 2007 data. Three of the recommended items were not available from the insurance claims data provided for both time periods, including time of injury, part of specific injury place and reason for presentation. Two of the unavailable items, time of injury and reason for presentation, were available on the insurance forms.

The overall fidelity of the data for the ASIDD recommended data items was 56.9% for the pre-July 2007 data and 56.8% for the post-July 2007 data.

Table 100. *Insurance claim form comparison with ASIDD recommended data items and % of missing data from available data from insurer's database.*

		Pre July 2007 forms		Post July 2007 forms	
No.	**Recommended ASIDD data item**	**Presence on Insurance form**	**Missing Data**	**Presence on Insurance form**	**Missing Data**
4	Time of injury	Y	-	Y	-
5	Date of injury record	Y	0.0%	Y	0.0%
12	Part of specific injury place	P	-	P	-
15	Phase or aspect of involvement in activity or event	P	0.0%	P	0.4%
16	Activity when injured – grade or level	P	0.6%	P[1]	0.9%
22	Specific structure injured	P	1.3%	P	1.0%
27	Reason for presentation	Y	-	Y	-
	Category Agreement Score (7.0 maximum)	**5.0**	**Fidelity of data provided**	**5.0**	**Fidelity of data provided**
	Proportion of ASIDD items present on form	**100%**	**56.9%**	**100%**	**56.8%**

[1]only partially available from 2009/10 form

Table 101 shows the results for the cricket consensus data items. The insurance forms contained at least some information on all (100%) of the consensus items, with consensus agreement scores of 7 out of 11. The items with the largest amount of missing data for all available items were the mechanism description (21.9%), mode of onset (15.4%) and activity of onset (9.3%). There were five data items, representing just under half of the consensus items, which did not have any information retrievable from the insurance claims data provided. One of the items, new/recurrent injury, that was not available in the insurance data supplied, was available on the insurance forms. The overall fidelity of the data for the consensus items was 50.3%.

Table 101. Insurance claim form comparison with cricket consensus data items and % of missing data from available data from insurer's database.

	Consensus Item/Intent	Post July 2007 forms	Missing Data
1	Player details (age, bowler type)	P	0.1%
2	Injury diagnosis including body region	P	-
3	Injury side (left, right, bilateral, NA)	P	-
4	New injury/recurrent injury	Y	-
5	Time of onset (match/training/other/gradual) including match details	Y	0.4%
6	Activity at onset (batting/bowling/fielding/gradual) including fielding position	P	9.3%[1]
7	Date of onset	Y	0.0%
8	Mode of onset[a] (impact, non-contact (acute, identifiable gradual, non-identifiable insidious), illness)	P [2]	15.4%
9	Mechanism description	P	0.8% (21.9%) [3]
10	Qualification as a significant injury	P	-
11	Details of surgery or other major treatment (if relevant)	P	-
	Consensus completeness rating (11 maximum)	**7.0**	**Fidelity of data provided**
	Proportion of consensus items present on form	**100%**	**50.3%**

[a] adopted from 2016 update,. N = not covered at all, P = partially covered, Y = fully covered

[1] Reduced to 4.0% when back coded from Description of injury event.

[2] When coded for from description of injury event, 15.4% of cases could not be identified.

[3] When coded for from description of injury event, Overall 21.9% of cases could not be identified; 15.4% on broad mechanism, 20.2% on specific mechanism, 30.2% on specific cricket action at time of injury.

Injury diagnosis accuracy

The activity of injury onset was checked by year to discern any patterns in the missing data. Figure 73 shows that much of the missing data can be accounted for in the 2013/14 insurance year. The missing data on the activity of injury onset was re-coded by the author of this thesis, using the description of injury event. After this process, there were still n = 212 claims (4.0%) where the activity of injury onset could not be identified.

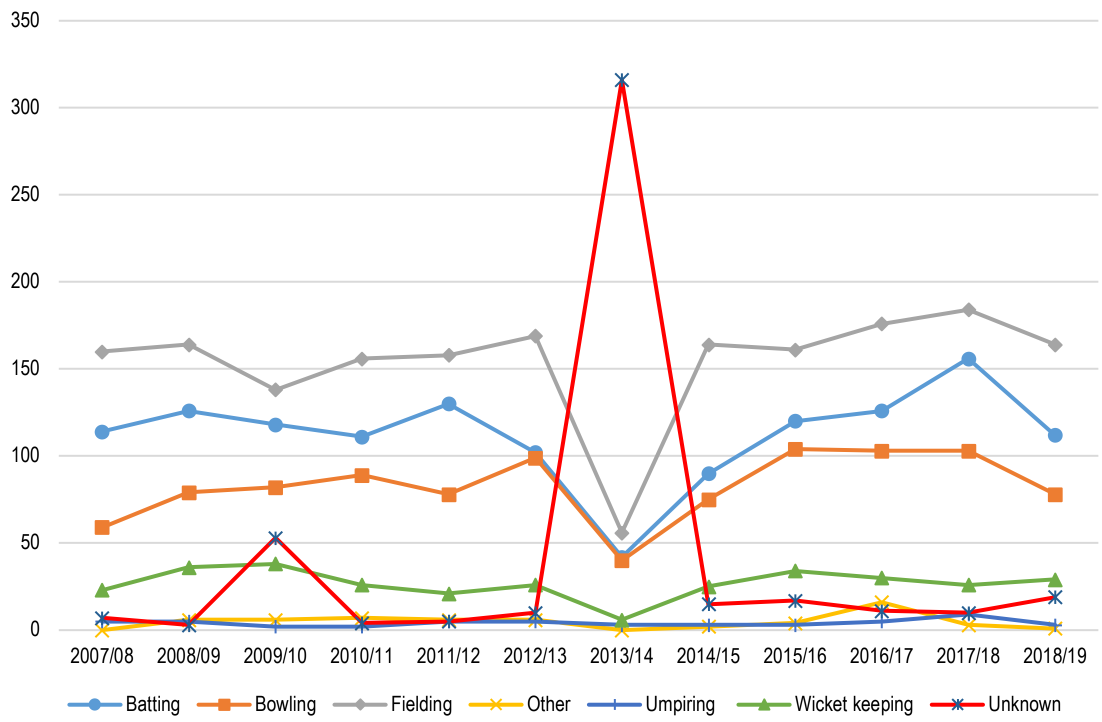

Figure 73. Annual numbers of claims by activity at injury onset for NCRPP claims showing missing (unknown) data.

The body location of injury and the injury nature were cross referenced against the description of injury event to assess the level of representativeness of that data. From a sample of 280 claims (~5% of all claims), the body location accurately reflected the description of injury in 83% of claims assessed, while the nature of injury was accurately matched in 37% of claims. The body location and injury nature were accurately mapped together in 34% of claims analysed.

An incidental finding was that the injury nature of 'dislocation' appeared to only have been used from 2013 onward in the dataset analysed.

Coding comparison for injury mechanism

Table 102 shows the analysis of the coding for injury mechanism. Coding agreement was the highest for the broad mechanism of injury and dropped with each level of specificity. The specific mechanism had the highest proportion of non-consensus claims between two coders and also had the lowest agreement proportion of the third coder.

Table 102. *Injury mechanism coding comparison analysis.*

Mechanism level	Initial agreement %	Cohen's Kappa (95% CI)	Number of non-agreement items[1]	Third Coder agreement[2]
Broad	86.5%	0.79 (0.74 – 0.83)	20/91 (22%)	11/20 (55%)
Specific	72.2%	0.74 (0.70 – 0.79)	74/146 (51%)	35/74 (47%)
Cricket specific action	65.1%	0.65 (0.60 – 0.69)	67/183 (37%)	35/67 (52%)
Ground impact causation	77.7%	0.30 (0.19 – 0.41)	N/A	N/A

Explanation: [1] for broad mechanism level: of the 91 claims that were not matched between coders, 20 remained unmatched on the second pass.[2] For third coder, there were 11 of the 20 unmatched broad mechanisms that agreed with at least one of the original coders.

8.5 Summary of key results

This chapter assessed the validity, completeness and fidelity of data available within the NCRPP insurance system. This information is an important step in understanding of the system as a potential injury surveillance tool for injuries to community cricketers in Australia. Key findings include:

- The data completeness and fidelity is high within the core data items, but decreases within the strongly recommended and recommended data items.
- The insurance data has a moderate fidelity with regard to the cricket injury consensus statement.
- There is some concern over the representativeness of the body location and injury nature, based on the description of injury event.
- Injury mechanism and injury factors are two areas that require improvement for future injury surveillance and injury prevention needs.

Previously in Chapter 7, the NCRPP was shown to have a moderate level of validity in terms of data collection compared to the ASIDD and the cricket injury consensus statements. This Chapter has identified high levels of data completeness and fidelity in the core and strongly recommended items of the ASIDD. These findings suggest the NCRPP system has potential to be useful as an injury surveillance tool for community level cricket, notwithstanding the shortcomings identified above.

Chapter 9. A descriptive analysis of injuries in community cricketers in Australia using the National Club Risk Protection Program insurance claims data from 2007 to 2019.

9.1 Chapter rationale

The previous Chapters demonstrate that the NCRPP system shows promise for injury surveillance in community level cricket. The NCRPP data is also unique in the sense that it is a repository of insurance claims specific to organised cricket, as opposed to general injury insurance such as the ACC system. This Chapter investigates the most recently available data from 2007/08 to 2018/19 and provides a descriptive analysis of the community level cricket injuries therein to provide a current profile of injuries in community cricket.

9.2 Aim

The aim of this Chapter was to investigate NCRPP claims for organised community-level cricket injury with the following objectives:

- To understand the profile of injuries (number, type, nature, mechanism) in cricket specific activities (batting, bowling, fielding and wicket keeping);
- Investigate injury severity and time lost to work due to cricket-related injury as a measure of injury burden for community players.

9.3 Methods

This study is an in-depth descriptive analysis of existing insurance claims data from July 1, 2007 to June 30, 2019. The study was approved by the Edith Cowan University Human Research Ethics Committee (2019-01144-FORTINGTON), refer to Appendix D.

Data Source & Variables

Data on claims for males and females were provided to the author of this thesis by JLT Sport/Marsh. An initial dataset was sent after discussion with representatives from JLT Sport/Marsh via phone conference. Further data were added after several email exchanges requesting additional detail in relation to items collected on the claims forms. Data were received in the form of an excel spreadsheet. Because of the relatively low numbers of female claims, information reporting was largely restricted to male injuries. Information on demographic and overall claims numbers is provided on females in sections 9.3.1 and 9.3.2.

Injury variables available were injury nature/type:

- Amputation/removal (including eyeball)
- Bruising contusion & crushing injury
- Dislocation
- Foreign body on/in ear, eye, nose
- Fracture of vertebral column
- Fractures
- Injuries to nerves/spinal cord
- Internal injury (chest, pelvis, abdomen)
- Intracranial injury (including concussion)
- Multiple injuries
- Open wound/cut/laceration
- Sprains, strains
- Superficial injury
- Tear/rupture
- Other (includes not applicable, other and unspecified injuries, to be advised and blank cells).

Body regions injured were grouped as follows:

- Head/neck/face (includes brain, head/skull/cranium, face, eye, ear, nose, neck, mouth, tooth/teeth);
- Upper limb (includes shoulder, upper arm, forearm, elbow, wrist and hand/fingers/thumb);
- Lower limb (includes hip/pelvic region, upper leg, thigh, knee, lower leg, ankle, achilles tendon, foot/toes);
- Trunk (includes abdomen, back/spine – upper or lower, chest, lower back/spine, trunk – multiple or unspecified locations, genitourinary system, reproductive system);
- Multiple locations;
- Other (includes nervous system in general, unspecified, not applicable, to be advised, blank cells)

Because of a lack of reliable participation data on community level cricket in Australia, population data were used for injury incidence rate (IIR) calculations per 100,000 population based on ages 5 to 80 years old. The age range used represents over 98% of the data available, notwithstanding the erroneous data identified in Chapter 8. Population data were sourced from the Australian Bureau of Statistics (202).

Injury burden was assessed on the basic of loss of income (LOI) paid. As the exact weekly amount of LOI paid for each claimant was not available in the dataset received, it was assumed that the maximum weekly amount ($500) was applied to all claims. From this assumption, the number of weeks LOI was derived by dividing the total LOI paid by 500. The LOI paid variable is not a definitive measure of injury severity as the claimants must wait two weeks before the scheme begins payment, thereby creating a new variable of weeks lost work time (weeks LOI +2) . To account for this, each LOI claim was given an additional two weeks of LOI due to the mandatory two weeks waiting period prior to payments beginning. Because of the waiting period, it is likely the data will underestimate the number of lower severity injuries that require less than two weeks off work.

In order to assess differences across variables such as age groups, activity at injury onset, injury nature, injured body location and combinations thereof, an overall annual injury burden, by variable of interest, is derived by multiplying the average number of LOI claims per year by the average weeks lost work time as shown in the following equation:

$$Injury\ burden\ (I_i) = \left(\frac{n_{LOI\ claims(i)}}{12}\right) \times \mu_{weeks\ LOI\ per\ claim(i)}$$

The injury burden is then a measure of work time weeks lost per year by variable of interest. The injury burden is also presented graphically, plotting the average weeks LOI per claim against the average number of LOI claims per year. A mean injury burden contour line is plotted, based on the average injury burden of the variable of interest, to allow for visual assessment of any variables that may be overrepresented in that category.

Statistical analysis

Annual IIR were calculated using crude population values as per the following equation:

$$IIR_i = \frac{injury\ count\ (n_i)}{population\ of\ interest\ (p_i)} \times 100{,}000$$

Descriptive statistical analysis was performed using Microsoft Excel (2016) and R, version 3.46.0 (R Core Team 2019) (204). Confidence intervals for IIR were calculated using a Poisson exact method (‘epitools’ package) (203) in R. Trend information on IIR data were calculated assuming a Poisson distribution (205) within a generalised linear model using a log link function in R. Where Poisson models were over dispersed, then a Quasi–Poisson analysis was performed. Trends were considered statistically significant if the p-value was less than 0.05. Descriptive statistics (n, %, 95% CI) were tabulated for body regions injured by activity of onset with confidence intervals calculated using Wilson methods (‘DescTools’ package) (208) in R.

9.4 Results

9.4.1 Overall claim numbers, age, sex and State characteristics

From 1 July 2007 to 30 June 2019, there were 5,249 successful claims for injury related to the NCRPP. The majority of claims were for males (n = 5,083, 96.8%). Figure 74 shows the distribution of claims by age groups for females and males. The average age of female claimants was 27.9 (SD 12.0) years and for males was 31.1 (SD 12.3) years.

The highest proportion of female claims occurred in the 20 to 24 years old age group (19.6%, 95% CI 14.2% - 26.5%). For males, the 20 to 24 years old age group was also the most common (16.3%, 95% CI 15.3% - 17.3%), with the 25 to 29 years old age group almost identical (16.2%, 95% CI 15.2% - 17.3%). The number of female claims was consistently higher proportionally than males in the age groups from 5 to 9 up to and including 20 to 24 years old, however these were not significant differences.

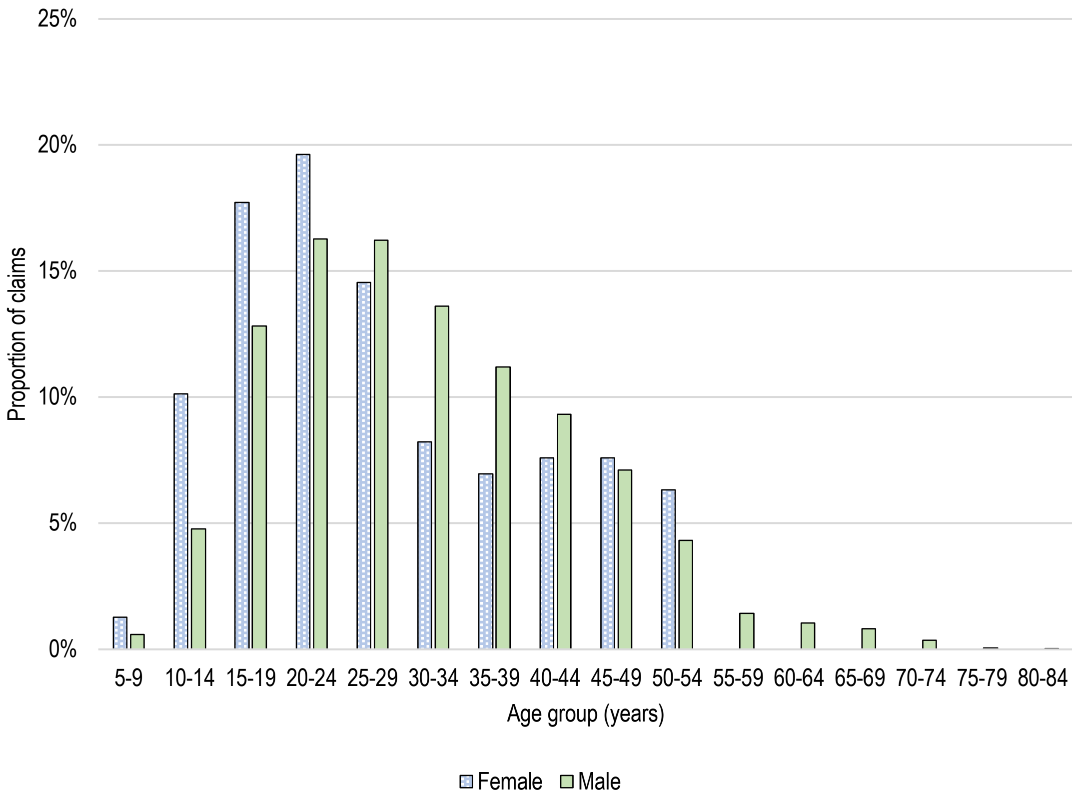

Figure 74. *Proportion of NCRPP claims by age group for males (n = 5,034) and females (n = 158) (2007/08 – 2018/19).*

Figures 75 to 78 show the proportion of males injured by activity (batting, bowling, fielding and wicket keeping). Batting injuries were most common in the 25 to 29 years old age group, bowling injuries tended more toward the younger age brackets with the 15 to 19 years old age group the most common. Fielding and wicket keeping injuries were most common in the 20 to 24 years old age group.

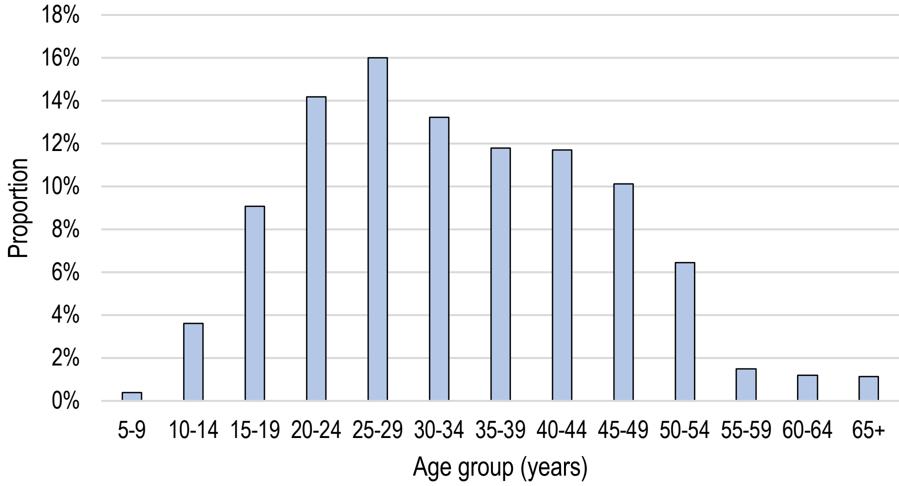

Figure 75. *Proportion of NCRPP claims for males where activity of onset was batting (n = 1,332) (2007/08 – 2018/19).*

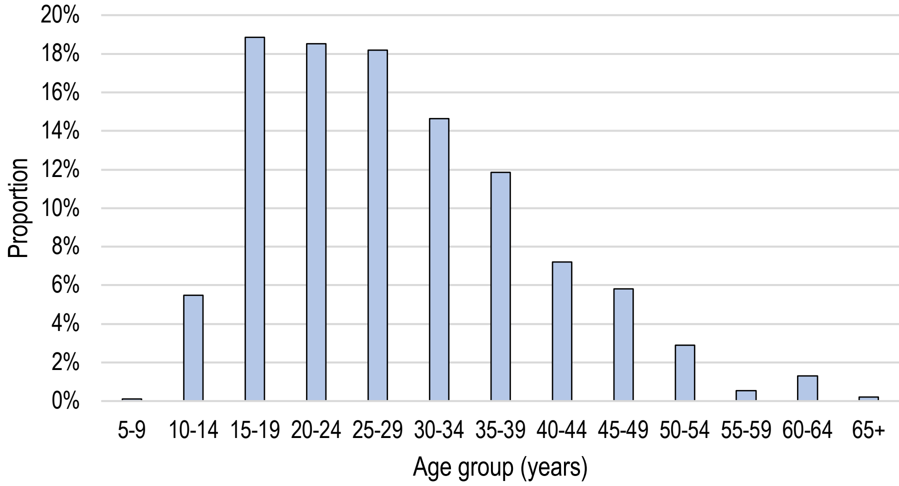

Figure 76. *Proportion of NCRPP claims for males where activity of onset was bowling (n = 929) (2007/08 – 2018/19).*

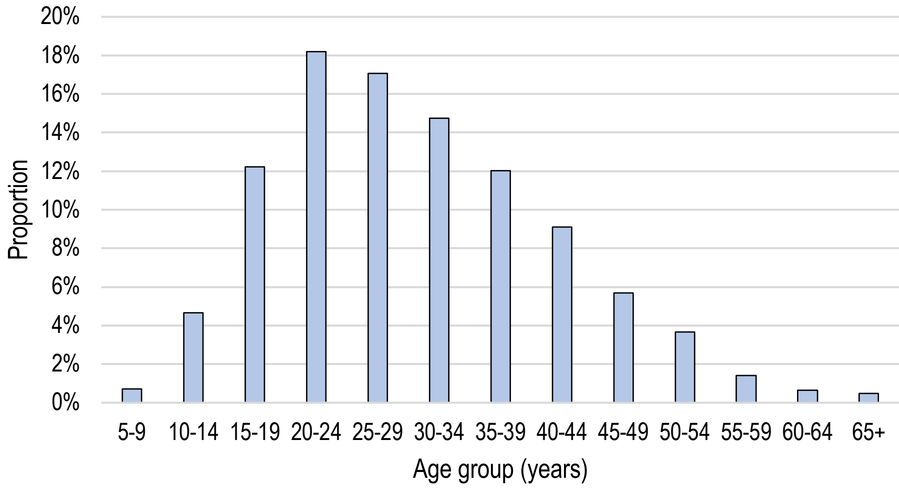

Figure 77. *Proportion of NCRPP claims for males where activity of onset was fielding (n = 1,823) (2007/08 – 2018/19).*

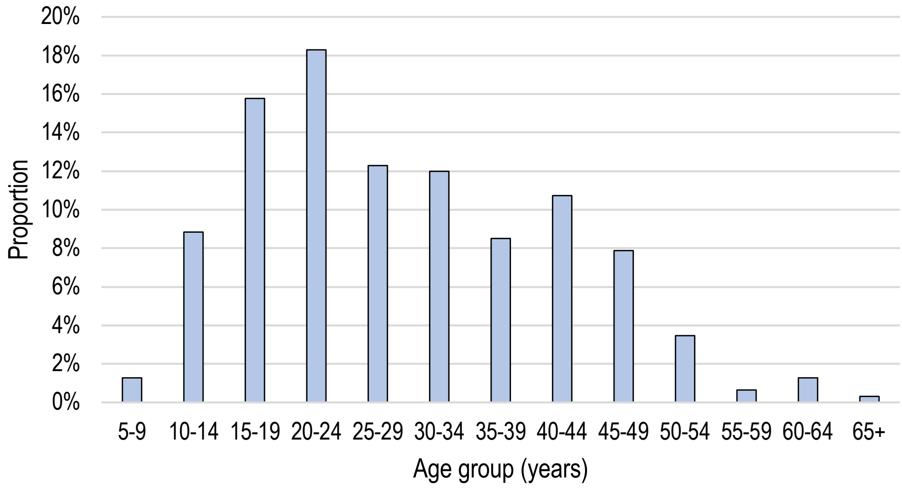

Figure 78. *Proportion of NCRPP claims for males where activity of onset was wicket keeping (n = 317) (2007/08 – 2018/19).*

Table 103 shows the proportion of claims by State and Territory around Australia for males and females. The largest number of claims occurred in Victoria for males and females. In New South Wales, there was a significant difference in the proportion of male (31.7%, 95% CI 30.4% - 33.0%) injuries and females injuries (21.4%, 95% CI 15.7% - 28.4%). In Queensland, there was also a significant difference between the injury proportions of males and females, however, on this occasion females (18.2%, 95% CI 13.0% - 25.0%) were more represented than males (10.7%, 95% CI 9.9% - 11.6%). The other States and Territories were not significantly different for male and female proportions.

Table 103. *Proportion of NCRPP claims by State and Territory in Australia for males and females (shaded values represent significant differences between male and female proportions by 95% CI).*

State or Territory	Female n	%	(95% CI)	Male n	%	(95% CI)
Australian Capital Territory	*	< 4.0%	(1.4% - 7.1%)	82	1.6%	(1.3% - 2.0%)
New South Wales	34	21.4%	(15.7% - 28.4%)	1611	**31.7%**	(30.4% - 33.0%)
Northern Territory	*	< 1.0%	(0.1% - 3.5%)	41	0.8%	(0.6% - 1.1%)
Queensland	29	**18.2%**	(13.0% - 25.0%)	545	10.7%	(9.9% - 11.6%)
South Australia	13	8.2%	(4.8% - 13.5%)	277	5.4%	(4.9% - 6.1%)
Tasmania	7	4.4%	(2.1% - 8.8%)	137	2.7%	(2.3% - 3.2%)
Victoria	63	39.6%	(32.4% - 47.4%)	2033	40.0%	(38.7% - 41.3%)
Western Australia	7	4.4%	(2.1% - 8.8%)	357	7.0%	(6.4% - 7.8%)
Total	**159**			**5083**		

* Cell supressed for value < 4.

9.4.2 Annual claims numbers and injury incidence rates (IIR)

The number of injury claims by males averaged 424 (SD ± 37.8) per year and females averaged 13.3 (SD ± 4.4) per year. Figure 79 shows the annual claims numbers for male and females. Male claim numbers have increased, on a three-year rolling average, from 408 in 2009/10 to

454 in 2018/19. Female claim numbers have increased, on a three-year rolling average, from 12 in 2009/10 to 18 in 2018/19. Both male (n = 491) and female (n = 25) claims peaked in 2017/18, before dropping the following year. This drop could be associated with a time lag in claims being submitted from the 2018/19 season.

Both male and female claims showed statistically non-significant trends with male claims increasing annually on average by 1.3% (95% CI -0.12% - 2.6%, p = 0.11 Quasi-Poisson) and female claims increasing annually on average by 3.6% (95% CI -1.5% - 9.1%, p = 0.20 Quasi-Poisson). Because, there are potential delays in claims submissions (refer to section 9.4.9), analysis of the data excluding the 2018/19 year indicates a statistically significant claim trend in males, increasing on average by 1.8% (95% CI 0.4 – 3.2%, p = 0.03 Quasi-Poisson). The female annual average claim trend increased to 4.9% (95% CI -1.0 – 11.1%, p = 0.14 Quasi-Poisson), but not to a level of statistical significance.

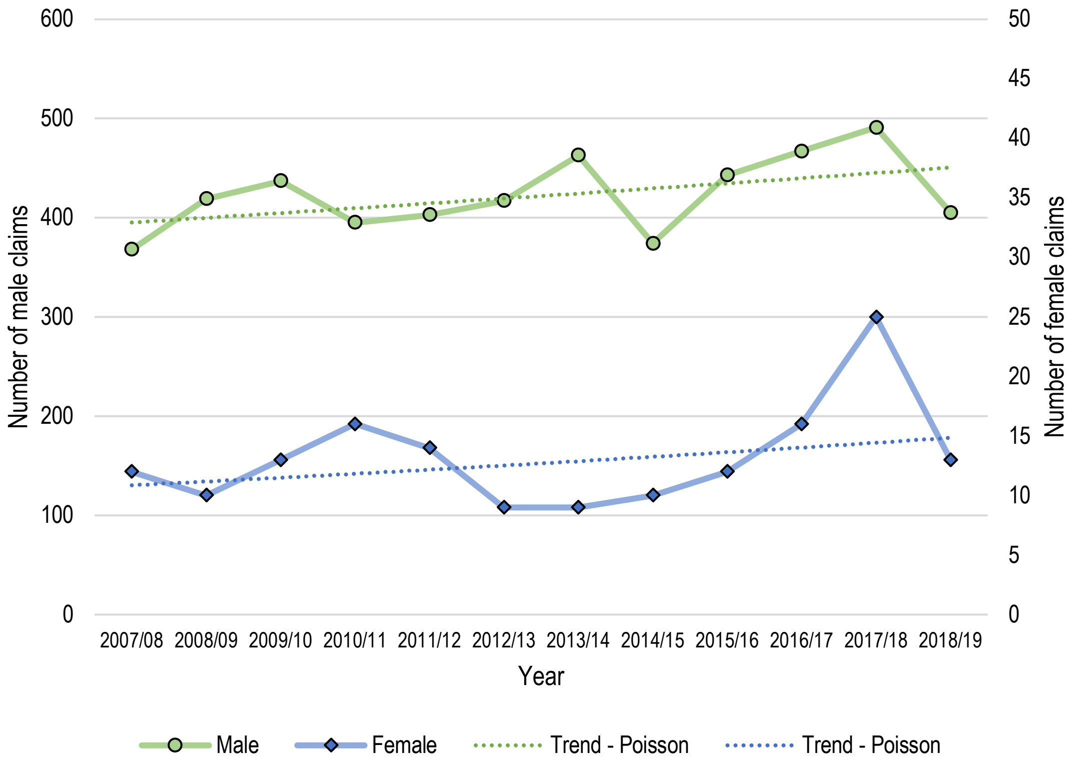

Figure 79. Annual NCRPP claims for males and females with trend line assuming Poisson distribution (2007/08 – 2018/19).

Figure 80 shows the annual claim numbers by activity. There was a period where the activity was not recorded in the dataset, as previously outlined in Chapter 9, and these are showed by the dashed lines. Visually, bowling and fielding had the largest upward trend in injury claims over the time frame investigated.

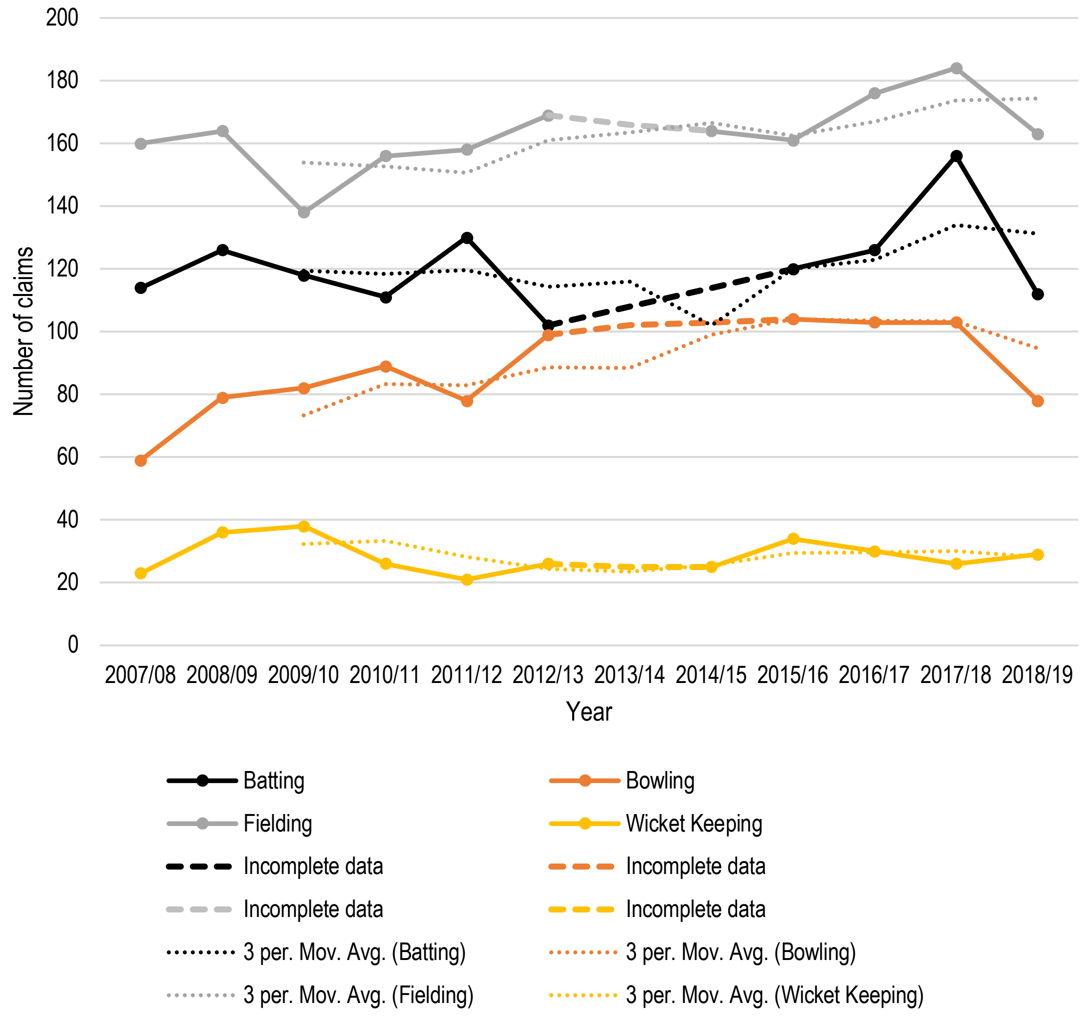

Figure 80. *Annual NCRPP claims by activity at injury onset (batting, bowling, fielding, wicket keeping). Incomplete data added based on 3 year rolling average (2007/08 – 2018/19).*

Figure 81 shows the proportions of male and female claims by month, based on date of incident. Both males and females show increased proportion of injuries in the early months of a typical cricket season, October and November. There were no significant differences between sexes by month of injury.

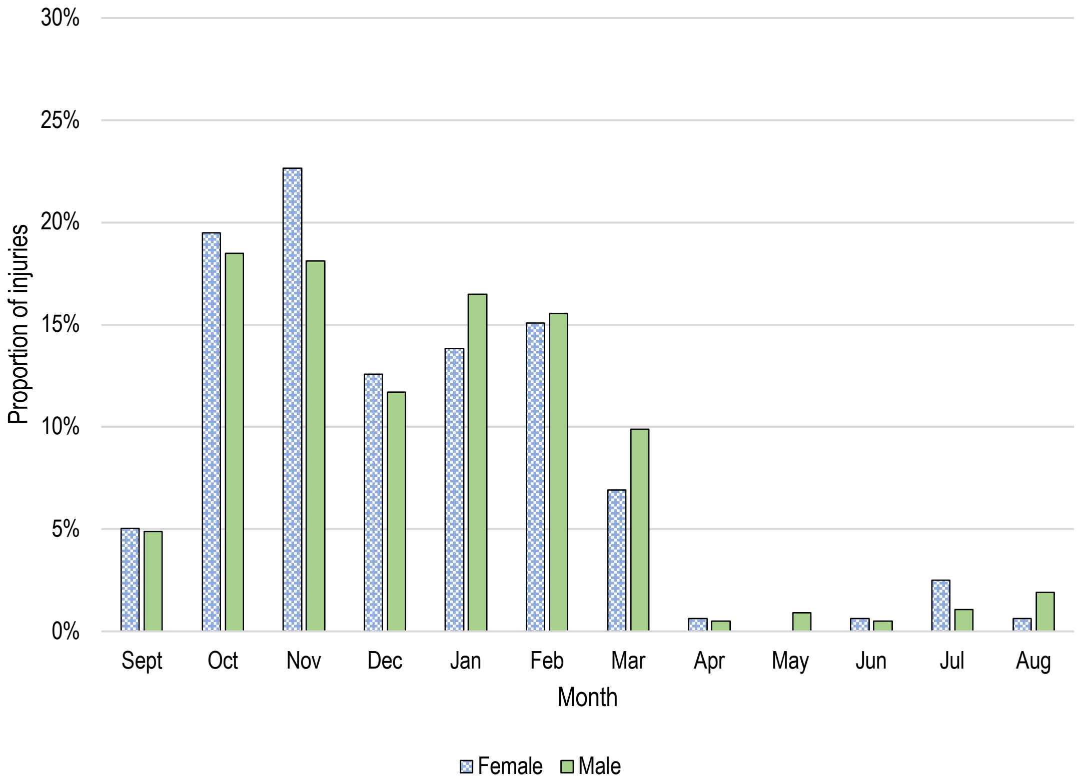

Figure 81. Proportion of NCRPP claims by month of incident for males (n = 5,083) and females (n = 159) with 95% CI (2007/08 – 2018/19).

Due to the relatively low numbers of female claims the remaining analysis is conducted on male claims only.

Figure 82 shows the annual IIR and trend for male claims by population aged 5 to 80 years. On a population basis, IIR in males aged between 5 and 80 years decreased on average by 0.46% per year (95% CI -8.2% - 8.0%, p = 0.91). When the 2018/19 year was excluded to account for claims submission delays, the IIR trend became slightly positive with an average increase of 0.07% per year (95% CI -8.7% – 9.7%, p = 0.99).

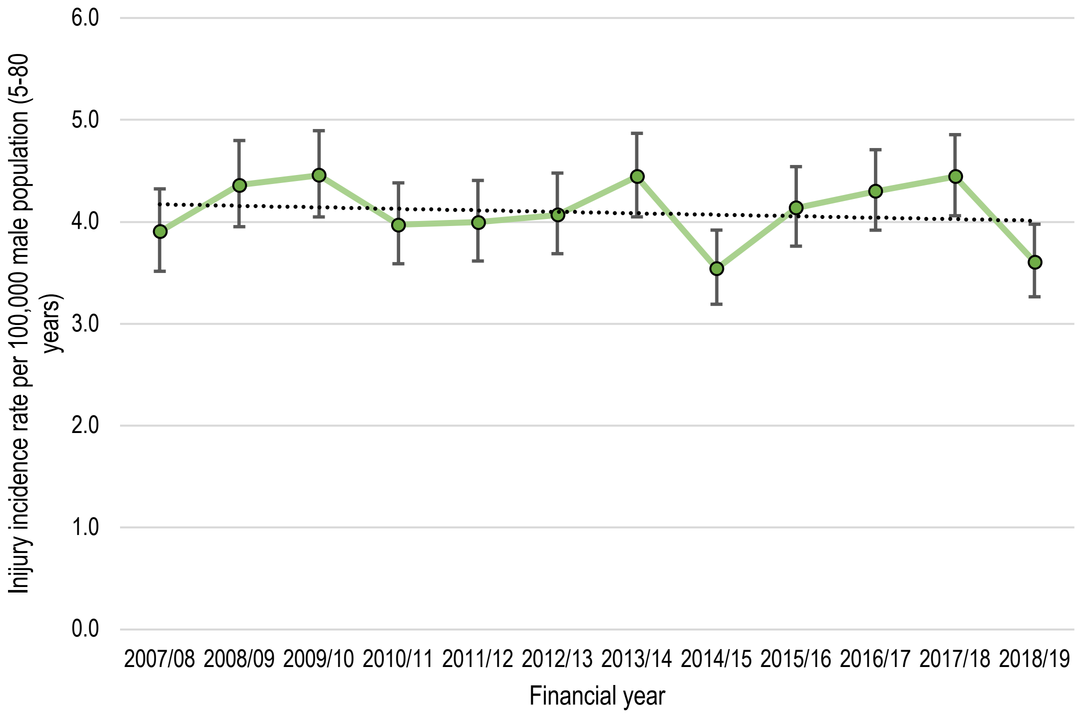

Figure 82. *Annual IIR per 100,000 male population aged from 5 to 80 years for NCRPP claims throughout Australia (2007/08 – 2018/19).*

IIR by State and Territory (Metro & Regional)

Figure 83 shows the annual IIR by population for male injury claims (n = 82) in the Australian Capital Territory (ACT). The average IIR of 3.9 per 100,000 population (95% CI 1.6 – 7.9) was similar to that of the national average of 4.1 per 100,000 population.

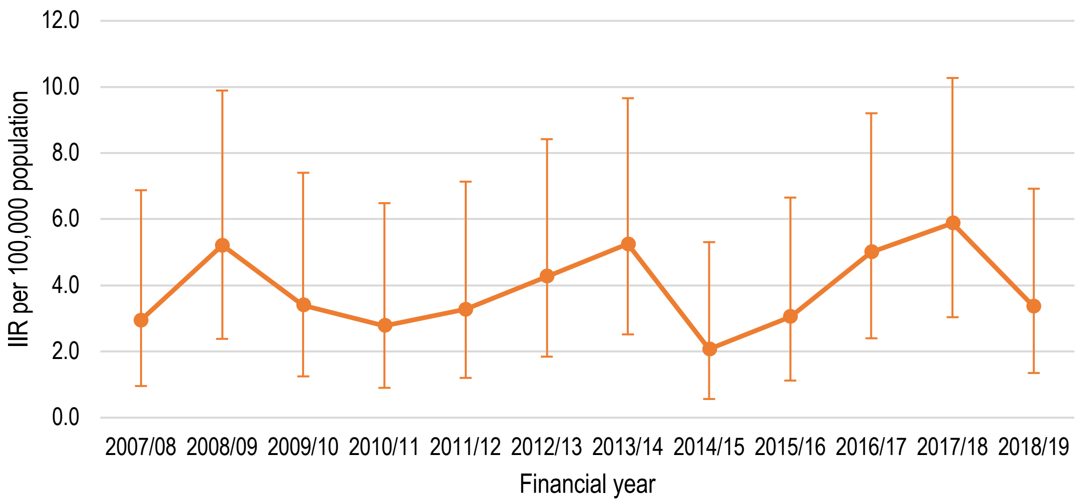

Figure 83. *Annual IIR per 100,000 male population aged from 5 to 80 years for NCRPP claims in the ACT (2007/08 – 2018/19).*

Figure 84 shows the IIR for metro (n = 1,029) and regional (n = 603) NSW. The average IIR for metro NSW was 3.6 per 100,000 population (95% CI 2.9 – 4.5) and slightly higher, but not significantly different to that in regional areas, 3.9 per 100,000 population (95% CI 2.9 – 5.1).

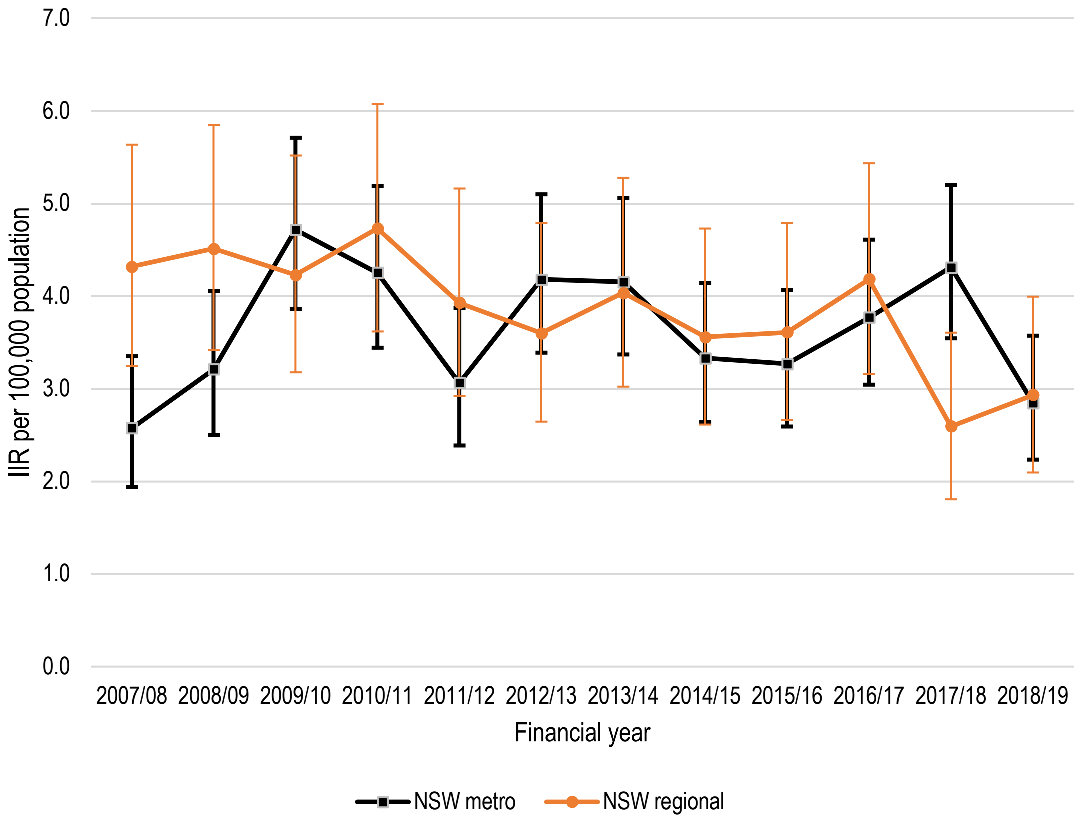

Figure 84. *Annual IIR per 100,000 male population aged from 5 to 80 years for NCRPP claims in NSW (2007/08 – 2018/19).*

Figure 85 shows the annual IIR by population for male injury claims in the Northern Territory (NT) (n = 42). The average IIR of 2.9 per 100,000 population (95% CI 0.8 – 7.7) was lower than the national average of 4.1 per 100,000 population.

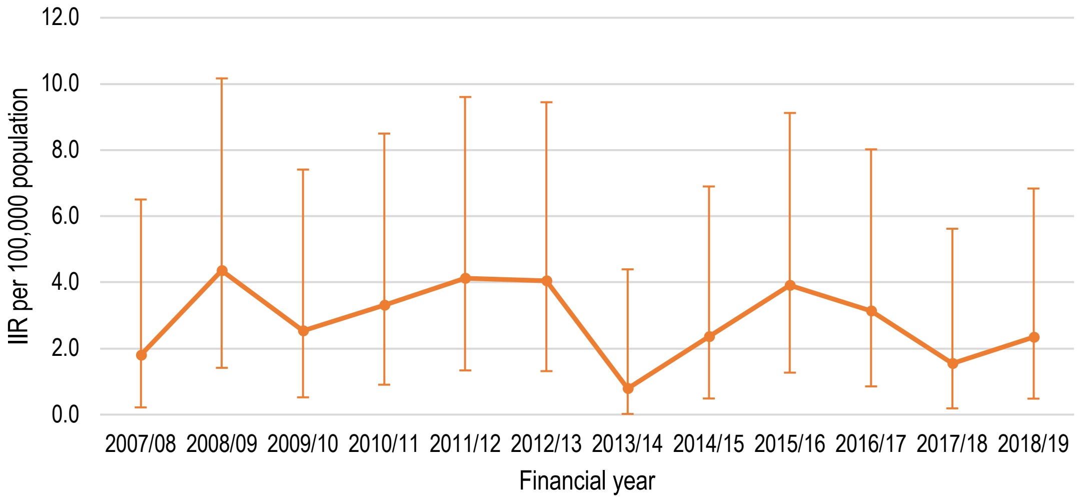

Figure 85. *Annual IIR per 100,000 male population aged from 5 to 80 years for NCRPP claims in the NT (2007/08 – 2018/19).*

Figure 86 shows the IIR for metro (n = 470) and regional (n = 105) Queensland (QLD). The average IIR for metro QLD was 3.6 per 100,000 population (95% CI 2.5 – 4.9) and significantly lower in regional areas, 0.7 per 100,000 population (95% CI 0.3 – 1.4).

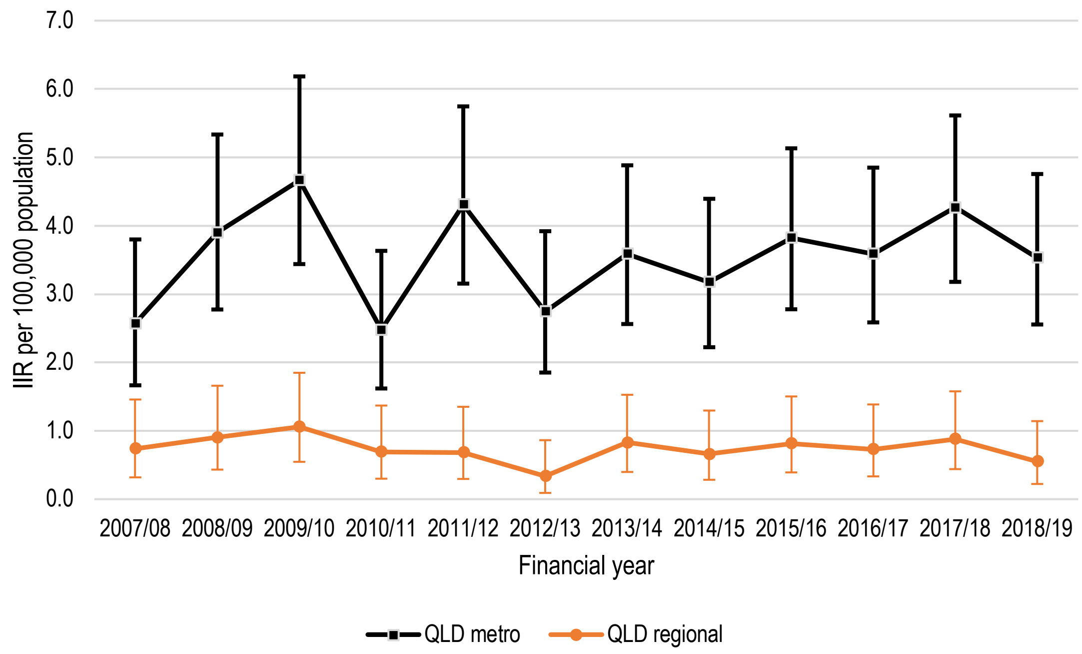

Figure 86. *Annual IIR per 100,000 male population aged from 5 to 80 years for NCRPP claims in QLD (2007/08 – 2018/19).*

Figure 87 shows the IIR for metro (n = 218) and regional (n = 72) South Australia (SA). The average IIR for metro SA was 2.9 per 100,000 population (95% CI 1.7 – 4.5) and slightly higher in regional areas, 3.1 per 100,000 population (95% CI 1.2 – 6.8).

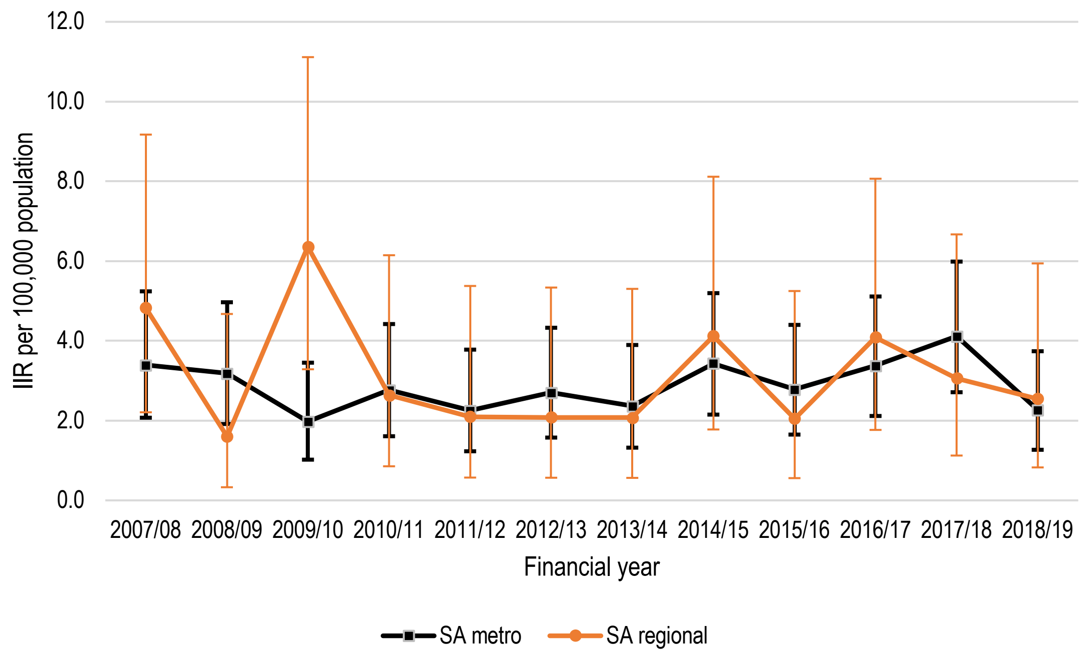

Figure 87. *Annual IIR per 100,000 male population aged from 5 to 80 years for NCRPP claims in SA (2007/08 – 2018/19).*

Figure 88 shows the IIR for metro (n = 69) and regional (n = 71) Tasmania (TAS). The average IIR for metro Tasmania was 4.5 per 100,000 population (95% CI 1.7 – 4.9) and slightly higher in regional areas, 4.7 per 100,000 population (95% CI 1.9 – 10.1).

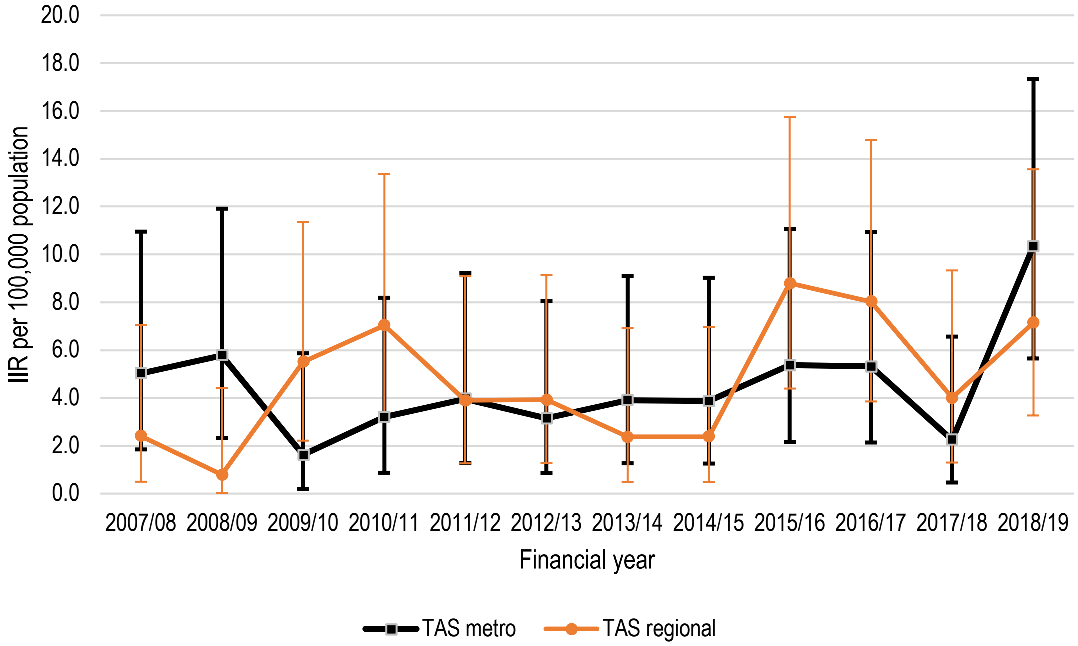

__Figure 88.__ Annual IIR per 100,000 male population aged from 5 to 80 years for NCRPP claims in Tasmania (2007/08 – 2018/19).

Figure 89 shows the IIR for metro (1,387) and regional (n = 679) Victoria (VIC). The average IIR for metro Victoria was 5.4 per 100,000 population (95% CI 4.4 – 6.4) and substantially higher in regional areas, 8.2 per 100,000 population (95% CI 6.2 – 10.6).

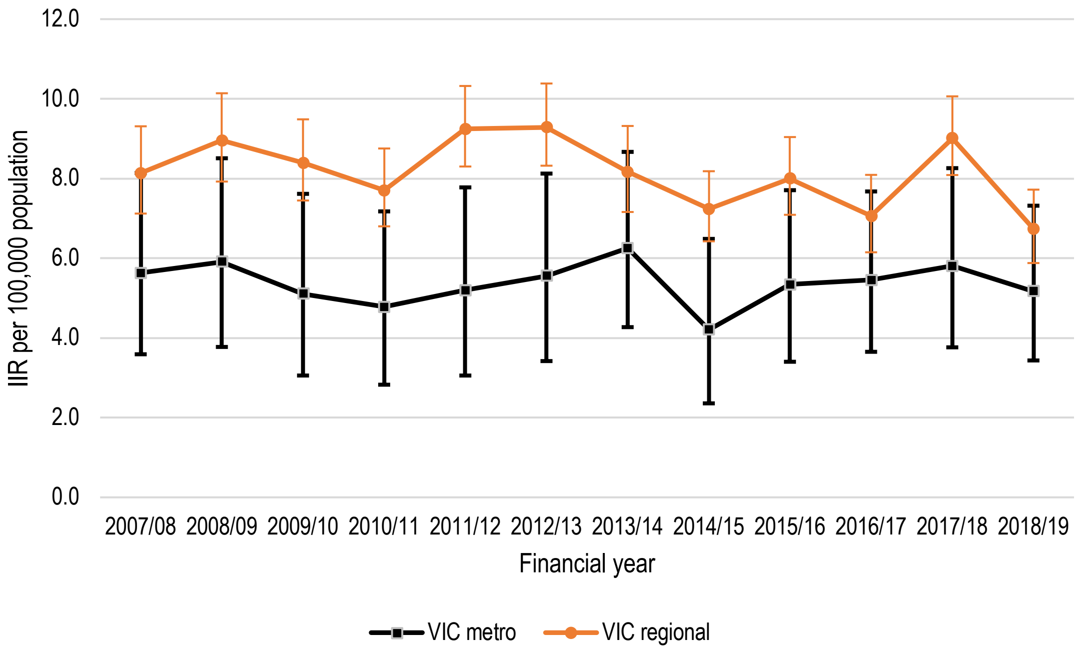

__Figure 89.__ Annual IIR per 100,000 male population aged from 5 to 80 years for NCRPP claims in Victoria (2007/08 – 2018/19).

Figure 90 shows the IIR for metro (n = 318) and regional (n = 42) Western Australia (WA). The average IIR for metro WA was 2.8 per 100,000 population (95% CI 1.9 – 4.1) and lower in regional areas, 1.3 per 100,000 population (95% CI 0.4 – 3.5).

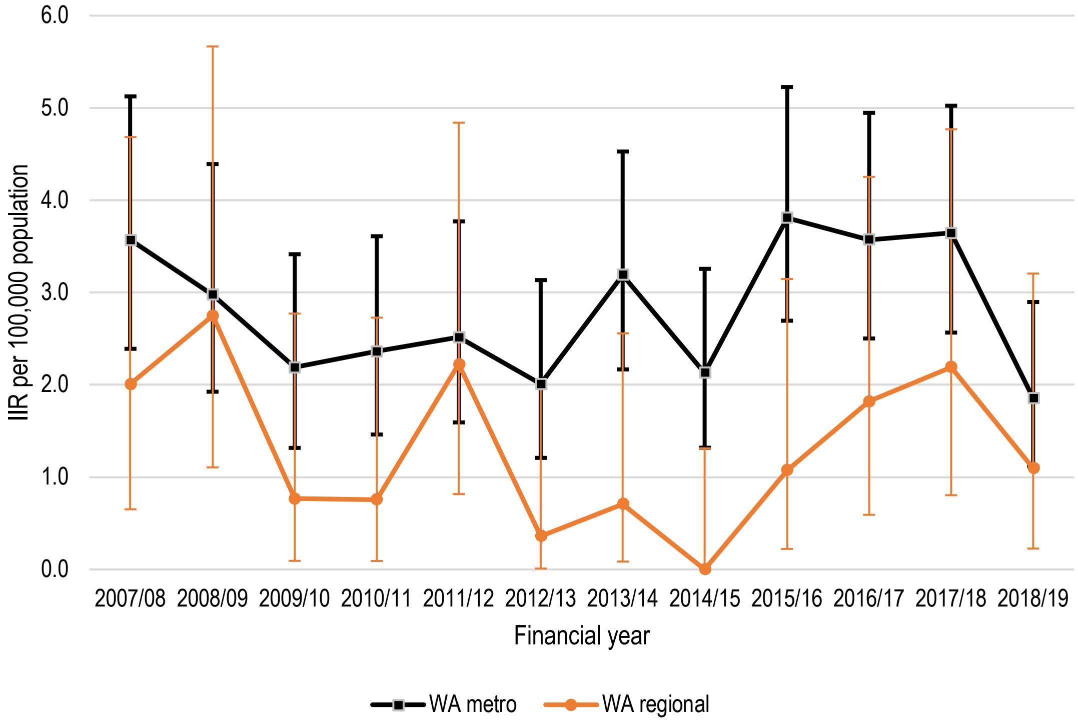

Figure 90. *Annual IIR per 100,000 male population aged from 5 to 80 years for NCRPP claims in WA (2007/08 – 2018/19).*

9.4.3 Injury nature by activity

Figure 91 shows the proportions of injury nature for males. Fractures (n = 1,889, 37.2%), followed by sprains and strains (n = 1,335, 26.3%) were the two most common injury natures.

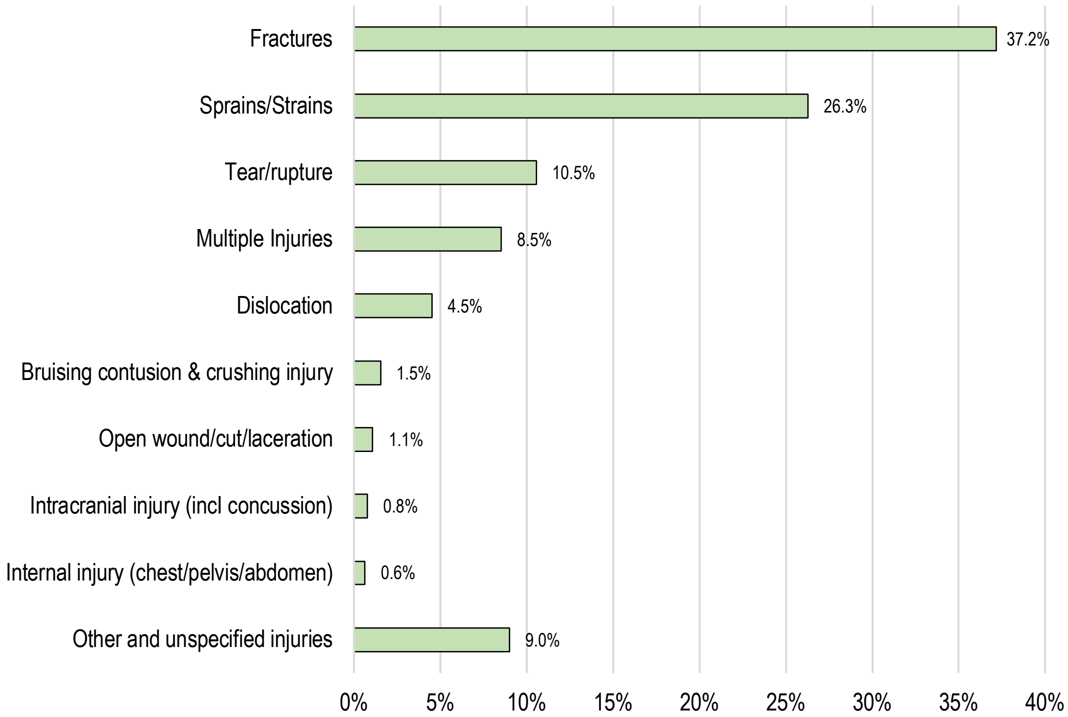

Figure 91. *Proportion of NCRPP claims for males by injury nature (n = 5,083) (2007/08 – 2018/19).*

Table 104 shows the proportions of injury nature for males by activity (batting, bowling, fielding and wicket keeping). For batting, fielding and wicket keeping, fractures were the most common injury nature, with wicket keeping having the highest proportion of fractures (55.0%, 95% CI 49.5% - 60.4%). Sprains or strains was the second most common injury nature and the most common for the activity of bowling (39.1%, 95% CI 36.1% - 42.2%).

Tear/ruptures were most common with the activity of batting (15.3%, 95% CI 13.5% - 17.3%). Dislocations were similar for fielding (5.1%, 95% CI 4.2% - 6.2%) and batting (4.9%, 95% CI 3.9% - 6.2%) and multiple injuries were most common with the activity of wicket keeping (10.3%, 95% CI 10.4% - 17.1%).

Rarer injury types, such as internal injury (chest, abdomen, pelvis), occurred more commonly in batting (0.9%, 95% CI 0.5% - 1.6%) and intracranial injuries were of similar proportions for batting (0.8%, 95% CI 0.5% - 1.5%) and fielding (0.8%, 95% CI 0.5% - 1.3%).

9.4.4 Injury location by activity

Overall, the lower limb was the most commonly injured body region (39.6%), followed by the upper limb (37.0%) and head, face and neck (16.0%) (Table 105). Batting had the highest proportion of lower limb injuries (52.8%, 95% CI 50.1% - 55.4%), closely followed by bowling

(49.0%, 95% CI 45.9% - 52.2%). The upper limb was proportionally the most common injured body region in fielding (51.5%, 95% CI 49.2% - 53.7%) followed by wicket keeping (50.9%, 95% CI 45.5% - 56.4%). The head, face and neck was proportionally the most common injured body region during wicket keeping (31.3%, 95% CI 26.4% - 36.5%), significantly more so than in batting (20.0%, 95% CI 17.9% - 22.2%). However, batting (n = 269) and fielding (n = 267) had far greater numbers of head, face and neck injuries than did wicket keeping (n = 100). Trunk and pelvis injuries were significantly more common when bowling (14.3%, 95% CI 12.2% - 16.6%) than any other activity.

Table 106 shows the number and proportion of injuries by specific body parts. The hand, fingers and thumb were the most commonly injured specific body region (20.8%), followed by the knee (19.6%) and shoulder (11.4%). The hand, fingers and thumb were proportionally the most common injured specific body region injured whilst wicket keeping (43.4%) and fielding (29.6%). The knee was proportionally the most common injured specific body region injured in bowling (25.1%) and batting (23.8%). Injuries to the teeth were most common in fielding (n = 187, 10.1%), batting (n = 124, 9.2%) but proportionally the most common in wicket keeping (n = 76, 23.8%).

Table 104. Number and proportion of NCRPP claims for males by injury nature and activity at injury onset (batting, bowling, fielding, wicket keeping). Shaded values represent significantly larger proportions by nature. Bold values are the maximum values for each injury nature by activity (2007/08 – 2018/2019).

	Batting			Bowling			Fielding			Wicket keeping			Other/unknown		
Injury nature	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**
Bruising contusion & crushing injury	29	**2.2%**	(1.5% - 3.1%)	17	1.7%	(1.1% - 2.7%)	17	0.9%	(0.6% - 1.5%)	*	< 0.6%	(0.2% - 2.2%)	8	1.5%	(0.8% - 3.0%)
Dislocation	66	4.9%	(3.9% - 6.2%)	23	2.3%	(1.6% - 3.5%)	94	**5.1%**	(4.2% - 6.2%)	8	2.5%	(1.3% - 4.9%)	38	7.2%	(5.3% - 9.7%)
Fractures	444	33.0%	(30.5% - 35.5%)	279	28.2%	(25.5% - 31.1%)	804	43.5%	(41.2% - 45.7%)	176	**55.0%**	(49.5% - 60.4%)	169	32.1%	(28.2% - 36.2%)
Internal injury (chest pelvis abdomen)	12	**0.9%**	(0.5% - 1.6%)	7	0.7%	(0.3% - 1.5%)	11	0.6%	(0.3% - 1.1%)	0	0.0%	(0.0% - 1.2%)	*	< 0.6%	(0.0% - 1.1%)
Intracranial injury (incl concussion)	11	**0.8%**	(0.5% - 1.5%)	5	0.5%	(0.2% - 1.2%)	15	**0.8%**	(0.5% - 1.3%)	0	0.0%	(0.0% - 1.2%)	< 7	< 2.0%	(0.5% - 2.5%)
Multiple injuries	99	7.3%	(6.1% - 8.9%)	77	7.8%	(6.3% - 9.6%)	166	9.0%	(7.8% - 10.4%)	33	**10.3%**	(7.4% - 14.1%)	52	9.9%	(7.6% - 12.7%)
Open wound/cut/laceration	9	0.7%	(0.4% - 1.3%)	9	0.9%	(0.5% - 1.7%)	19	**1.0%**	(0.7% - 1.6%)	*	< 0.6%	(0.1% - 1.7%)	14	2.7%	(1.6% - 4.4%)
Sprains strains	366	27.2%	(24.9% - 29.6%)	387	**39.1%**	(36.1% - 42.2%)	424	22.9%	(21.1% - 24.9%)	44	13.8%	(10.4% - 18.0%)	105	19.9%	(16.7% - 23.5%)
Tear/rupture	206	**15.3%**	(13.5% - 17.3%)	117	11.8%	(10.0% - 14.0%)	134	7.2%	(6.1% - 8.5%)	15	4.7%	(2.9% - 7.6%)	62	11.8%	(9.3% - 14.8%)
Other/unknown	105	7.8%	(6.5% - 9.3%)	68	6.9%	(5.5% - 8.6%)	166	9.0%	(7.8% - 10.4%)	41	12.8%	(9.6% - 16.9%)	72	13.7%	(11.0% - 16.9%)
Total (n = 5,033)	**1,347**	**26.5%**		**989**	**19.4%**		**1,850**	**36.4%**		**320**	**6.3%**		**527**	**10.4%**	

* Values suppressed due to low counts. Shaded values represent significant difference to other values based on non-overlapping 95% CI.

Table 105. Number and proportion of NCRPP claims for males by broad body region and activity at injury onset (batting, bowling, fielding, wicket keeping). Shaded values represent significantly larger proportions by body region. Bold values are the maximum values for each body region by activity (2007/08 – 2018/2019).

	Batting			Bowling			Fielding			Wicket keeping				
	n	**%**	**95% CI**	**N**	**%**	**95% CI**	**N**	**%**	**95% CI**	**N**	**%**	**95% CI**	**Total**	**%**
Head, face and neck	269	20.0%	(17.9% - 22.2%)	83	8.4%	(6.8% - 10.3%)	267	14.4%	(12.9% - 16.1%)	100	**31.3%**	(26.4% - 36.5%)	719	16.0%
Upper limb	291	21.6%	(19.5% - 23.9%)	261	26.4%	(23.7% - 29.2%)	952	**51.5%**	(49.2% - 53.7%)	163	50.9%	(45.5% - 56.4%)	1,667	37.0%
Trunk and pelvis	41	3.0%	(2.3% - 4.1%)	141	**14.3%**	(12.2% - 16.6%)	52	2.8%	(2.1% - 3.7%)	6	1.9%	(0.9% - 4.0%)	240	5.3%
Lower limb	711	**52.8%**	(50.1% - 55.4%)	485	49.0%	(45.9% - 52.2%)	542	29.3%	(27.3% - 31.4%)	47	14.7%	(11.2% - 19.0%)	1,785	39.6%
Multiple locations	15	**1.1%**	(0.7% - 1.8%)	6	0.6%	(0.3% - 1.3%)	11	0.6%	(0.3% - 1.1%)	*	< 0.7%	(0.2% - 2.2%)	34	0.8%
Other/unknown	20	1.5%	(1.0% - 2.3%)	13	1.3%	(0.8% - 2.2%)	26	1.4%	(1.0% - 2.1%)	*	<0.7%	(0.2% - 2.2%)	61	1.4%
Total (n = 4506)	**1,347**			**989**			**1,850**			**320**			**4,506**	

* Values suppressed due to low counts. Shaded values represent significant difference to other values based on non-overlapping 95% CI.

__Table 106.__ Number and proportion of NCRPP claims for males by specific body location and activity of injury onset (batting, bowling, fielding, wicket keeping). Bold items in the Total column represent top three specific body locations injured (2007/08 – 2018/2019).

	Batting		Bowling		Fielding		Wicket keeping			
Body Location	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**Total**	**%**
Abdomen	*	< 0.4%	*	< 0.4%	4	0.2%	-	0.0%	8	0.2%
Achilles tendon	131	9.7%	15	1.5%	19	1.0%	*	< 0.4%	~170	~4.0%
Ankle	58	4.3%	85	8.6%	113	6.1%	6	1.9%	262	5.8%
Back/spine - upper or lower	32	2.4%	127	12.8%	40	2.2%	6	1.9%	205	4.5%
Brain	-	0.0%	*	< 0.4%	-	0.0%	-	0.0%	*	-
Chest	5	0.4%	6	0.6%	7	0.4%	-	0.0%	18	0.4%
Circulatory system in general	*	< 0.4%	-	0.0%	-	0.0%	-	0.0%	*	-
Ear	*	< 0.4%	-	0.0%	-	0.0%	-	0.0%	*	-
Elbow	7	0.5%	9	0.9%	9	0.5%	4	1.3%	29	0.6%
Eye	31	2.3%	5	0.5%	18	1.0%	6	1.9%	60	1.3%
Foot & Toes	36	2.7%	30	3.0%	15	0.8%	*	< 0.4%	83	1.8%
Forearm	14	1.0%	*	< 0.4%	11	0.6%	-	0.0%	28	0.6%
Genitourinary system in general	4	0.3%	*	< 0.4%	*	< 0.4%	-	0.0%	7	0.2%
Hand Fingers and Thumb	108	8.0%	141	14.3%	547	29.6%	139	**43.4%**	**935**	**20.8%**
Head/skull/cranium/	79	5.9%	18	1.8%	36	1.9%	*	< 0.4%	136	3.0%
Hip/Pelvic region	24	1.8%	34	3.4%	21	1.1%	5	1.6%	84	1.9%
Knee	321	23.8%	248	25.1%	289	15.6%	27	8.4%	**885**	**19.6%**
Lower Leg	81	6.0%	33	3.3%	44	2.4%	4	1.3%	162	3.6%
Mouth	7	0.5%	5	0.5%	9	0.5%	5	1.6%	26	0.6%
Multiple Locations	15	1.1%	6	0.6%	11	0.6%	*	< 0.4%	34	0.8%
Neck	5	0.4%	*	< 0.4%	4	0.2%	-	0.0%	*	<0.4%
Nose	21	1.6%	5	0.5%	13	0.7%	10	3.1%	49	1.1%
Reproductive system in general	-	0.0%	-	0.0%	*	< 0.4%	-	0.0%	*	-
Shoulder	73	5.4%	83	8.4%	342	18.5%	17	5.3%	**515**	**11.4%**
Tooth/Teeth	124	9.2%	48	4.9%	187	10.1%	76	23.8%	435	9.7%
Trunk - multiple or unspecified locations	*	< 0.4%	7	0.7%	*	< 0.4%	-	0.0%	< 10	<0.4%
Unspecified locations	14	1.0%	12	1.2%	23	1.2%	*	< 0.4%	~ 50	~1.0%
Upper Arm	67	5.0%	17	1.7%	20	1.1%	*	< 0.4%	105	2.3%
Upper Leg	60	4.5%	40	4.0%	41	2.2%	*	< 0.4%	143	3.2%
Wrist	22	1.6%	8	0.8%	23	1.2%	*	< 0.4%	55	1.2%
Total	**1,347**		**989**		**1,850**		**320**		**4,506**	

5-10%	10-20%	20-30%	**40-50%**

* Values suppressed due to low counts.

9.4.5 Top six injury natures by specific body location and activity

Table 107 shows the number and proportions of the top six injury natures and the most common specific body locations affected by cricket activity.

Fractures most commonly occurred to the hands, fingers and thumb (40.0%), followed by the teeth (16.7%). Fielding accounted for 52.1% of all hand, fingers and thumb fractures, 36.5% of all teeth fractures, and 67.9% of all shoulder fractures. Batting accounted for 67.5% of knee fractures.

Sprains and strains were most common in the knee (29.7%), followed by the shoulder (14.6%). Bowling and fielding accounted for n = 131 (33.0%) each of the knee sprains and strains, while fielding accounted for 60.0% of the shoulder sprains and strains. Nearly half of the back sprains and strains occurred with bowling (45.7%) and batting accounted for 75.8% of Achilles tendon sprains and strains.

Table 107. *Number and proportions of NCRPP claims for males with the top six injury natures and associated top four to five specific body locations by activity of injury onset (batting, bowling, fielding, wicket keeping) (2007/08 – 2018/2019).*

Nature *Body location*	Batting (n)	%	Bowling (n)	%	Fielding (n)	%	Wicket keeping (n)	%	Other/unknown (n)	%	Total	%
Fractures	**444**		**279**		**804**		**176**		**186**		**1,889**	
Hand Fingers and Thumb	91	20.5%	101	36.2%	393	48.9%	94	53.4%	76	40.9%	755	40.0%
Tooth/Teeth	89	20.0%	37	13.3%	115	14.3%	54	30.7%	20	10.8%	315	16.7%
Shoulder	22	5.0%	12	4.3%	112	13.9%	4	2.3%	15	8.1%	165	8.7%
Knee	79	17.8%	10	3.6%	22	2.7%	< 4	< 1.0%	5	2.7%	117	6.2%
Ankle	10	2.3%	16	5.7%	40	5.0%	< 4	< 1.0%	8	4.3%	75	4.0%
Sprains Strains	**366**		**387**		**424**		**44**		**114**		**1,335**	
Knee	89	24.3%	131	33.9%	131	30.9%	17	38.6%	29	15.6%	397	29.7%
Shoulder	17	4.6%	38	9.8%	117	27.6%	6	13.6%	17	9.1%	195	14.6%
Ankle	21	5.7%	46	11.9%	44	10.4%	4	9.1%	21	11.3%	136	10.2%
Back/spine – upper/lower	23	6.3%	58	15.0%	28	6.6%	5	11.4%	13	7.0%	127	9.5%
Upper Leg	38	10.4%	30	7.8%	31	7.3%	< 4	< 5.0%	8	4.3%	109	8.2%
Achilles tendon	75	20.5%	9	2.3%	12	2.8%	-	0.0%	< 4	< 2.0%	99	7.4%
Tear/rupture	**206**		**117**		**134**		**15**		**64**		**536**	
Knee	60	29.1%	65	55.6%	67	50.0%	5	33.3%	24	12.9%	221	41.2%
Achilles tendon	51	24.8%	5	4.3%	6	4.5%	< 4	< 7.0%	7	3.8%	70	13.1%
Shoulder	5	2.4%	12	10.3%	18	13.4%	3	20.0%	11	5.9%	49	9.1%
Ankle	16	7.8%	6	5.1%	12	9.0%	< 4	< 7.0%	5	2.7%	40	7.5%
Lower Leg	18	8.7%	< 4	< 3.0%	< 4	< 2.0%	< 4	< 14.0%	< 4	< 2.0%	28	5.2%
Multiple Injuries	**99**		**77**		**166**		**33**		**58**		**433**	
Hand Fingers and Thumb	< 4	< 3.0%	17	22.1%	71	42.8%	22	66.7%	12	6.5%	125	28.9%
Knee	30	30.3%	15	19.5%	29	17.5%	< 4	< 10.0%	11	5.9%	88	20.3%
Shoulder	4	4.0%	8	10.4%	24	14.5%	< 4	< 3.0%	4	2.2%	41	9.5%
Ankle	7	7.1%	11	14.3%	14	8.4%	-	0.0%	5	2.7%	37	8.5%
Other/Unspecified	**46**		**19**		**80**		**23**		**49**		**217**	
Tooth/Teeth	34	73.9%	9	47.4%	67	83.8%	19	82.6%	19	6.5%	148	68.2%

The knee was most commonly associated with the injury nature of tear/rupture (41.2%). Fielding (30.3%), bowling (29.4%) and batting (27.1%) were similarly implicated in the knee tear/rupture injuries. Batting accounted for 72.9% of Achilles tear/ruptures and 64.3% of lower leg tear/ruptures. Fielding accounted for 56.8% of multiple injuries occurring to the hands, fingers and thumb and also 45.3% of other and unspecified injuries to the teeth.

9.4.6 Injury mechanism by activity

Because there was low agreement between the author of this thesis and colleagues (MM and LF) when classifying injury mechanism to provide accurate quantitative data, a more qualitative description is provided to give insight to the injury mechanisms reported for each cricket-related activity.

Batting

Acute overexertion was the most commonly reported injury mechanism for batting with an almost equal amount of these injuries deemed to be due to sudden changes in speed or sudden changes in direction respectively. Where sudden changes of speed were involved, the most common specific cricketing actions involved were setting off for a run followed by running between the wickets. For sudden changes of direction, playing a shot and running between the wickets were the two most common specific cricketing actions involved.

Being struck, hit or having contact with another object or person, was the second most common injury mechanism when batting. The vast majority of these were due to being hit by the ball. Contact with the ground was the second most common followed by contact with another person. The specific cricket activity within batting was found to be 'unknown' or 'unclear' for the majority of injuries where the ball was involved, but otherwise was associated with playing a shot. Where contact with the ground or with another person was involved, this predominantly occurred during running between wickets. The specific cause of contact with the ground when running between the wickets was found to be largely due to slip, trip or fall, followed by intentional dive.

From the description of event variable, there were 17 (1.2%) claims due to a failure of the helmet whilst batting. Twelve (71%) resulted in head and facial fractures. In seven (41%) cases the ball forced its way between the grill and the helmet peak, and in three cases (18%) the ball struck the batter under the grill. There were two cases where the grill had deflected enough to contact the player's face. The majority (82%) of these incidents occurred prior to 2014, a point in which helmet design standards were updated (41).

There were 93 (6.8%) claims of injury associated with the ball deflecting off the bat when playing a shot, representing 34.5% of all head, face and neck injuries for batters. The mean age for these injuries was 34.3 years (SD 10.4 years). Figure 92 shows that there has been an overall decline in these incidents. However, since 2010/11, there has still been on average six (n = 6) claims per year for this mechanism of injury. The majority of the incidents resulted in fractures (n = 55, 59%), and most of those were to the teeth (n = 34, 62%) and head/skull/cranium (n = 13, 24%).

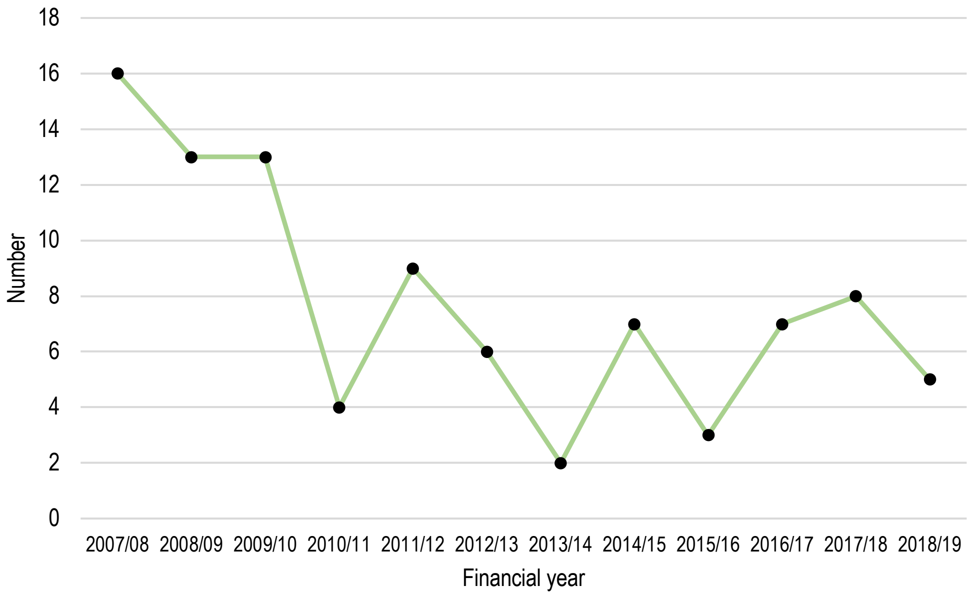

Figure 92. *Number of injuries to the head, face and neck due to impact from the ball deflecting off the edge of the bat whilst batting (2007/08 – 2018/2019).*

Bowling

Acute overexertion was the most commonly stated injury mechanism for bowling. A sudden change in direction was the most common agency given and occurred largely during delivery and to a lesser extent in the follow through. A sudden change in speed was the next most common agency stated, which again largely occurred during delivery and to a lesser extent in the run up.

Being struck, hit or having contact with another person or object was the second most common injury mechanism for bowling. The ball accounted for the vast majority of these injuries, most often in the follow through and predominantly in the act of trying to catch the ball (caught and bowled).

Fielding

Being struck, hit or having contact with another object or person, was the most commonly reported injury mechanism for fielding, and also the most common for all cricket activities. The ball was the most commonly stated agency of injury and catching was the predominant specific fielding activity, followed by attempting to field the ball. The ground was the next most common agency given, with attempting to field the ball followed by catching as the two most common fielding specific activities. Where the ground was involved when attempting to field the ball, by far the most common causative factor was an intentional dive, followed by fall, slip, or trip and to lesser extent sliding.

Acute overexertion was the second most common injury mechanism for fielding reported. A sudden change in direction whilst attempting to field the ball, followed next by catching were the leading agencies stated that were specific to the activity of fielding. A sudden change in speed was less commonly stated and involved a roughly equal proportion of fielding activities such as throwing and chasing the ball.

There were 14 (0.8%) incidents where fielding in close was identified from the injury description variable. Thirteen (93%) of these injuries resulted in head or facial injury, with at least six (43%) being fractures.

Wicket keeping

The major injury mechanism when wicket keeping was reported as being struck, hit or having contact with another object or person, where the ball was the predominant agency and mostly occurred when catching. Acute overexertion injuries occurred to a lesser extent than they did during other cricket activities, but was associated with sudden changes of direction when attempting to field or catch the ball.

There were 23 injuries associated with the ball deflecting off the batter's bat, representing 23% of the head/face and neck injuries. The majority of injuries were fractures (n = 14, 61%) and most of those were to the teeth (n = 10, 71%).

Umpiring

Injuries to umpires mostly occurred due to them being struck, hit or having contact with another object or person, where the ball was predominantly the agency. Acute overexertion, where a sudden change in direction occurred was a less commonly reported occurrence and tended to involve an umpire moving to avoid collision with a player or in moving to get into a position to adjudicate a run out.

9.4.7 Activity of injury onset by age group

Figure 93 shows the proportion of injury claims by activity of injury onset and age groups. Fielding is the activity with the highest proportion of injury claims by age group up to the 40-44 years old age group. The 5-9 years old age group has the highest proportion and 62% (n = 8/13) were fractures with 50% of those being to the teeth/tooth. Another spike in fielding injury proportion occurred in the 55-59 years old age group with 38% (n = 10/26) were fractures to the hand/finger/thumb. Bowling injury claims proportions peaked in the 15-19 years old age group with 19% (n = 34/175) associated with fractures to the back/spine (upper/lower) body region. Bowling injury claims decrease then decrease with increasing age group until a spike in the 60-64 years old age group, driven by sprains/strains (n = 7/12) with no majority body region associated. Batting injury claim proportions increase with age groups with 63% (n = 54/86) of the claims in the 50-54 years old age group being associated with sprains/strains or rupture/tear. Forty-eight percent of those injuries were to the Achilles tendon or lower leg.

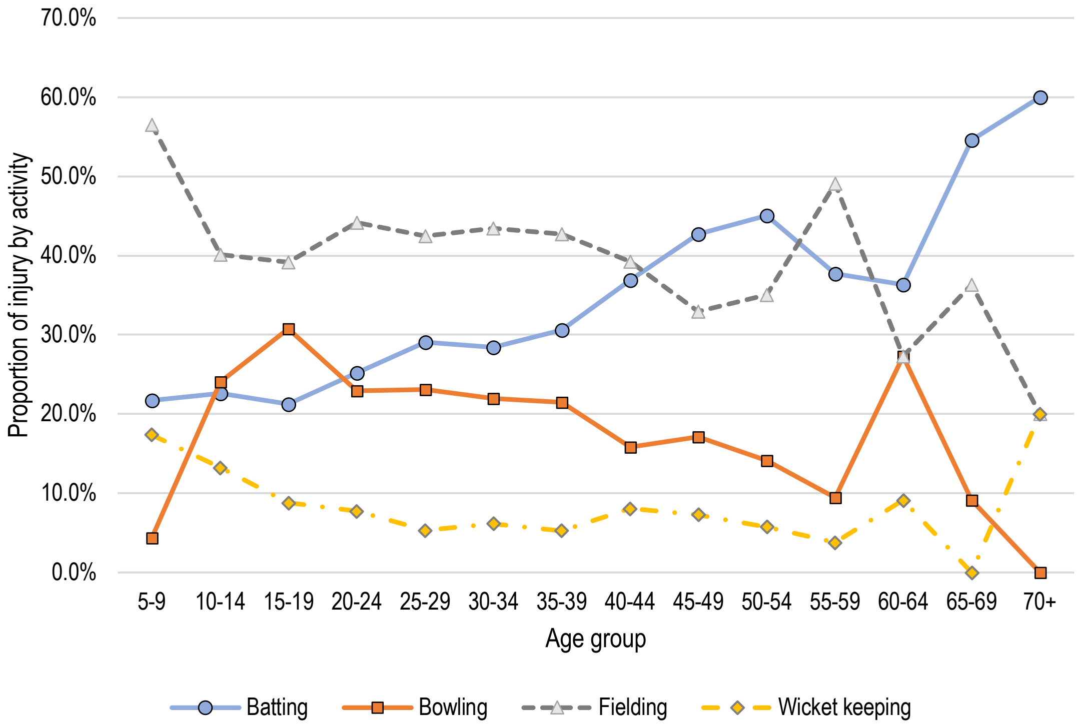

Figure 93. *Proportion of claims by activity of injury onset and age group for NCRPP claims (2007/08 - 2018/19).*

9.4.8 Injury setting and profile by time of year

There were n = 4,198 (82.6%) claims associated with match injury, n = 725 (14.3%) claims associated with training injury and n = 77 (1.5%) claims associated with warm up/down injuries. The proportion of training injuries were much higher than playing in the three months (July, August, and September) typically preceding the start of the cricket season in Australia.

Table 108 shows the relative numbers and proportions of claims pertaining to the cricket-related activity of onset. Bowling injuries were overrepresented in the months preceding a typical season start, which corresponded to trunk and back injuries in bowlers also being overrepresented than the overall injury proportions in the same months (August 5.7%, September 9.9%). Trunk and back injury claims were also slightly higher proportionally during the months of February (17.0%) and March (11.8%), compared to the overall injury claims proportion for those months (15.5% and 9.9% respectively).

Head, face and neck injury claims were proportionally higher than overall injury claims in the month of February (19.0% c/w 15.5%). This coincided with the peak of intracranial injuries (33%), of which 46% were associated with batting and 31% with fielding.

Table 108. Number and proportion of NCRPP claims for males by month of incident by activity of injury onset ((batting, bowling, fielding, wicket keeping).

	Overall (n)	%	Batting (n)	%	Bowling (n)	%	Fielding (n)	%	Wicket Keeping (n)	%
January	838	16.5%	249	**18.5%**	164	**16.6%**	286	15.5%	55	**17.2%**
February	790	15.5%	226	**16.8%**	145	14.7%	289	**15.6%**	46	14.4%
March	503	9.9%	126	9.4%	104	**10.5%**	189	**10.2%**	34	**10.6%**
April	25	0.5%	9	**0.7%**	5	**0.5%**	8	0.4%	< 4	< 0.5%
May	46	0.9%	16	**1.2%**	9	**0.9%**	16	0.9%	< 4	**1.0%**
June	26	0.5%	4	0.3%	4	0.4%	10	**0.5%**	7	**2.2%**
July	54	1.1%	11	0.8%	10	1.0%	22	**1.2%**	< 4	< 1.0%
August	97	1.9%	26	1.9%	28	**2.8%***	26	1.4%	< 4	< 1.0%
September	248	4.9%	65	4.8%	66	**6.7%***	73	3.9%	13	4.1%
October	940	18.5%	220	16.3%	179	18.1%	380	**20.5%**	56	17.5%
November	921	18.1%	240	17.8%	179	18.1%	327	17.7%	66	**20.6%**
December	595	11.7%	155	11.5%	96	9.7%	224	**12.1%**	33	10.3%
Total	**5083**		**1347**		**989**		**1850**		**320**	

Note: Bold numbers represent proportions greater than overall proportions and numbers marked with * represent values > 1.3 times the overall proportion.

9.4.9 Injury severity/burden

Overall, 1,305 male claimants applied successfully for loss of income, which amounts to an average annual proportion of 25.7% of claims (95% CI 24.5% - 26.9%). Figure 94 shows, for males, the proportion of loss of income claims per year along with the annual number of claims. The three-year moving average for annual proportion of LOI claims dropped from 26.0% to 22.2%.

The average number of days between an injury occurrence and a claim being made was 87 days. There were 89 claims that surpassed the nominated 270 day lodgement period, 16 of which still received LOI payments, indicative of the discretionary nature of the trust aspect of the scheme. When only claims that were lodged within the 270 day time limit were included, the average days to claim was 78 days. When LOI claims were examined, the average days to claim dropped to 61 days (57 days for claims within the 270 day limit).

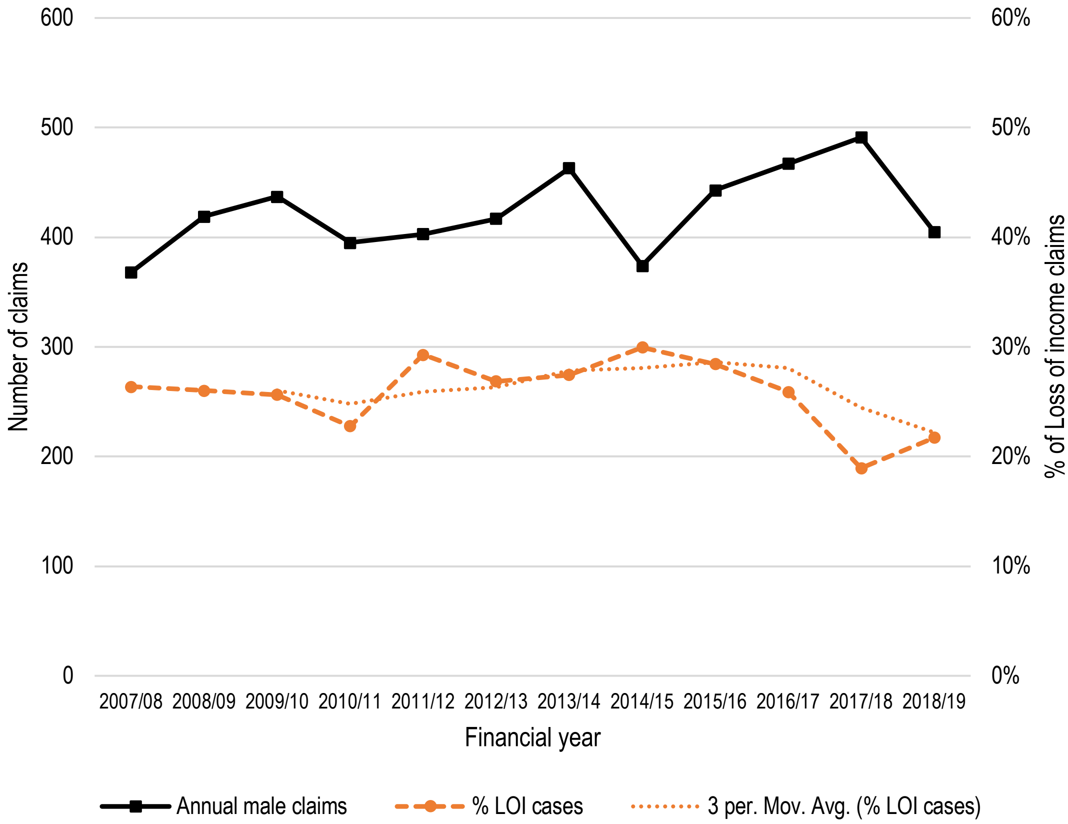

Figure 94. *Annual number of NCRPP claims for males and proportion of loss of income (LOI) claims with three year rolling average (2007/08 – 2018/19).*

The top four age groups for males requiring loss of income payments were the 20 to 24 (n = 283), 25 to 29 (n = 227), 30 to 34 (n = 202) and 35 to 39 (n = 156) years old age groups, with 66% of cases occurring in these age groups.

Figure 95 shows the average number of weeks of loss of income (LOI) paid by age group for males. The 60 to 64 years old age group incurred the highest average number of weeks LOI paid (15.8 weeks). The average number of weeks LOI paid generally increased with increasing age up to the 45 to 49 years old age group before reducing, notwithstanding the 60 to 64 years old outlier.

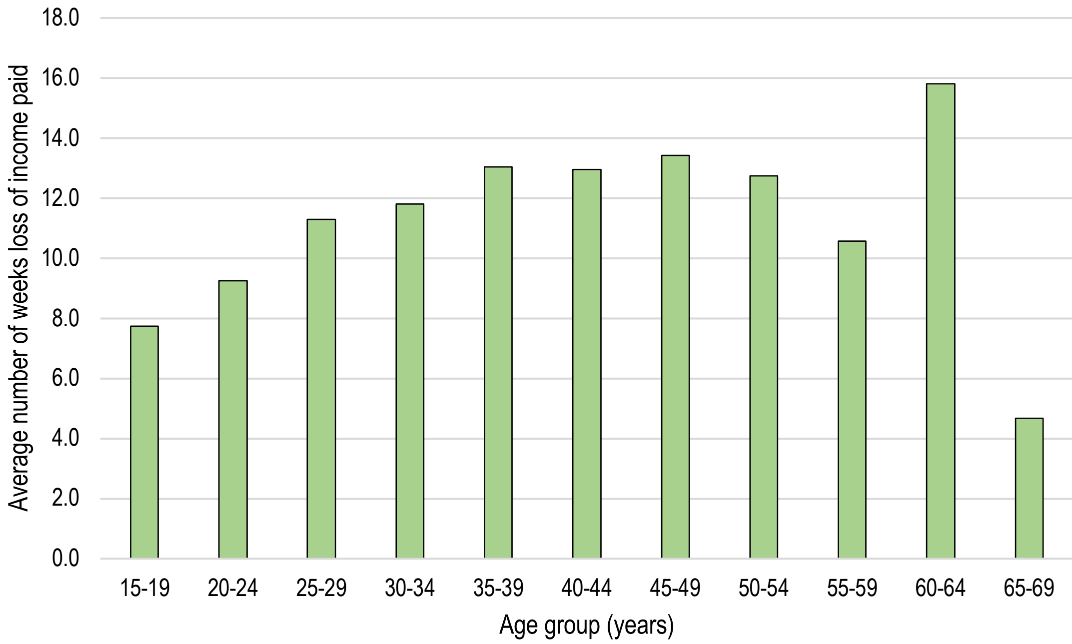

Figure 95. *Average number of NCRPP claims for males (n = 1,305) resulting in LOI claims by age group (2007/08 – 2018/19).*

The distribution of injury burden by age group is shown in Figure 96. The 20 to 24 years old age group had the largest net injury burden, closely followed by the 25 to 29 years old age group.

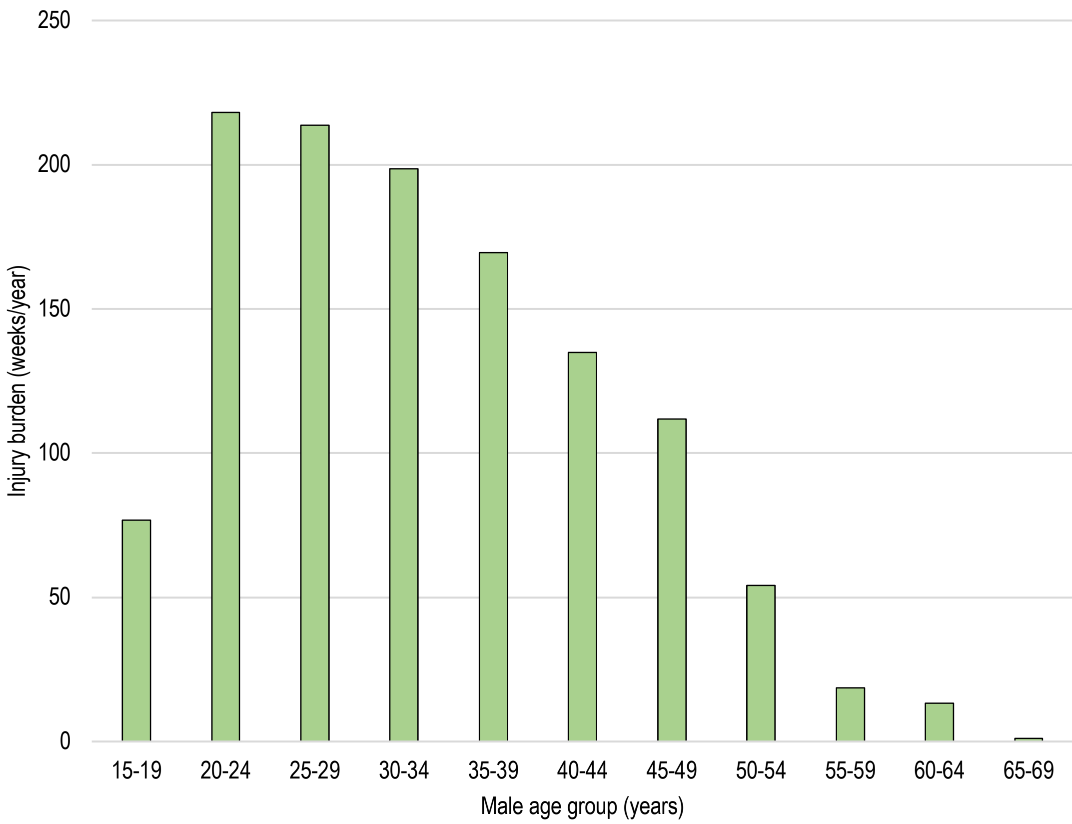

Figure 96. *Net injury burden based on NCRPP claims for males by age group (2007/08 – 2018/19).*

There were 1,155 (23%) claims for LOI that could be identified with an activity of either batting, bowling, fielding or wicket keeping, in males. Table 109 shows the breakdown by activity. Fielding and wicket keeping activities made up almost 50% of the claims for LOI and fielding registered the highest injury burden measure of 469.0 weeks LOI per year. Bowling had the highest average weeks LOI per injury claim.

Table 109. *Number of NCRPP claims for males resulting in loss of income (LOI) claims by activity, total weeks, average weeks per claims and injury burden (weeks/year) (2007/08 – 2018/19).*

Activity	LOI claims	LOI claims (%)	Weeks LOI	Weeks LOI (%)	Average weeks LOI per claim	Injury burden (Weeks/year)
Fielding	510	44.2%	5,628	42.6%	11.0	469.0
Batting	377	32.6%	4,411	33.4%	11.7	367.6
Bowling	205	17.7%	2,524	19.1%	12.3	210.3
Wicket keeping	63	5.5%	648	4.9%	10.3	54.0
Total	**1,155**		**13,211**		**11.4**	**1,100.9**

Table 110 shows the number of LOI claims, total weeks LOI, average weeks LOI per claim and the total burden as measured by weeks lost per year, for each injury nature. Fractures were the most common injury nature receiving LOI benefits (n = 537) and had the highest burden on average of 431.3 weeks per year lost work time. Internal injuries to the chest, pelvis or abdomen recorded the highest average weeks lost per claim (20.1), but had a low average annual incidence (< 1 claim per year), compared to fractures (44.8 claims per year). Tear/rupture recorded the second highest average weeks LOI per claim of 14.6.

Table 110. *Number of NCRPP claims for males resulting in loss of income (LOI), total weeks, average weeks per claim and injury burden (weeks/year) by injury nature (2007/08 – 2018/19).*

Injury nature	LOI claims	LOI claims (%)	Weeks LOI	Weeks LOI (%)	Average weeks LOI per claim	Injury burden (Weeks/year)
Fractures	537	46.5%	5,176	39.2%	9.6	431.3
Sprains strains	243	21.0%	2,943	22.3%	12.1	245.3
Tear/rupture	146	12.6%	2,132	16.1%	14.6	177.7
Multiple injuries	117	10.1%	1,572	11.9%	13.4	131.0
Dislocation	50	4.3%	647	4.9%	12.9	53.9
Other/unknown	30	2.6%	393	3.0%	13.1	32.8
Internal injury [1]	9	0.8%	181	1.4%	20.1	15.1
Bruising, contusion & crushing	11	1.0%	103	0.8%	9.4	8.6
Intracranial injury [2]	6	0.5%	43	0.3%	7.2	3.6
Open wound/cut/ laceration	6	0.5%	21	0.2%	3.5	1.8
Total	**1,155**		**13,211**		**11.4**	**1,100.9**

[1] Chest Pelvis Abdomen, [2] including concussion

Table 111 shows the top five specific body locations and their LOI claims, total weeks LOI, average weeks per claim and burden. Injury to the knee had the highest burden (278.2 weeks/year). The hands, fingers and thumb had the highest number of LOI claims (n = 326), but the lowest average weeks LOI per claim (8.0 weeks/claim). The shoulder and Achilles tendon had the highest average weeks LOI per claim (15.1 weeks/claim each).

Table 111. *Number of NCRPP claims for males resulting in loss of income (LOI) claims, total weeks, average weeks per claim and injury burden (weeks/year) by top five body locations (n = 887 claims) (2007/08 – 2018/19).*

Body location	LOI claims	LOI claims (%)	Weeks LOI	Weeks LOI (%)	Average weeks LOI per claim	Injury burden (Weeks/year)
Knee	252	28.4%	3,338	32.6%	13.2	278.2
Hand/fingers/thumb	326	36.8%	2,614	25.5%	8.0	217.8
Shoulder	145	16.3%	2,186	21.3%	15.1	182.2
Achilles tendon	81	9.1%	1,225	12.0%	15.1	102.1
Ankle	83	9.4%	870	8.5%	10.5	72.5
Sub Total	**887**		**10,233**			

Table 112 shows the average weeks LOI and burden by injury nature and cricket activity. Fielding (216.0 weeks/year) and batting (127.8 weeks/year) made up 80% of the injury burden for the hands, fingers and thumb. Batting (88.2 weeks/year) and fielding (84.4 weeks/year) also made up 70% of the injury burden for sprains and strains and similarly for tear/rupture. Internal injuries (chest, pelvis, abdomen) occurring in batting had the highest average weeks LOI per claim (27.0 weeks), followed by tear/rupture injuries in bowlers (18.0 weeks). The highest injury burden for wicket keepers was due to fractures (27.2 weeks/year) and for bowling it was sprains and strains (63.8 weeks/year).

Table 112. *Number of NCRPP claims for males resulting in loss of income (LOI), average weeks per claim, burden (weeks/year) by injury nature for each cricket activity (2007/08 – 2018/19).*

Injury nature (n)	Batting		Bowling		Fielding		Wicket keeping		Total	
	Average weeks LOI	Burden (weeks/year)	Average weeks LOI	Burden (weeks/year)	Average weeks LOI	Burden (weeks/year)	Average weeks LOI	Burden (weeks/year)	Average weeks LOI	Burden (weeks/year)
Bruising contusion & crushing injury (11)	12.2	6.1	5.0	0.8	6.7	1.7	0.0	0.0	9.4	8.6
Dislocation (50)	12.5	17.8	7.0	2.9	15.0	32.4	5.0	0.8	12.9	53.9
Fractures (537)	10.8	127.8	9.8	60.4	9.1	216.0	9.1	27.2	9.6	431.3
Internal injury (9)	27.0	11.3	12.5	2.1	10.5	1.8	0.0	0.0	20.1	15.1
Intracranial injury (6)	6.8	2.8	0.0	0.0	9.0	0.8	0.0	0.0	7.2	3.6
Multiple injuries (117)	10.6	28.3	13.5	24.8	15.3	66.2	12.8	11.8	13.4	131.0
Sprains strains (243)	11.3	88.2	12.8	63.8	12.4	84.4	15.1	8.8	12.1	245.3
Tear/rupture (146)	13.7	74.3	18.0	50.9	13.6	49.8	10.3	2.6	14.6	177.7
Other/unknown (26)	12.6	9.4	8.3	2.1	16.3	14.9	9.3	2.3	13.3	28.8

Table 113 shows the top five specific body locations injured by injury nature and cricket activity. Hand, fingers and thumb fractures were proportionally the most common in all activities, with wicket keeping having the highest proportion within fractures (69%). Hands, fingers and thumb fractures occurring in fielding created the largest average injury burden within the injury nature of fractures. Knee fractures (25%) were of similar proportion to hands, fingers and thumb (29%) for batting. The highest proportion of shoulder fractures occurred in fielding (26%).

Sprains and strains to the knee were universally associated with the highest injury burden in all activities, with bowling having the highest injury burden (28.9 weeks/year). Shoulder injury burden due to sprains and strains was highest whilst fielding (38.2 weeks/year). Achilles tendon injury burden was highest for batting (40.9 weeks/year), however, bowling recorded an average weeks LOI almost twice that of batting (25.5 weeks, c/w 12.6 weeks for batting).

Tear/rupture injuries followed a similar pattern to sprains and strains, with the knee and Achilles tendon being the highest two injury burden body locations. Fielding injuries causing tear/rupture were most burdensome for fielders (31.3 weeks/year), closely followed by bowlers (28.0 weeks/year). The injury burden for shoulder tear/rupture was larger in the bowling activity. The pattern of injury burden and average weeks LOI was similar for the Achilles tendon in batting and bowling as it was in sprains and strains.

The knee was the body location most commonly involved in multiple injuries, accounting for 36% of the injury burden for the injury category. Multiple injuries to the knee associated with batting accounted for the highest proportion of injury burden by activity when injured (51%).

Table 113. Top four injury nature NCRPP claims (n = 1,043, 90% of LOI claims) for males by most common specific body location for each cricket activity resulting in loss of income (LOI). Average weeks LOI per claim, injury burden (weeks/year) and total injury burden per injury and body location also shown (2007/08 – 2018/19).

Injury nature (n)	Batting		Bowling		Fielding		Wicket keeping		Total	
Body location (n)	Average weeks LOI	Injury burden (weeks/year)	Average weeks LOI	Injury burden (weeks/year)	Average weeks LOI	Injury burden (weeks/year)	Average weeks LOI	Injury burden (weeks/year)	Average weeks LOI	Injury burden (weeks/year)
Fractures (537)	**10.8**	**127.8**	**9.8**	**60.4**	**9.1**	**216.0**	**9.1**	**27.2**	**9.6**	**431.3**
Hand fingers, thumb (269)	9.6	36.8	7.4	26.7	7.6	96.3	8.3	18.7	8.0	178.4
Shoulder (60)	16.5	5.5	10.3	2.6	12.8	55.3	7.0	0.6	12.8	64.0
Knee (39)	15.2	31.8	10.0	2.5	14.7	12.3	3.0	0.3	14.4	46.8
Ankle (34)	13.2	5.5	14.8	7.4	7.8	14.3	12.0	1.0	9.9	28.2
Upper arm (23)	12.9	16.1	0.0	0.0	11.5	7.7	0.0	0.0	12.4	23.8
Sprains strains (243)	**11.3**	**88.2**	**12.8**	**63.8**	**12.4**	**84.4**	**15.1**	**8.8**	**12.1**	**245.3**
Knee (81)	11.9	23.8	13.3	28.9	8.1	18.8	17.0[1]	4.3	11.2	75.8
Achilles tendon (48)	12.6	40.9	25.5	8.5	18.8	7.8	0.0	0.0	14.3	57.3
Shoulder (37)	9.5	1.6	15.2	7.6	16.5	38.4	39.0[1]	3.3	16.5	50.8
Ankle (48)	9.4	3.9	11.4	8.6	9.1	6.8	4.0[1]	0.3	9.8	19.7
Upper arm (13)	12.9	10.8	8.3	2.1	0.0	0.0	0.0	0.0	11.8	12.8
Tear/rupture (146)	**13.7**	**74.3**	**18.0**	**50.9**	**13.6**	**49.8**	**10.3**	**2.6**	**14.6**	**177.7**
Knee (64)	12.2	20.3	18.7	28.0	15.0	31.3	16.0[1]	1.3	15.2	80.9
Achilles tendon (30)	16.2	32.3	28.7	7.2	14.3	3.6	0.0	0.0	17.2	43.1
Shoulder (9)	6.0	0.5	23.0	7.7	15.8	5.3	0.0	0.0	17.9	13.4
Ankle (10)	16.3	5.4	6.0	1.0	17.0	5.7	0.0	0.0	14.5	12.1
Upper arm (9)	14.0	8.2	10.5	1.8	0.0	0.0	0.0	0.0	13.2	9.9
Multiple injuries (117)	**10.6**	**28.3**	**13.5**	**24.8**	**15.3**	**66.2**	**12.8**	**11.8**	**13.4**	**131.0**
Knee (35)	12.2	14.3	23.0	9.6	17.8	20.8	12.0	2.0	16.0	46.6
Hand fingers, thumb (31)	3.0	0.3	7.3	3.7	6.8	9.6	15.1	8.8	8.6	22.3
Shoulder (13)	6.0	1.0	8.5	1.4	22.3	16.8	0.0	0.0	17.7	19.2
Ankle (12)	7.7	1.9	12.5	4.2	12.8	5.3	0.0	0.0	11.4	11.4

Legend* 10-20% 20-30% 30-40% 40-50% 50%+

* % of total injury burden by injury nature. [1] Relative Standard Error (RSE) > 25% - values should be used with caution.

Figure 97 is a graphical representation of the injury burden by injury nature. The mean injury burden contour (dashed line) represents the average weeks per year for all injury LOI claims. Fracture, sprains and strains, tear/rupture and multiple injuries all over-represented injury types.

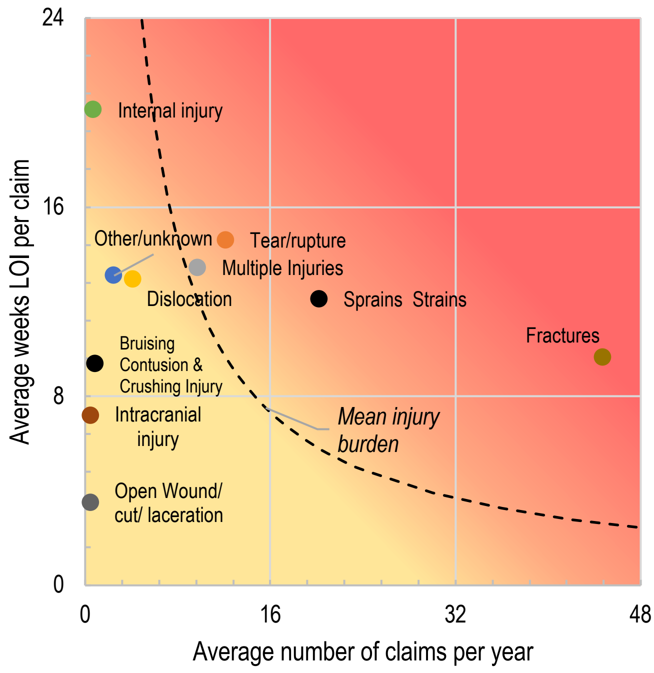

Figure 97. *Graphical representation of injury burden for male NCRPP claims by injury nature (2007/08 – 2018/19). Colour shading indicates conceptual increase in injury burden, with red indicating higher burden (not to scale).*

Figure 98 is a graphical representation of the injury burden by body location. The mean injury burden contour represents the average weeks per year for the top five body location injury LOI claims. The knee and hands, fingers and thumb are all over-represented.

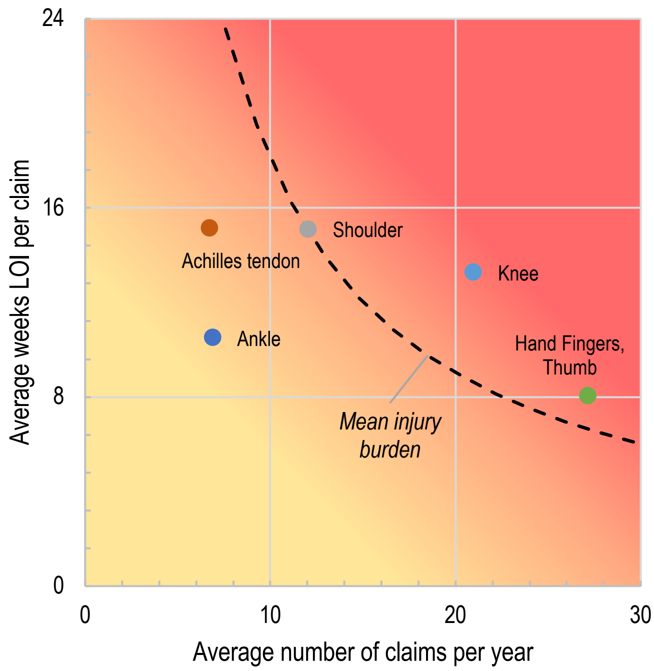

Figure 98. *Graphical representation of injury burden for male NCRPP claims for top five injured body locations (2007/08 – 2018/19). Colour shading indicates conceptual increase in injury burden, with red indicating higher burden (not to scale).*

Figure 99 is a graphical representation of the injury burden by cricket activity. The mean injury burden contour represents the average weeks per year for the all injury LOI claims. Batting and fielding are over-represented.

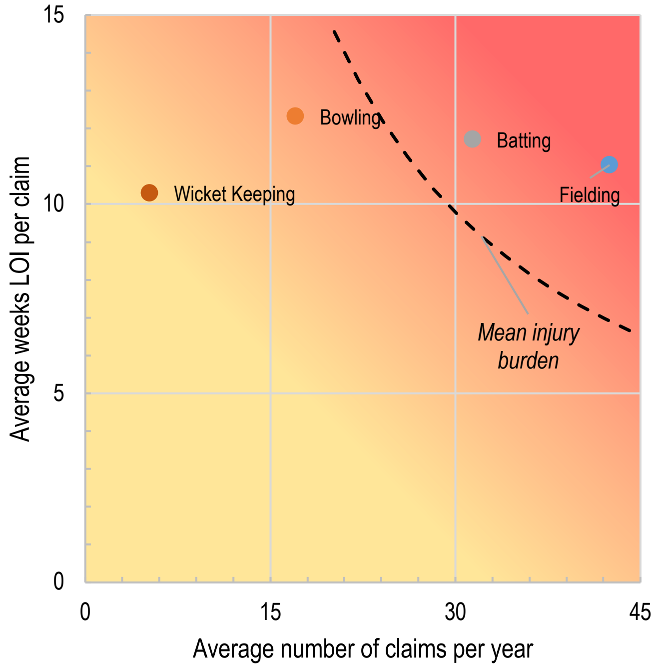

Figure 99. Graphical representation of injury burden for male NCRPP claims by activity of injury onset (2007/08 – 2018/19). Colour shading indicates conceptual increase in injury burden, with red indicating higher burden (not to scale).

Fatalities occurring in community level cricket

There were five fatalities associated with the playing of community level cricket during the time period investigated. The specific circumstances of the majority of fatalities were unable to be identified from the description of injury event. All events occurred to players with the majority involved in either batting or fielding. The injury nature was either recorded as not reported, multiple injuries or other and unspecified injuries.

9.5 Summary of key findings

Chapter 9 has examined the injuries associated with insurance claims under the NCRPP in Australia from 2007/08 to 2018/2019. The NCRPP scheme is the only repository in Australia that collects ongoing injury data in organised cricket. Presentation of the data in this thesis represents significant new research knowledge. Previous datasets investigated in Chapter 4 and Chapter 5 using hospital and ACC insurance claims data were based on estimates of organised cricket based primarily on the place of activity as being a place for sport or recreation. The information described in Chapter 9 provides a new insight into the injury profile of community cricketers throughout Australia in line with aim 1 and research question 1 of this thesis. Critically, Chapter 8 suggested there are some issues with the quality and completeness of the data analysed in Chapter 9. Thus, the following key injury findings are cautiously presented:

- There was a non-significant rise in annual cricket injury claims for males. The annual IIR per 100,000 population showed a slight decrease over time at 0.46% per year (95% CI -8.2% - 8.0%).
- Overall, the lower limb was the most commonly injured body region.
- Fielding was the activity resulting in the most injury claims.
- The lower limb was the most commonly injured body region in batters and bowlers, with the knee being the most common location.
- The upper limb was the most commonly injured body region in fielding and wicket keeping, with the hand/fingers/thumb being the most commonly injured location.
- Fractures was the most common injury nature overall (38%).
- Fielding, wicket keeping and batting were activities most likely associated with fracture type injuries. Sprains/strains were most commonly associated with bowling.
- Just over half of the fractures to the hand/fingers/thumb occurred during fielding.
- Sprain/strain and rupture/tear were the main injury natures occurring to the knee.
- Fractures and other unspecified injuries to the teeth were most common in claims associated with fielding.
- Acute overexertion, most commonly due to setting off for a run was the most common mechanism of injury for batters, followed by being struck by the ball.
- Fielding injuries occurred mostly due to being struck by the ball while attempting a catch.
- Acute overexertion, mostly during the delivery phase, was the most common mechanism of injury for bowlers.
- The majority of injuries occurred during matches (82%).
- On average, 26% of claims included a LOI claim.
- Injuries associated with batting, bowling, fielding and wicket keeping accounted for 1,100 weeks/year of lost work time.

- Fielding injury claims had the highest injury burden with 469 weeks/year LOI paid.
- The knee had the highest injury burden by body location at 278 weeks/year.
- Fractures to the hand/finger/thumb had the highest injury burden by nature and location at 178 weeks/year.
- There were five fatalities reported. Two of the fatalities appeared to be related to systemic health events, while the circumstances other the remaining three fatal events could not be identified from the description of injury event.

Chapter 10. Discussion

This chapter is divided into four parts. The first part summarises and discusses the outcomes of the research in regard to research question 1 and aim 1. The second part summarises and discusses the quality, completeness, validity and representativeness of an existing insurance system in line with research question 2 and aim 2. From there, the strengths and limitations of the thesis are discussed and future research directions are suggested.

10.1 Research question 1 and aim 1

The first research question of this thesis asked "What are the injuries reported in community level cricketers?" The aim was to understand the injury causes, trends and burden in community cricket. Four data sources and two approaches were used in addressing question 1: 1) Existing peer reviewed literature was systematically searched and summarised; 2) hospital data were investigated with a descriptive analysis; 3) public insurance claims data from NZ and; 4) Australia-wide private insurance claims data were also investigated with descriptive analysis. The quality of the data, via validity and completeness assessments, from hospital and insurance sources (items 2 to 4 above), were also investigated.

The specific findings relating to research question 1 and aim 1 are summarised and discussed below, addressing the following items, in order of:

- Injury prevalence
- Injury incidence rates
- Injury nature
- Injured body part/region
- Injury diagnosis (body part and nature)
- Activity and/or setting at injury onset
- Injury mechanism
- Injury severity/burden
- Other findings including injury trends, age, sex, time of year, geographic location and treatment provider factors in community level cricket injury.
- Quality of existing information
- Implications of the findings

10.1.1 Injury prevalence

In epidemiological terms, prevalence is a measure of the proportion of the population of interest who has the condition being investigated at a specific time point or period of time (217). The prevalence can be a good measure of the overall burden of a condition, e.g. cricket-related injury at the community level. However, prevalence is sensitive to methods of data collection, the injury definition used and population of interest (217).

Acute medical attention injuries in community cricket were most commonly derived from hospital data. The proportion of cricket-related cases varied depending on the country and the timeframe of data collection, making direct comparisons impractical. Within Australia, cricket-related ED presentations represented 5.5% of sports-related cases nationally over the 1989-1993 period (139). The study of Victorian hospital data in Chapter 4, found an overall period (2012 – 2015) prevalence of 2.6% (136). According to Cricket Australia, Victoria had 33% of registered participants in 2018/19 (personal correspondence, A. Hepburn, Cricket Australia), suggesting Victoria has a relatively good representation of the Australian cricket playing population. Given this assumption, the prevalence of cricket-related ED presentations in Australia has potentially halved over a 30 year period.

Cricket-related medical attention injuries were also examined using insurance claims data in NZ as part of two more general studies separated by around 20 years (104, 162). The prevalence of cricket-related injury in these studies increased from 4% (162) to 5% (104) (Table 19, Chapter 3). However, the latter study only looked at five sports, cricket included, and as such would likely have overestimated the relative prevalence of cricket-related injury.

Where cross-sectional research has been conducted on community cricket-related injury, there has been a wide range of injury prevalence reported, reflective of the varying injury definitions and specific populations studied. The two highest proportions of injury reported were in studies (187, 190) that used pain as an injury definition, rather than the more common time loss variations. Where adolescent bowler cohorts were investigated, studies tended to have higher proportions of injured participants than when all activities were investigated (185, 188). A surprising result was the relatively high proportion of participants injured in Sri Lankan schoolboy cricket matches (70%) (182). A junior level study in Australia, reported a much lower proportion in comparison (11%) and included match and training injuries (174). The large differences may be attributable to the self-reported nature of the data collection, different environmental conditions and/or organisational management in Sri Lanka, compared to Australia. An example of this was noted by Gamage et al (182), who reported that helmet wearing is not compulsory at junior levels at present in Sri Lanka. The laxity in helmet wearing policy in Sri Lanka may indicate a more general problem around protective equipment usage, possibly reflective of socio-economic issues.

10.1.2 Injury incidence rates

Whilst prevalence provides a picture of injury at a point or period in time, incidence is a measure of the new injuries occurring to a population at risk (218). Injury incidence rates, i.e. the number of new cases over specific period of time, have traditionally been used in sports injury research and with appropriate exposure measures can be a definitive measure of inference of injury trends (218, 219). Much like prevalence, incidence rates are dependent upon factors such as injury definitions and exposure measures (218).

The injury incidence rates reported in the studies reviewed in Chapter 3 were difficult to compare due to the variability in the exposure measures used, populations sampled and injury profile analysed. One study that surveyed sports-related injury in the La Trobe Valley region of Victoria, Australia in the mid-1990s, found cricket to have the highest injury rates by population and participation (191). Here the study used a definition of an injury as any injury regardless of whether it needed treatment or affected participation (191). Cricket also was reported to have the highest rate of significant injuries, defined as injury which required treatment or affected activities of daily living and/or sport performance (191). Typically, in other grey literature reports, cricket has ranked anywhere from 4th to 9th in terms of sport-related ED presentation numbers (Table 114) and more recently 14th in ED presentations when based on participation IIR for the whole of Victoria (136). The La Trobe Valley study (191) may indicate issues with regional participation differences, historically higher cricket-related injury or many more injuries occurring not serious enough to require acute medical attention.

There was some evidence that injury rates have been decreasing within the acute medically treated injury category. Hume et al (162) reporting 99 hospitalisations per 100,000 participants in the Dunedin region of NZ in the late 1980s and Walker et al (129) reporting 39 hospitalisations per 100,000 participants per year over the period from 2000 to 2005. Perera et al (86) reported an overall downward trend on cricket-related hospital treated injuries rates by participation in females in Victoria, Australia, over a 12 year period from 2002/03 to 2012/13. This appeared principally to do with a relatively large increase in participation (54% on 3 year rolling average) compared to injury hospitalisations (21% on 3 year rolling average) in female cricketers over the time period (86). Finch et al (169) reported a decreasing trend of concussion hospitalisations related to cricket in Victoria, Australia, between 2002/03 to 2010/11. In this case, cricket was the exception, with other sport-related concussion trending upwards over the same time period. It is possible that a mandatory helmet policy in junior cricketers, introduced in Australia in the early 2000s, may have contributed to the downward trend of concussions. From Chapter 4, the overall population-based annual IIR for hospital treated cricket-related injury in males aged between five and 64 years was found to be increasing, but not significantly.

Chapter 5 looked at cricket-related ACC insurance claims in NZ from 2008/09 to 2018/19. There was an average of 5,597 successful claims for males per year and 521 per year for females aged between 5 and 64 years. The overall number of claims (male and females, aged 5 to 64 years) had a significant upward trend, on average increasing by 1.5% per year. There was no significant trend in the annual IIR by population of male or female claims. Chapter 9 looked at the NCRPP insurance claims in Australia from 2007/08 to 2018/19 and found that while the overall claim numbers increased non-significantly for both male and female claims, the annual IIR by population was relatively steady.

Soomro et al (171) found that Sydney Grade cricketers had a lower overall IIR than their elite counterparts, almost by a factor of a third. However, Soomro et al (171) also found that the lower back injury incident rate was higher in community levels compared to elite levels. They also noted that the IIR they derived was similar to that of basketball, tennis and soccer. Gamage et al (182) reported injuries based on match injuries per 100 respondents, from which Sri Lankan school boy cricketers had a higher incidence of injury than junior cricketers in other countries such as Australia and South Africa. The original consensus statement on cricket injury acknowledged the challenge of exposure measure, even for better resourced elite level systems (13). It is evident from the studies included in this thesis that this is still problematic.

Whilst prevalence and injury incidence rate measures can be useful for indicating the overall size of the injury problem, the information gathered and analysed in this thesis has shown that, when viewed in isolation for community level cricket injury, they are not informative of the driving factors behind injury occurrence. Having discussed the ‘how many’ aspects of community level cricket injury, it is equally, if not more, important to understand the ‘what’, ‘where’, ‘when’ and ‘who’ aspects of injury surveillance.

Table 114. *Grey literature reporting hospital and/or emergency department presentation data for cricket related injury in Australia.*

			Emergency Presentations				Hospital Admissions				
Study / Report (Reference)	**Date/Years investigated**	**Age group**	**Number**	**Proportion of all sports**	**IIR per 100,000 population**	**IIR per 100,000 participants**	**Number**	**Proportion of all sports**	**IIR per 100,000 population**	**IIR per 100,000 participants**	**Ratio of Hospital Admissions to ED presentations**
Victorian Injury Surveillance System (VISS)– Hazard Ed. No. 9 (220)	1989 – 1990 (2 years)	< 15 years	254	10% 4th out of 5 sports	NR	NR	NR	NR	NR	NR	-
VISS – Hazard Ed. No. 15 (221)	1991 – 1993 (3 years)	≥ 15 years	370	9% 5th out of 12 sports	NR	NR	26	7.0% 4th out of 12 sports	NR	NR	1 : 14.2
Victorian Injury Surveillance & Applied Research (VISAR) – Hazard Ed No. 51 (222)	1999 – 2001 (3 years)	All	1968	4.9% 8th out of 30 sports	NR	NR	253	NR	NR	NR	1 : 7.8
Australian Institute of Health & Welfare (AIHW) – sport related hospitalisations in Australia (223)	2002 – 2003 (1 financial year)	All	-	-	-	-	1034	2.3%	5.3 [1] 12th out of 20 sports	121.3 [1] 12th out of 16 sports	-
Boufous et al (NSW) (224)	2003 – 2004 (1 financial year)	All	-	-	-	-	502 [2]	4.4% [1]	3.7 11th out of 24 sports	103.4 [3] (91.4 [4]) 12th of 18 sports	-
Victorian Injury Surveillance Unit (VISU) – Hazard Ed. No. 74 (225)	2007/08 – 2009/10 (3 years)	≥ 15 years	2,698	NR	NR	NR	832	7.0% 5th out of 16 sports	NR	134.0 5th out of 16 sports	1 : 3.2
AIHW – Australian sports injury hospitalisations (226)	2011 – 2012 (1 financial year)	≥ 15 years	-	-	-	-	913	2.5% 13th out of 25 sports	5.0 12th out of 22 sports	254.0 [5] 11th out of 22 sports	-
AIHW – Hospital care for Australian sports injury (227)	2012 – 2013 (1 financial year)	≥ 15 years	-	-	-	-	-	-	-	25.6 [6], 14.8 [7], 9.9 [8] 5th out of 20 sports	-

Notes:
1. Participant IIR for ages ≥ 15 years. Population based IIR for all ages (for ≥ 15 years IIR = 5.1 per 100,000 population) .
2. Includes cases coded for both sport & leisure activity code and athletic/sports area place code.
3. IIR for 2003 ages ≥ 15 years.
4. IIR for 2004 ages ≥ 15 years. IIR for other age groups (ranking): 0-14 years: 107 (10th), 15-34 years: 265 (11th), 35-54 years: 118 (10th), 55+ years: 12 (10th).
5. IIR for all participants. IIR males = 262, females = 113
6. IIR for facial fractures for men and women.
7. IIR for facial fractures for women (5th out of 20 sports).
8. IIR for hip fractures for women (5th out of 20 sports).
NR = Not Reported

10.1.3 Injury nature

Understanding injury nature helps to identify the most common types of injuries occurring, and in turn, help direct specific preventative measures. The top of the sports injury pyramid represents the most severe of injuries. For cricket, fatalities related to head trauma was the most common injury nature followed by suspected commotio cordis (3). Chapter 9 identified five cricket-related fatalities in Australia over the 2007-2019 period, from insurance claims. Although the causes were mostly unclear, it is likely all were due to systemic health causes (e.g. cardiovascular) rather than traumatic impact (228).

From the Victorian hospital data examined in Chapter 4, fractures were the most common injury nature for admissions in males. Similar results were seen across existing literature looking at all injuries in adults (i.e. ≥ 15 years old) (86, 129). 'Dislocation, sprain and strain' was the most common injury nature presenting to ED, with fractures second. Again, similar results were reported in the existing literature looking at all injuries (86, 129), except for children under 15 years of age, where fractures were often as or more common than sprain and strain, bruising and open wounds (139). Whilst 'dislocation, sprain and strain' was the most common overall injuries category presenting to Victorian EDs, fractures were shown to be increasing over time to the point where they had exceeded dislocation sprain and strain as the as the highest individual injury nature in the 2016/17 year. The reason for the relative increase in fractures in males presenting to EDs is unclear.

From the Chapters reporting insurance claims data (Chapters 5 and 9), there was an interesting difference in the most common injury nature reported. From ACC claims data in NZ, soft tissue injury was by far the most common broad injury nature (81%), with sprains and strains being the most common specific injury nature within the soft tissue category. The study by King et al (104) reported a slightly lower proportion of soft tissue injuries (64%) and a higher proportion of fractures (31%) than the data reported in Chapter 5. The reason for the differences between the results seen in this thesis and those reported by King et al (104) may be attributed to the fact that in Chapter 5, the data analysed were restricted to places of recreation or sports. In contrast, the NCRPP claims data in Australia reported fractures as the most common injury nature, followed by sprain and strain. When all soft tissue related injury types are combined from the NCRPP data (including sprain/strain, tear/rupture and bruising/contusion/crushing injury) the proportion amounted to 38%. The large difference between the proportion of ACC soft tissue injuries and the NCRPP data is likely due to the differences in the claim threshold between the two systems. The ACC system is accessible for all accidental injury, while the NCRPP system only covers those injuries not already covered by the national health system (Medicare) or where a loss on income is incurred.

Existing literature from retrospectively collected injury data in South African adolescent cricketers, report sprain and strain at similar proportions to the ACC data (61% (185)- 74%

(188)). Prospectively collected data were largely restricted to junior cricketers and whilst sprain and strain was more common in Sri Lankan school boy cricketers (182), bruising and inflammation/swelling was more common in Australian junior cricketers (174).

Stress fractures have long been a major concern for bowlers in cricket at all levels. They are a particular concern at elite levels due to the length of time away from the game that results and the difficultly in rehabilitating the player (68). The proportion of stress fractures reported in prospectively collected injury data in Australian bowling cohorts (age range 12 to 22 years) varied from 29% to 47% (51, 173, 175), whereas stress fractures were reported retrospectively in South African adolescent (U15 to U19) cricketers varied from 3% to 5% (185, 188). The large differences might, in part, be due to the different data collection methods, however two of the Australian studies focused specifically on lower back injuries or morphologies (173, 175), and included imaging (computer tomography (CT) and/or magnetic resonance imaging (MRI)) to help diagnosis. There were only seven stress fractures in the ACC claims data, four of which were identifiably associated with bowling (0.03%), however no body location was available. For the NCRPP data, less than five vertebral fractures were claimed (< 0.1% of all claims), not all of which were due to bowling (< 0.2% of bowling claims). The relatively low number of stress fractures claimed in insurance systems may be attributable to the difficultly in diagnosing the issue initially. It is known that with the ACC system, the initial or working diagnosis may be later reclassified but the dataset may not be updated when future examinations are undertaken (121). Thus an initial lumbar sprain may later be diagnosed as a stress fracture a few weeks/months later when not resolving, but the database is not updated.

10.1.4 Injured body part/region

Trauma related fatalities were most often due to injury to the head/face/neck, followed by the chest (3). Of the relatively few fatalities reported in the NCRPP data recorded, the abdomen was the most commonly reported body region involved, however, the circumstances around the incidents were not clear in the available data.

From the Victorian hospital data analysed in Chapter 4, around 60% of hospital admissions and ED presentation injuries occurred to the wrist/hand or head, with the wrist/hand being the most common for both. A similar profile was seen in the existing literature with the upper limb typically being the most commonly injured body region in both ED and hospital admissions, except for children under 15 years of age, where head/neck/face was a more common location (Chapter 3, Table 23).

A different body region profile was observed in the insurance claims data. From the ACC claims data analysed in Chapter 5, upper limb (27%) and lower limb (29%) injuries were of similar proportions, however it was the trunk/back region that was most commonly injured (34%). Of the upper limb injuries, the shoulder was the most commonly injured body part

(55%). For the lower limbs it was the knee (34%) and for the trunk/back, it was the lower back/spine (74%). The data received from the ACC appears to be at odds with the King et al (104) study that reported much higher upper (35%) and lower limb (46%) injury proportions as well as a substantially lower trunk/back (2%) injury proportion. There is no obvious reason for the substantial discrepancies in the body region data. Several possible reasons may include: 1) the substantially larger pool of data used in this thesis and the fact that the data used to assess body regions involved was a subset of the overall data which included only those which were associated with a known activity (i.e. batting, bowling, fielding or wicket keeping); or 2) the potential for the King et al (104) data to have been drawn from an online portal of the ACC website that was subsequently closed down due to data inconsistencies (personal communication: S. Gianotti, ACC). For the NCRPP claims data from Chapter 9, the upper (37%) and lower (40%) limbs were also of similar proportions and made up over three-quarters of the injury claims. For the upper limbs, hands/fingers/thumb accounted for 56% of claims, whilst the knee accounted for 50% of the lower limb claims. The relative common incidence in lower back injury in the ACC data is an interesting finding given the NCRPP claims data in Australia reported only 5% in comparison. The difference may be a reflection of the nature of the no-fault accident claim system and/or the general population-level of lower back injury in NZ. Another difference in the insurance data, compared to the hospital data, is the lower proportion of head/neck/face injuries. The lower proportion would not be unexpected, given the insurance claims data should be more representative of a greater range of injury severities, particularly the ACC claims data.

The existing literature, using retrospectively collected data, tended to report upper limb at a level equal to or of greater proportion to lower limb injuries (Table 41, Chapter 3). Prospectively collected data tended toward lower limb injury proportions being greater than upper limb (Table 31, Chapter 3). The reason for the relative difference in upper and lower limb proportions could be to do with the nature of the data collection methods, injury definitions and included number of cases.

10.1.5 Injury diagnosis (body part and nature)

From the hospital data analysed in Chapter 4, fractures to the wrist/hand and head were most common in admissions, whereas for ED presentations, wrist/hand fractures and open wounds to the head were the most common.

From the ACC insurance claims data in Chapter 5, for both males and females, fractures most commonly occurred to the fingers, thumb and hands. The most common soft tissue injuries were lower back sprains and knee sprains and open wounds occurred mostly to the hands, fingers and thumb, followed by the lips. From the NCRPP data in Chapter 9, fractures were most common in the hands, fingers and thumb, similar to the ACC data. Sprain and strain was most commonly associated with the knee and shoulder and tear/rupture was most commonly associated with the knee and Achilles tendon. The lower limb was the most common body region associated with NCRPP injury claims overall, with the knee being the most common specific body region injured in batters and bowlers. The upper limb was most commonly injured in fielding and wicket keeping with the hand/fingers/thumb was the most common specific injured body region overall. Whilst the back (upper or lower) was most common in bowlers in this dataset, it ranked only sixth overall. The lower back was the most common body region injured in the ACC data from NZ. This is a substantial difference between the two datasets and may relate to the differing nature of the data collection. As mentioned previously, the no-fault nature of the ACC scheme may increase the likelihood of more injury complaints being reported. The lower back injury numbers may be reflective of a population based issue as much as a sporting one.

The majority of the fractures reported in South African schoolboy cricketers (185, 188) occurred to the upper limbs, consistent with both the hospital and insurance claims data findings. Only one study, that used prospectively collected injury data, reported injury diagnosis (182). Amongst Sri Lankan schoolboy cricketers, the study identified knee and elbow abrasions, followed by thigh muscle/tendon strains as the most common injury occurrences (182). Hand and wrist fractures were relatively low in incidence in comparison, but were still the most common body region fractured (182).

10.1.6 Activity and/or setting at injury onset

The activity at injury onset (i.e. batting, bowling, fielding, or wicket keeping) was largely unavailable from the Victorian hospital data analysed in Chapter 4 and the majority of the acute medical attention injury articles reviewed in Chapter 3. Much more detail on activity could be found in retrospective and prospective data collection studies reviewed in Chapter 3 and through the insurance claims data examined in Chapters 5 and 9. In terms of the variations of the sport (i.e. outdoor and indoor cricket), only the ACC data had identified variables. The hospital data theoretically includes both variations but there is no means (i.e. ICD-10-AM codes) of being able to discern between them. The ACC data also was able to identify activity of injury onset (were available) for hospital treated cases, showing batting and fielding as the most common activities associated. The NCRPP data were specific to the outdoor form of the game.

As far as cricket injury claims in NZ were concerned, injuries involving bowling made up almost two thirds (60%) of the claims with activity noted. Fielding and batting each made up 18% with wicket keeping the other 4%. For both batting and bowling, lumbar sprains were the most common injury. Sprain of the knee and leg was the most common injury associated with fielding, ahead of finger/thumb sprains, while finger/thumb sprains were the most common injury diagnosis for wicket keeping claims. Facial injuries, mostly to the teeth, were the second most common injury in wicket keepers. The fact that finger/thumb fractures were slightly more common in batting claims than fielding or wicket keeping, might suggest the relative velocity of the ball, and/or the finger potentially being jammed against the bat as important factors in determining the degree of injury. Not surprisingly, given the projectile nature of cricket, batting, fielding and wicket keeping were the most commonly associated activities with fracture injuries. Sprains/strains were most common in bowling. Almost half of the back sprains/strains were associated with bowling, consistent with the repetitious nature of the activity and from prospective studies on bowling cohorts (51, 173, 175, 177, 178).

In Australia, the distribution of claims by activity was different to that of the NZ system. The activity of fielding accounted for 36% of the injury claims, batting 27%, bowling 19% and wicket keeping 6%. Fielding accounted for over half (52%) of the hand/finger/thumb fracture claims. For wicket keeping, similar to the ACC data, teeth fractures were the second most common injury behind hand/finger/thumb fractures. Teeth injuries, particularly fractures were also quite common in fielding in general. Across all activities, sprain/strain or rupture/tear was the most common injury to the knee. Achilles tendon sprain/strain or rupture/tear was heavily associated with batting, accounting for 75% of that structure's injury claims. Bowling accounted for 46% of sprains to the back/spine (upper or lower). There was only one study in the existing literature that examined a similar population to the NCRPP, being premier level cricketers in Sydney, NSW, and that found that 30% of injuries were to the trunk/back (20% to the lower back specifically) (171). An unexpected finding in the NCRPP data were the number of hand/finger/thumb fractures for bowlers being slightly greater than that for batters. The reasons for this shall be explored in the injury mechanisms section to follow.

The large difference in the bowling and fielding proportions between the ACC and NCRPP data may be attributed in part to the different claims thresholds of the two insurance systems, as previously mentioned. There may also be some inherent bias in the ACC data, where claimants who claim for bowling injury are more likely to fill out the injury description.

Typically, from prospectively collected data, fielding was the most common cricket specific activity associated with injury, in agreeance with the NCRPP data. This was also evident in two bowling focused studies that reported injury across all activities (177, 178). It has long been known that bowlers are susceptible to lower back injury through the dynamics of the bowling action and work load (194), but few studies have noted the lower back associated with other activities. Gamage et al (182) reported lower back injuries as the most common body region for Sri Lankan school boy wicket keepers, and also reported the lower back as accounting for 7% of batting-related injuries, fourth behind the thigh, hand and knee. Lumbar injuries in elite level wicket keepers made up 25% (n = 1 of 4) of the total in Australian cricketers, whilst batting (2%) and fielding (3%) were far less common (47).

There were three South African studies that used similar retrospective survey methods and populations (school boy cricketers) to collect injury data with associated activity (185, 186, 188). Figure 100 shows the data plotted over the time periods covered. Although the data is should be interpreted with caution, the interesting observation is that injuries associated with batting have declined, whilst fielding injuries have increased over time. It may be possible that the increase adoption in effective protective equipment for batters has helped drive the batting injury proportions down, and conversely the increase in intensity and athleticism of fielding associated with the shorter formats of the game may be involved the increase in injury proportion. Bowling injury appeared to be ubiquitous and more in line with the findings of the ACC data.

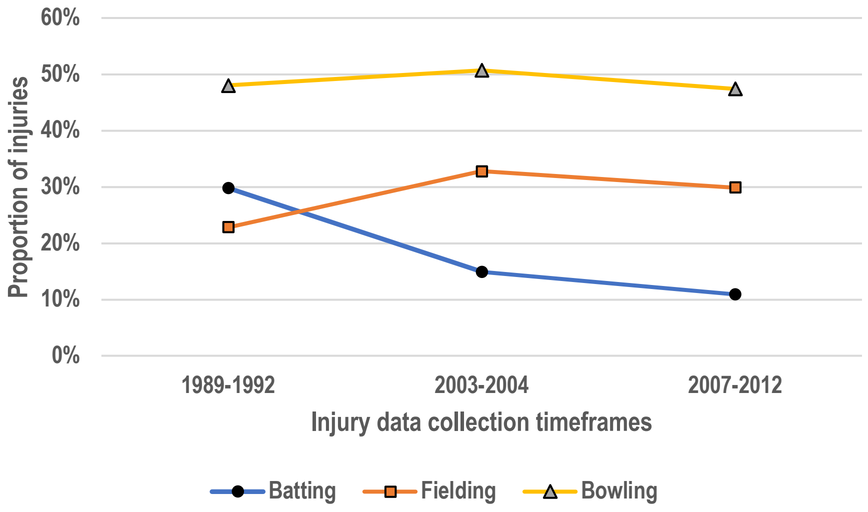

Figure 100. *Proportions of injury associated with batting, bowling and fielding for studies, using similar methods and populations, looking at South African schoolboy cricketers over three time periods (185, 186, 188).*

The majority of community cricket injuries were reported as occurring in matches throughout existing literature (range 33% - 66%) and the NCRPP data (83%). Retrospective studies have reported training can account for anywhere between 12% and 47% of community cricket injuries (174, 185, 186, 188, 189). The only prospective study that reported injury setting proportions looked at junior cricketers in Victoria, Australia, and found 34% of injuries occurred at training (174). Elite level cricket studies report match injuries occurring in a range from 69% to 80% and training injuries from 20% to 26% (67, 71, 229). This is an important finding, as clearly studies that focus only on match injury surveillance are likely to be underestimating the overall injury incidence.

10.1.7 Injury mechanism

The mechanism of injury is modelled by Bahr and Krosshaug (230) in terms of information on the inciting event, playing situation, player/opponent behaviour, gross biomechanical description and detailed biomechanical description proximal to the outcome, the understanding of which is essential for preventing injuries. The manner of injury mechanism information was highly variable depending on the data source investigated in this thesis. The hospital data relied upon predefined ICD-10-AM or National Minimum Health Dataset (NMHD) codes, as well as extracting some information from text fields (ED presentations). The ACC data provided injury factor variables based on the accident cause, contact and external agent, which can be used to elucidate a narrative of the mechanism. With the NCRPP data, the description of event variable was used to code the injury mechanism from codes derived from the ASIDD. The following is a summary of the injury mechanisms as derived from each of the datasets investigated and existing literature reviewed.

Traumatic fatal cricket-related injuries, historically, have most often been due to being struck by the ball (3). The majority of injuries in both ED presentations (54%) and admissions (46%) were due to being struck by the ball. Within the hospital data, the vast majority of injuries to the wrist/hand (90%) and also to the head (95%) were due to being hit/struck/crush. Upper limb injuries, other than to the wrist/hand, tended to be more commonly associated with falls and lower limb with overexertion. The major mechanism of being struck by the ball is unsurprising given the projectile nature of the sport and is consistent with the results from the existing literature on acute medical attention injuries in community cricket in Chapter 3 (Table 25).

From community cricket injuries in NZ (ACC claims data), the ball was the most common agent of injury, being involved in 67% of all injuries. Batting and bowling were similar in proportion where the ball was the external agent of injury. On the surface this appears surprising, however when the injury cause factor is investigated, around half of the bowling injuries were due to a strain or twisting movement with strenuous movement involving the ball. This might be translated to the injury occurring during the bowling action, which was reported as the most common phase of the activity where injury occurred in South African adolescent bowlers (185, 188). Wicket keeping was the activity proportionally most associated with direct contact with the ball, followed by batting. Impact with the ground was more common in fielding, with impact from the ball second. The ground impact from fielding injury was primarily caused by a loss of balance. Whether this was in the act of chasing or catching the ball or attempted ground fielding remains unknown.

Contrary to hospital and the ACC data, when looking at the NCRPP claims data from Australia, acute overexertion was found to be the main mechanism of injury for batters, with being struck by the ball second. Setting off for a run was the most common batting action where acute overexertion was involved and this correlates with the incidence of lower leg injuries for batters. The sudden acceleration required can lead to an excessive load on the calf muscle and Achilles tendon complex, such as in the celebrated case of the Australian test captain at the time, Steve Waugh, in 2001 (231). The reason for the difference in the primary injury mechanism in the NCRPP data is not clear, but may have something to do with the age profile of the claimants. The average age of the male claimants in the NCRPP data were 31 years old, compared to 28 years old in the ACC data. Also the hospital data showed that the proportion of broad mechanism of injury by hit/struck/crush reduced with increasing age groups and conversely the proportion of overexertion and/or strenuous movements increased with older age groups (Table 52, Chapter 4).

Anecdotal claims have suggested that, for those who resist wearing helmets while batting, the majority of head injuries occur due to the ball deflecting off top edges of the bat (232). However, the evidence gathered here would suggest there are fewer cases than initially thought. A third of the head/face/neck injuries occurring to batters was the result of being struck by the ball deflecting off the claimant's bat when playing a shot. The fact that the annual numbers of this type of injury mechanism have dropped since 2008/09 is suggestive of an uptake in helmet wearing whilst batting, the proportion is still high enough to advocate wearing a helmet against any sort of bowling.

Protective performance issues with helmets were exposed in an elite level study that lead to the rewriting of the British Standard used in their manufacture (41). The majority of injuries in matches came from where the ball forced its way between the helmet peak and the faceguard (41). In the NCRPP data, 1.2% of batting injuries and 6.3% of head/face/neck injuries batting, were due to some failure of the helmet to protect the claimant, with 41% of cases related to the ball forcing its way between the peak and faceguard. The majority of these claims (82%) occurred prior to 2014, the time after which helmets were manufactured to the new standards. The reduction in claimants reporting issues with helmets may also indicate that players, who commit to wearing helmets, are adopting the newer standard of protection.

The NCRPP data showed that being struck by the ball while attempting a catch was the most common injury mechanism in fielders. There was generally not enough information from the description of event variable to identify where the fielder was positioned when attempting the catch. Analysis of elite level cricket identify the positions behind the batter, such as the wicket keeper, slips cordon and gully positions (refer to Appendix B for relative locations), receive 60% of the catching chances (233). Also, a recent Australian study on elite cricketer's hand fractures, reported 80% of fielding related fractures occurred within the infield area (within 30 metres of the batter) of the ground (234). Knowledge of where players were positioned when attempting to field or catch the ball (as required in the cricket injury consensus (13)) might be useful when assessing future injury prevention strategies. The NCRPP data showed wicket keepers had a higher proportion of head/face/neck injuries than batters, highlighting the importance of these players wearing helmets, particularly when keeping up to the stumps.

From the existing literature reviewed in Chapter 3, fielding was also most commonly associated with finger injuries in both outdoor and indoor forms of cricket (146, 151, 188). Diving for a catch was a common mechanism of injury for fielding in Sri Lankan school boy cricketers (182). For South African schoolboys, catching followed by chasing/sliding in the field were the most common mechanisms (185, 188). Being struck by the ball was the most common mechanism for junior Australian batters and overexertion for bowlers (174). South African schoolboy batters were similarly injured either by the ball, running between wickets or through prolonged batting (overuse), while bowlers were most often injured in the delivery phase of bowling (185, 188). From the retrospective South African studies, the proportion of batting injuries has dropped over time while the proportion of fielding injuries has increased (185, 186, 188), possibly reflecting the increased dynamic nature of fielding in the newer formats of the game (i.e. 20/20).

Comparison of community level injury activity with the elite level is not straightforward, given the proficiency and intensity levels will be different, however bowling tends to dominate the activity of injury. The exceptions in the last 20 years are the male West Indies (66) and female Australian domestic and international players (69), where fielding has been shown to be the dominant activity of injury (Table 3, Chapter 1).

Bowling injury mechanisms were consistent with those reported in the literature of both prospective and retrospectively collected injury data (177, 178, 185, 188). One difference noted from the analysis of the NCRPP data were the relative common occurrence of bowlers being struck by the ball. The majority of these incidents occurred in the follow through and were most often associated with trying to catch or field the ball. Whilst Davis (233) noted that the majority of chances went behind the stumps (i.e. to the keeper or slips), the bowler was the most likely player to miss or drop a catch (47%). Bowlers also made up 20% of the hand fractures from fielding off their own bowling in elite Australian cricketers (234). The reason for this is likely due to the lack of response time between delivering the ball and then attempting to catch the ball whilst following through from the bowling action, particularly for fast bowlers. The lack of preparation for a catch would be a driving factor for not getting one's hands in the correct position in time and predisposing injury.

10.1.8 Injury severity

Injury severity was reported via different proxy measures. Injury severity in hospital treated injuries was measured by the proxy of length of admission bed stay. For ACC insurance claims data, the number of work days paid (WDP) and similarly for the NCRPP insurance claims data, the number of weeks of lost income paid (LOI) were used as proxy measures for severity. The NCRPP LOI claims were also extended to assess an injury burden measure that was the product of the incidence and the number of weeks LOI.

For hospital data, the majority of injuries that necessitated admission (86%), required less than two days bed stay. Fracture was the most common injury nature requiring a bed stay of two days or more. The lower leg knee was the most common injured body location needing a bed stay of two or more days, followed by the head. The majority of injuries needing two or more days bed stay were due to being struck by the ball. It is difficult to assess the true severity of hospital treated injuries from this dataset due to the likelihood that once a patient is stable and capable of home or self-care, it likely they will be discharged from hospital. The ongoing burden of the injury is lost from that point in the dataset. From the existing literature, four percent (4%) of cricket-related hospitalisations in NZ were identified as serious non-fatal injuries (equated to a ≥ 5.9% chance of death) over the 2000 to 2005 period, most of which were head injuries (129).

For ACC insurance claims data (Chapter 5), only 4% of claims resulted in WDP, with the majority of those injury claims resulting in 30 to 179 work days paid in both males and females. Bowling was the most common activity leading to injury claims resulting in WDP, making up nearly half the claims. Knee injuries were the most commonly associated with WDP for batting and bowling and were a close second behind fingers/thumb for fielding. Although they were rare (n < 4), facial injuries, particularly eye/orbit injuries were the most severe in terms of WDP for batting. Previous studies have shown cricket to be over represented in terms of severity of eye injuries (149). This highlights the need for appropriate face protection in line with the updated helmet standards.

At the elite level, stress fractures to the lower back typically result in the longest time lost from the game (67, 68). There were only seven stress fractures reported in the ACC data, representing only 0.3% of all WDP claims. Most (57%) of the stress fractures were associated with bowling, but the associated body location was not known. It is tempting to assume they are to the lower back, however previous studies have shown the lower leg (e.g. tibia) is another possible location in bowlers (175). Lower back sprains accounted for 12% of the WDP greater than 180 days, lumbar vertebrae fractures accounted for 6% and knee ligament tears/ruptures accounted for 10%.

On average, 26% of male claims per year required LOI payment. This is large in comparison to the ACC data, where 4% of claims required WDP, and indicative of the difference in claim requirements between the two schemes previously mentioned. Fielding injury claims contributed 43% of the injury burden as measured by weeks LOI per year. Fifty percent of the injury burden associated with fractures was due to fielding injuries. Fielding accounted for 54% of the injury burden due to fractures to the hand/fingers/thumb and 86% of the injury burden for fractures to the shoulder. Batting accounted for 68% of the injury burden due to fractures to the knee. Both the knee and hand/fingers/thumb were over represented compared to the mean injury burden of the top five injured body locations as batting and fielding were for injury burden by activity.

By collating the NCRPP LOI data into an equivalent measure to the ACC WDP data (Figure 71, Chapter 5), a skew toward the more severe time brackets can be observed (Figure 103). The proportion of LOI claims requiring greater than 180 days in the Australian data is around four times that of the NZ data. This is, again, likely due to the differences in claim acceptance thresholds of the two schemes.

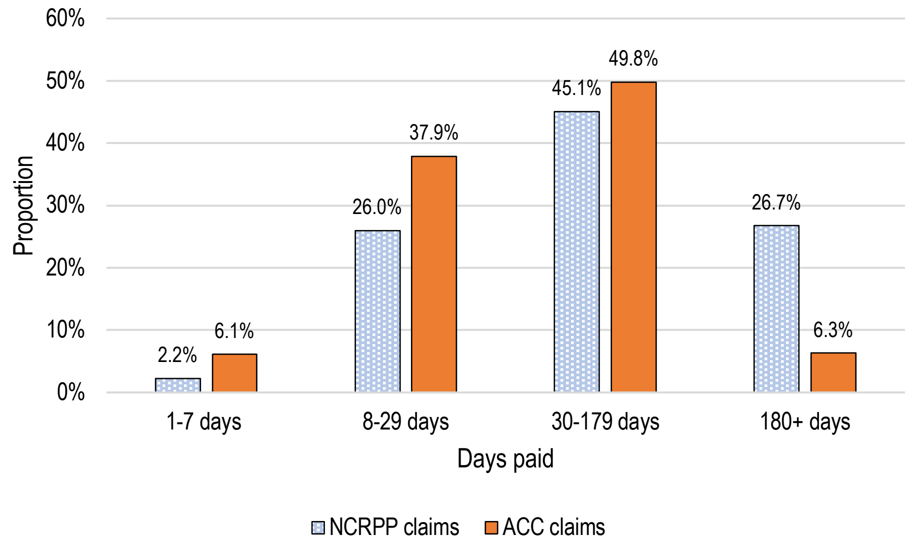

Figure 101. *Comparison of NCRPP claims (2007/08 – 2018/19) and ACC claims (2008/09 – 2017/18) severity measures.*

Sri Lankan school boy cricketers missed the most match time due to fractures to the hand/wrist from fielding injury (182). Batters missed the most match time due to head/face injury, whilst bowlers missed the most match time due to thigh strains (182). Gamage et al (182) reported that the lower back injuries to Sri Lankan school boy cricketers were all muscle/tendon strains, consistent with the findings of ACC claims data, however the majority did not result in match time loss. Milsom et al (188) and Stretch (185) noted stress fractures in South African school boy cricketers made up 3% and 2% respectively of the total injuries. Milsom et al (188), reported 41% of the bowling injuries were strains to the lower back, and the most common injury severity was greater than 21 days recovery (25%), and overall recovery of greater than 21 days was the most common outcome for all activities. Stretch (185), also reported 41% of injuries as chronic, but does not define this injury category, so we don't know the recovery timeframe these types of injuries carry. Stretch does report the time out of cricket of greater than 21 days was proportionally similar to 1 to 3 days, for all activities. Soomro et al (171) reported lower back injuries as the most severe, on average, for match weeks lost in Sydney grade cricketers with an average age of 25 years, followed by the knee, hand and then calf injury.

10.1.9 Other findings related to injury

Injury trends

From the one study identifying traumatic cricket-related fatalities, Brukner et al (3) reported five fatalities from organised cricket in the 28 year period from 1990 to 2018. The study reported no cases due to head trauma, suggesting protective equipment was being implemented and effective in limiting traumatic deaths (3).

For hospital treated injuries in Victorian males, wrist/hand injuries have been increasing over the timeframe investigated, and while head injuries trended downward overall, there was noticeable increasing trend from the 2013/14 year onward in both admissions and ED presentations. As with head injuries in general, a similar occurrence was seen in intracranial injuries. The reason for the increase in head injuries is unknown. There may be some association with an increase awareness of head trauma around the high profile cricketers death in late 2014 and the subsequent concussion policy introduced by Cricket Australia (53), which may have been adopted by community associations and clubs. However, given the official policy was only published in 2017, community awareness may be the driving factor.

The reasons for the increasing trend in wrist/hand injuries is also unknown. Several possibilities include: an increase in the number of and proficiency in fast bowlers, leading to an increase in batting injuries associated with being struck by the ball, an increase in fielding and/or wicket keeping injuries due to more aggressive fielding positions or due to the increased power of cricket bats (54), and/or the increase in number of short form matches that require more athletic fielding and also engender harder hitting. Soomro et al (171) reported significantly higher IIRs for short form matches in their single year analysis of Sydney Grade cricket in 2015-16 season (171). Another possibility is the quality of hand protection worn by community level batters and wicket keepers. Previous studies have suggested, that even at the highest levels, batters tend to go with comfort over protection (39). The higher the quality of the protective equipment, the higher the likely cost, and given there is some concern over the costs associated with community sport (235), it is possible that community cricketers will substitute protective quality for lower cost variations. Added to this possibility is a general lack of consumer advice on any manufacturers standards for batting or keeping gloves, unlike the case of helmets which are regulated through the British Standard BS7928:2013, and now mandated or strongly advised by cricketing governing bodies (236).

When looking at ACC data in NZ for all activities, male outdoor cricket injury claims on average increased annually significantly. This increase appeared to be driven predominantly by bowling and fielding injury claims. Wicket keeping was the only activity were there was an average annual decrease in injury claims. The reasons for this are unknown, but may have something to do with more players wearing helmets when keeping up to the stumps. There was an overall drop in the number of facial injuries associated with wicket keeping in males, and a sharp drop in finger/thumb injuries in the first two years of the study, which then remained relative steady after that.

The increase in male bowling injury claims in outdoor cricket appeared to be driven by lower back, shoulder, knee and ankle injuries. The knee and lower back were also implicated in the overall rise in fielding injury claims, although there was a lot more natural variation from year to year. The variation may be accounted for in the less predefined movements required in fielding compared to the more repetitive actions of bowling. The knee and lower back were similarly involved in the overall increase in male batting injury claims, as well and the hand/wrist. However, the increase was mitigated somewhat by a decrease in facial injuries associated with batting, which may be an effect of an increase in protective equipment usage, such as helmets with face grills. Interestingly, there was an increase in the number of neck, back of head/vertebrae injuries associated with batting. Whilst the apparent drop in head and face injuries overall may indicate an increase uptake in helmet usage, the increase in neck, back of head/vertebrae injuries could be a reflection of the continued usage of older style helmets with less protection in the posterior region of the head and neck, a region noted as deficient in the Ranson et al (42) study on helmets in elite level cricketers.

For the NCRPP insurance claims data in Australia, the IIR trend by population for males was, as mentioned earlier, relatively flat. When looking at claims by activity, the dataset was hampered by missing data on player positions (activity) around the 2013/14 season. Nonetheless, slight upward trends could be noticed for batting, bowling and fielding related claims, whilst wicket keeping was relatively level over the time period investigated.

With the NCRPP data, some comparison could be made with the Victorian hospital data in regard to the three trends of interest discussed earlier: wrist/hand fractures, head injuries and intracranial injuries. When the NCRPP data were examined for wrist and hand fractures in Victoria, there was a non-significant average increase of 2.5% (95% CI 0.91% - 5.9%, p = 0.14) (Figure 102).

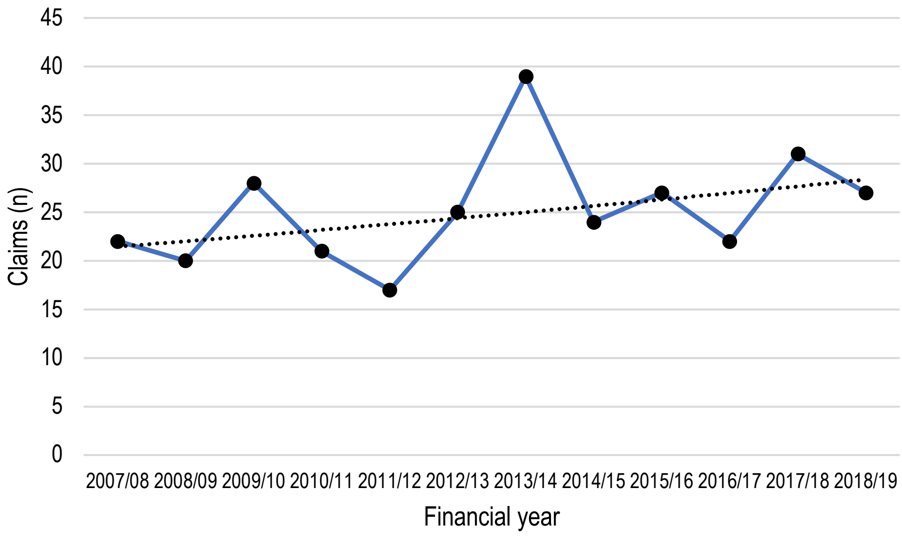

Figure 102. *Wrist, hand, fingers and thumb NCRPP claims for Victorian males from 2007/08 to 2018/19. Dotted line represents Poisson trend.*

The overall downward trend in head injuries was also reflected in the NCRPP data for Victoria as well as the slight upward trend in the years since 2014/15 (Figure 103). Overall there was an average decrease in head injury claims of 4.3% (95% CI 1.3% - 7.0%, $p = 0.02$) per year.

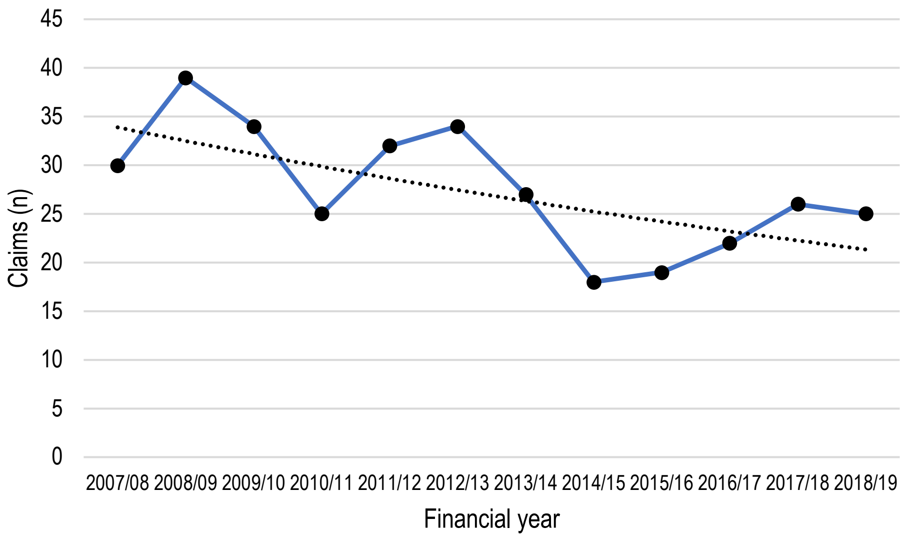

Figure 103. *Head injury (including face) NCRPP claims for Victorian males from 2007/08 to 2018/19. Dotted line represents Poisson trend.*

The intracranial injury claim numbers were too small in Victoria alone to be meaningful, but when the national figures are examined (Figure 104) there is an upward trend from 2010/11 with a prominent spike in the 2016/17 financial year that might correlate to the increased awareness of Cricket Australia concussion protocols being developed around the time. The other interesting fact, that lacks an explanation, is that after the large spike in 2016/17, the number of intracranial injury claims dropped to zero the following year. The drop may be a relative correction in player knowledge or behaviour around concussion that had been anticipated at the elite levels (68).

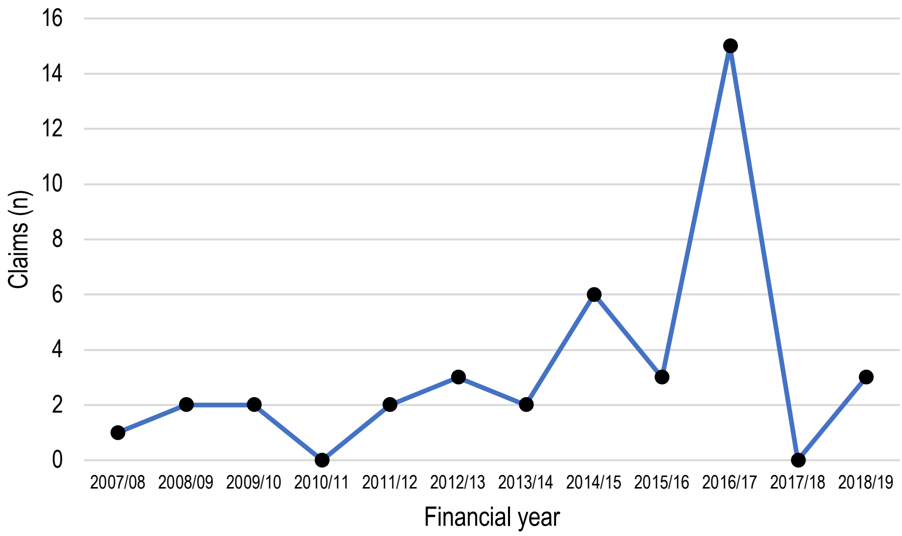

Figure 104. *Intracranial injury NCRPP claims for Australian males from 2007/08 to 2018/19.*

From the existing literature, there is some evidence of changes to head/face/neck and lower limb injury proportions over time. Shaw et al (46) reported a drop in head injuries (62% to 4%) in the seasons subsequent to the introduction of mandatory helmet use for junior cricketers in NSW, Australia over the 2002/03 to 2004/05 seasons. There was some overall indication of a reduction in batting injuries and coincident increase in fielding related injuries in South African schoolboy cricketers from the early 1990s to early 2010s (185, 186, 188). The reasons for these changes are not obvious, especially as these were separate studies, albeit using similar methods. A more widespread adoption of helmets while batting may have contributed even though South Africa was slower and less rigid in adopting mandatory helmet usage policies than other major cricketing nations such as Australia and England (45). The advent of shorter formats of the game and more athletic fielding techniques may also have contributed to the increase in relative proportions of fielding injury. Other indirect evidence that protective equipment may be reducing injuries in community cricket is the drop in the proportion of cricket-related dental injuries in NZ from 9% in the 1990s to 4.6% in the 2000s from insurance claims data (99, 102).

Age related factors

For the hospital data examined in Chapter 4, the IIR of males in the 5 to 14 and 45 to 64 years old age groups had significant increases in ED presentations over the time period investigated. The 45 to 64 years old age group also had a non-significant increase in IIR for admissions, while the 5 to 14 years old age group had a non-significant decrease in IIR for admissions. Injuries to the knee and lower leg were proportionally more common with increasing age group. Older ages also appeared to be linked to a higher proportion of two or more days bed stay required for admissions. A recent Sport Australia publication indicated that the 45+ years old age group had some of the strongest association with cricket as their major sport of interest and represent around 18% of the participants (5). Cricket, being a less physical-contact based sport, likely allows players to continue playing more comfortably into their forties and fifties. Given this information a more concerted research effort is required to identify injury patterns in older age groups for cricket as continued exercise is valuable for well-being and community engagement.

Injuries to the head in both ED presentation and admissions were far more common in the 5 to 14 years old age group than older age groups. The 5 to 14 years old group were also significantly more commonly injured through being struck by the bat or through collision with another player than any other age group in admission cases, something also previously observed in the existing literature in Australia and NZ (138, 139). This age group was also significantly more associated with injuries from falls. These factors identify the 5 to 14 years old age group as one of high risk of serious injury. Coaching and training should allow for the various levels of coordination, strength and familiarity with the sport to help minimise this potential. Lower risk forms of the sport, such as the development pathways of Junior Blasters (5 to 7 years) and Master Blasters (7 to 9 years) have been useful as a low risk starting point for children. These forms of introductory cricket have only been specifically investigated once and shown to have a proportionally much lower incidence of injury (4% (95% CI 1% - 7%) compared to 16% of registered players) over the 2002/03 to 2004/05 seasons in Australia (46). Finch et al (174) also noted that, although not specifically mentioning introductory forms of cricket, there were no U8 players injured in the 2007/08 season.

For ACC claims in NZ, the 15 to 19 years old age group in females was the most common age group in each of the cricket activities. For males, the 15 to 19 years old age group were accounted for the most bowling and wicket keeping injury claims, however the 25 to 29 years old age group accounted for the most batting and fielding injury claims. Indoor cricket was associated with a slightly older age profile which may be to do with the convenience factor of playing indoor, most likely in the evenings and matches being shorter than the outdoor formats.

The age profiles of males, by activity, for NCRPP claims in Australia were similar to the ACC data. The most common age group for bowling and batting injury claims was the same (15 to 19 and 25 to 29 years old respectively). The fielding age group in Australia was slightly younger (20 to 24 years old) and the wicket keeping slightly older (20 to 24 years old). In males, there was similarity between the NCRPP (Figure 93, Chapter 9) and ACC (Figure 66, Chapter 5) dataset in the patterns of the relative proportions of injury claims by age group and activity at injury onset, however the proportions were different. The ACC injury claims were more weighted toward bowling and the NCRPP injury claims were more weighted toward fielding aspects. These differences could be, in part, due to the nature of each systems data collection.

Also the differences may be associated with the fact that the NCRPP data is purely organised cricket, while the ACC data analysed still likely includes some informal cricket.

The severity of injuries was impractical to assess from insurance claims for younger age groups using WDP or LOI paid as these age groups are less likely to be working and as such is a far less appropriate measure.

Sex related factors

The proportions of ED presentations in hospital data analysed in Chapter 4 was similar to those reported by Fernando et al (136) despite their numbers including females. This is unsurprising given the relatively small proportion of female cases. There was, however, a noticeable difference between the admissions in the 5 to 14 years old group in males compared to those reported in females by Perera et al (86). Females were, proportionally (24%) (86), twice as represented in admission for the 5 to 14 years old age group than males (12%) were in the data analysed in Chapter 4 of this thesis. Perera et al (86) used participation figures derived from Cricket Australia indicating female participation had increased three-fold (~ 18,000 to ~ 59,000) in the 12 years analysed and continued to grow, at around 30% per year (86). With an increase in participation, an increase in injury presentation might be expected. However, it may not be purely a participation factor driving the differences in admissions between sexes. The proportions of ED presentations were relatively similar for females (25%) in the Perera et al study (86) and males (22%) from Chapter 4. This could suggest females, particularly those in the younger age groups, may be incurring more serious injuries requiring hospital admission, than their male counterparts. Additional research is required to understand this discrepancy.

In terms of injury natures reported in hospital treated cricket injury, fractures resulting in admission were more common in males (53%) compared to females (47%) (86). Dislocation sprain and strain injuries were less common in ED presentations for males (29%) compared to females (36%) (86). Fractures were also more common in ED presentations for males (26%) compared to females (17%) (86). It is unclear why males incur more fractures, however it may be related to the relatively higher ball speeds faced by batters from the bowler's delivery (69) or off the bat for fielders. Admissions due to injuries caused by being struck by the ball were similar for males (46%) compared to females (45%) (86), however, injuries due to being struck by the ball presenting to ED were higher for females (64%) (86), compared to males (54%). Again, the reasons for the difference in impact injuries is not obvious, but may be linked to the relatively larger proportion of younger (5 to 14 years old) females requiring hospital attention. Younger female players may not have had the early development advantages of their male counterparts and as such maybe less skilled in the areas that predispose impact by the ball, such as batting, fielding and wicket keeping. A similar comparison is made of elite Australian female players with regard to wrist and hand injuries, which are the most commonly associated with impact with the ball (69).

With regard to injury severity in hospital treated cricket injuries, females were reported as having proportionally more injuries requiring two or more bed days stay (21%) (86) compared to males (14%). Whilst the ED presentation to admission ratio for males might suggest they are more commonly admitted to hospital for cricket related injury, females may, on average, have potentially more serious injuries when they are admitted. As noted previously, more analysis or additional information is required to quantify this.

From NZ ACC claims data, the number of claims in the 10 to 14 years old female age group rose relatively sharply from 2012/13. The reasons for this rise in young female cricket-related claims is unknown, but may have something to do with an increase in participation. Cricket NZ reported an increase in modified formats of the game in the 2012/13 season, and in successive seasons report larger than previous increases in overall participation (237). There is no identification of the sex distribution in these figures, however a separate report on women's cricket in NZ reported a sharp rise in female junior programme participation from 2012/13 (238).

In terms of injury nature in ACC claims, females had a significantly higher proportion of dental injuries than males and a non-significantly higher proportion of concussion injuries. Overall concussion was a relatively small proportion of all injury (0.4%), however, the fact that concussions can be considered a traumatic brain injury it is still a finding of some importance. The higher proportion of concussions in females may be associated with the suggestion that females are more honest in reporting symptoms, something tendered for rugby union concussions in NZ (239). King et al (239) reported that the costs associated with female rugby union concussions dropped over time and suggested a more honest reporting of symptoms could lead to better early treatment and less likelihood of subsequent injury. Another possibility, relating to the ACC data, is that the higher proportion of dental injury in females is linked to concussions. The dental and concussion injury claims are likely linked to females being more commonly injured by the ball when wicket keeping and fielding than males.

For hospital treated claims associated with the ACC, the proportion of males and females requiring hospital treatment was similar to the overall distribution. Males had significantly higher proportions of upper limb injuries, while females had significantly higher lower limb injuries. Females had a significantly higher proportion of soft tissue injuries, while males had a significantly higher proportion of fracture/dislocations. There were no significant differences between sexes on the proportions of activity involved, however, males were more commonly treated for injuries associated with batting, and females were more commonly treated for fielding injuries.

Where ACC claims required WDP, males were more than two times likely to claim than females. Males requiring WDP were most commonly in the 25 to 29 years old age group and females were in the 30 to 34 years old age group.

For NCRPP claims in Australia, female injury claims were more commonly associated with the younger age groups (from 5 to 9 years to 20 to 24 years age groups). The finding reflects the hospital and ACC data in this regard and may have something to do with an increase in participation in this cohort, as mentioned previously.

Time of year

Using the NCRPP claims data, a brief analysis of injury proportions, by activity, for each month of the season was conducted to assess any patterns of injury. Several things stood out from this analysis: 1) bowler injury claims were overrepresented in the months preceding the season, i.e. preseason training/practice. This appeared to correspond to an increase in back and trunk injury claims in the same months. This may highlight a lack of fitness or appropriate conditioning predisposing injury; 2) Head, face and neck injury claims peaked in February, coinciding with a peak in intracranial injuries, 77% of which occurred to batters and fielders. There may be some influence of faster, harder grounds and pitches (where turf wickets are used) in the typically hotter summer months after the New Year. The drawbacks of the amount of protective equipment available for batters with regard to heat stress has previously been documented (49). Perceived or actual heat exertion issues in these hotter months may result in players being less likely to wear a protective helmet when batting.

Geographic location

An examination of geographic location (regional locations versus metropolitan locations) was undertaken with the Victorian hospital data in Chapter 4. Regional cases were overrepresented compared to the average population and the IIR for regional cases was shown to be significantly higher in 2011 and 2016 for ED presentations. This may be an indication of a higher relative level of participation in regional areas as a recent VicHealth report showed regional Victoria having a participation rate of 20% compared to metropolitan Melbourne 14% in 12 common sports, including cricket (240). The report also noted that that regional-growth areas had the highest participation growth and other regional areas participation growth was larger than metro areas (240). Similar patterns have been previously observed over the 2003/04 to 2011/12 period in Victorian regional hospitals (241) in which it was suggested that the increasing numbers of hospital treated injuries from sports was more to do with a growing need for more improved sports injury management rather than a severity problem. The results from the hospital data in this thesis might suggest that in regional areas it is easier to access hospitals than other health service providers. Given the majority of organised cricket matches occur on weekends, access to other out-of-hours health care may be limited. With the advent of concussion and head trauma policies being adopted by cricket associations around the country, this may also be driving hospital treated injuries upward disproportionately in regional areas. The conclusions and recommendations by Wong Shee et al (241) with regard to additional research into the factors influencing patients choice of treatment provider are still highly pertinent, at least for regional community cricket.

The NCRPP data enable a state by state examination of the regional versus metro distribution of injury claims in Australia. There were some differences seen from state to state. Queensland registered significantly higher IIR in metro areas than regional areas, which may be due to the distribution of the State's population, with large sparsely populated areas in the West and North. A similar pattern, but of less magnitude, was noted in WA. Victoria, conversely, had a significantly higher IIR for regional areas than metro, consistent with the findings in the hospital data. This again may reflect the smaller size of the State and also in part to the relative growth of regional centres, the fact that Victoria has a larger sport participation in regional areas and the increased participation in sports, particularly in the regional growth centres (240).

Treatment providers

Outside of the hospital data, the ACC claims data were the only data source that provided explicit information on the initial care provider type. The NCRPP data has some information relating to costs associated with claims where physiotherapy, dental, or chiropractic were claimed, however, these may or may not be the point of initial care.

For the ACC claims data from NZ, GPs and physiotherapy made up 85% of the providers first seen by claimants with cricket-related injury. This is an important finding, as Chapter 3 showed, the majority of acute medical-attention injury data previously published around cricket-related injury is taken from hospital data. The finding that GPs were the most common first point of contact for cricket-related injury in NZ is consistent with the Nicholl et al study (167), which reported that the family doctor was the most common point of contact for exercise related morbidity incidents in the UK in the mid-1990s. The finding is also consistent with the Mummery et al (166) study which reported GPs treated 50% of the surveyed injuries, compared to the 35% for physiotherapists. The fact that physiotherapy was only slightly below GPs in the proportion of ACC claims attended (42% compared to 43%) might reflect the increasing popularity of that modality over time, and their specialisation into sports injury management. However, where the activity of injury onset was known (i.e. batting, bowling, fielding, or wicket keeping), physiotherapy became the most common health professional seen by a factor of 2.5. If the assumption that the inclusion of activity of onset reflects more organised forms of cricket is true, then it would indicate that physiotherapy and/or sport medicine centres could be a more representative source of organised sport injury data.

Additionally, when activity of injury onset was included, the overall proportion of fractures reduced and the proportion of soft tissue injury increased. If the assumption that the inclusion of activity of onset reflects more organised forms of cricket is true, then it might suggest organised cricket lessens the incidence of fracture and dislocation injuries. The majority of fractures were shown to be of the fingers, so with the likely increased usage of hand protection in organised cricket, such as batting and wicket keeping gloves, it would make sense that this injury incidence would be relatively lower. The relative increase of shoulder dislocation/subluxations may, on the flip-side, be indicative of a more serious intent on the part of fielders in organised cricket, perhaps diving to save runs or catch the ball. The increase in proportion of soft tissue injury when activity of injury onset was included may also reflect this increased intensity.

Within the ACC claims data, there were only 8% of claims that attended hospital, the majority (85%) of which were associated with outdoor cricket injury. Batting and fielding were the most common activities associated with hospital treatment, with impact from the ball the most common mechanism. When body regions were collated and compared, for males, with the ED presentation data from Victorian males presented in Chapter 4, they matched for rank, in terms of the most presenting cases; i.e. the order by most cases/claims was: wrist/hand (including fingers/thumb), head (including face, ears, eyes, nose), ankle/foot, knee/lower leg, shoulder and upper arm. This helps identify the Victorian hospital data as being reasonably representative for males of similar cricketing populations.

The proportion of ACC claims cases of impact from equipment for children under 15 years of age was similar to that reported from the Victorian hospital data analysed in Chapter 4 (11% c/w 12%). However, when activity was taken into account, the proportion dropped to 6%. The proportion of hospital treated cases dropped from 8% to 4% when activity of injury onset was included. If the assumption that the inclusion of activity of onset reflects more organised forms of cricket, then it might imply that the Victorian hospital data overestimates the extent of organised community cricket injury.

10.1.10 Quality of existing information

This section discusses the quality of the information extracted from the existing sources examined in Chapters 3, 4, 5 and 6, and helps put the outcomes into a more useable context. The data investigated from Chapter 9 is dealt with in detail in section 10.2 of the discussion.

Successful injury prevention strategies require good quality data (242). There has been a trend toward more prospective recording of cricket injuries at the national and international levels of the game (48, 66, 67, 70, 71). Prospective injury surveillance is generally considered superior to that using retrospective data collection methods primarily due to the bias encountered in injury recall, especially when beyond three months (72, 243, 244). In the review conducted in Chapter 3, only two studies (174, 182) using prospective data collection methods reported widely on all aspects of the game (i.e. batting, bowling, fielding). Both studies had self-identified limitations. Finch et al (174) identified their study as lacking the population size and the luxury of multiple seasons of data to provide sensitivity for accurate risk assessments. Gamage et al (182) noted the weaknesses of their study as the self-reporting of injuries without validation and a relatively low response rate. The value of longitudinal data, however, was shown in the study by Shaw et al (46), where observations around the introduction of protective equipment policies could be assessed.

In terms of the reporting quality and likelihood of bias amongst peer reviewed studies presenting injury data in community cricketers, 14 studies were found to have a low likelihood of bias and most of those (n = 11) were in the medical attention category. No study using retrospective methods of data collection were found to have low likelihood of bias, and three studies were found to have a high likelihood of bias in this category. Reasons for this are the inherent bias in the retrospective methods such as recall and selection bias. Another common thread running through the majority of studies, regardless of the data source, was the lack of reporting around missing information. In many cases, that may have just been a lack of reporting informing the reader there was no missing information, however without an explicit statement to this effect this knowledge cannot be assumed.

Studies of injury defined as medical attention, on the whole, had a higher proportion of fully answered critical appraisal items, followed by prospective data and retrospective data studies. There appeared no obvious link between the date of the study publication and whether the likelihood of bias was high. Studies with a high likelihood of bias were published across all the decades covered by this review. Studies of injury defined as medical attention were the only group of studies that had a proportion of low likelihood of bias studies greater than 50%. The reasons for the higher proportion of low likelihood of bias in studies of injury defined as medical attention is likely due to the context of the study using existing data based on established, routine collections. Whilst the use of existing data affords an inexpensive and quick method of data collection, there can still be issues with the quality of the data itself.

As far the prospectively collected injury data studies were concerned, there was a finding of limited, consistent injury data the met the recommendations as prescribed by the consensus statements (13, 14) and the ASIDD (11), for guiding community player safety. Much of what has been published only addresses specific groups of bowlers or junior age groups. Despite the existence of cricket-specific surveillance guidelines since 2005, this thesis has highlighted several challenges with injury data collection and reporting, in community-level cricket.

The general approach of the ASIDD and the elite driven focus of the cricket consensus guidelines were reflected in the completeness of items addressed by the studies included in this review. Most studies included around 80% of the core data items of the ASIDD. The major limitations from assessment against the ASIDD were the lack of reporting on mechanism and injury nature. In comparison, most studies fared poorly against the standards outlined for the international consensus statement on cricket injury surveillance. Key areas that lacked completeness against the consensus statements were:

- Injury diagnosis. Many studies included the body region but not the injury nature. Where they did, there was often no mapping of nature against region. Having this information together would be more informative from a preventative point of view.
- Player role when injured. As mentioned previously, cricket players have specialist roles but they still also need to participate in most aspects of the game. It is crucial from an injury prevention perspective to understand whether, for example, bowlers are being injured while bowling, while fielding or batting.
- Injury mechanism. Several studies used broad terms for the injury mechanism, such as contact or non-contact injuries while others were slightly more specific with descriptions such as contact with moving object, although this still does not differentiate between the ball, a bat or a collision with another player.

Despite the fact that seven of the studies were designed for data collection prior to the publication of the initial cricket injury consensus, they had a higher average completeness rating than the eight studies that collected data after the consensus statement was published. Perhaps this reflects difficulties in adopting its recommendations at a community level.

For the hospital data assessed in Chapters 4 and 6, the fact that 83% of the ASIDD core items were present in some form reflects that many of the data items outlined in the ASIDD are based on similar standards for injury surveillance used in the hospital system (15). It is perhaps not surprising that only 22% of the cricket injury consensus items were fully available within the hospital datasets analysed, given hospitals are a public health service designed to accommodate a large array of acute and/or chronic injury and disease cases, and not just sports injuries. In Australia, in 1998, the advent of Australian Modification to the World Health Organisation (WHO) International Classification of Disease (ICD-10) coding system (known as ICD-10-AM), greatly increased the capacity of hospitals to code for injury in sports and recreational activities. By 2002, a full range of sports and recreation activity codes were introduced allow a greater ability to capture sports injury data, particularly in hospital admissions data (245). This addition to the ICD-10 makes hospital data, in Australia, particularly useful for assessing acute sports injury in the population. However, there are still limitations in the completeness of data for sports injury surveillance (245, 246).

Historically, with hospital data, the completeness of activity when injured data has been impaired due to incomplete or missing data. In the previous level of coding under the ICD-9 system, it was shown that 55% of cases in 1996-97 did not identify the sporting activity being undertaken (247). A study of NSW hospital separations in 2003-04 reported a reduced proportion of incomplete or missing information (33%) (245), perhaps indicating an improvement in data collection over time. However, the most recent evidence points towards an underestimation of sports injuries in the hospital system (245).

One of the major limitations of hospital data in community cricket injury surveillance is the lack of complete data on the place of activity. This limits the accuracy of any assumption that by analysing those injuries that occur in places of sports and athletics areas are most likely to be associated with organised forms of the sport. Although the place of activity has been shown to have limited use in identifying sports/leisure injuries, it is important in assisting with prevention measures (246). Another limitation is the incomplete data associated with injury cause/factors, particularly in the case of ED presentations analysed in Chapter 4. This, in particular, can hamper prevention efforts, as a full understanding of the injury factors and mechanisms are important (230, 246). Finch et al (246) argued that ICD-10-AM codes may need to be refined to better classify activity, place of injury and information on external causes of injury for sports/leisure injuries, and this analysis has shown this to be a particularly pertinent recommendation for cricket.

The ACC insurance claims data faired only slightly better than hospital data for completeness compared to the cricket injury consensus items. This might be deemed more of an arbitrary measure, given the difference was due to the availability of 24% of claims having identifiable cricketing activity (i.e. batting, bowling, fielding, wicket keeping) available compared to the 4% in hospital data. However, the magnitude of the claims data, meant that 24% was a relatively large sample size (n = 19,971) for conducting descriptive analysis.

The ACC scheme is not a sport specific insurance system, but covers all accidental injury, whether work, sport, leisure or otherwise related. Despite this, the system still captures a rich amount of sports injury data. The information supplied by the ACC was only minimally missing data within the regularly collected data items. The process of data item collection occurs initially with the claimant visiting a health professional, where an electronic form is filled out. There are several items which are not mandatory and these include the free text field of the description of injury event, from which the cricketing activity at injury onset was derived. The reason the fields are not mandatory is due to the no-fault system under which the ACC insurance scheme runs and cover is provided due the injury occurring and not how it occurred. The ACC also provide a disclaimer on the variability of the free text fields, which can make it difficult to accurately search for specific text.

The minimal missing data within the ACC dataset may be attributable to its coverage of the larger non-acute or hospital setting data collection. The variability in health provider experience may provide some additional bias/inaccuracy within the ACC data as mentioned in Chapter 5 (121). Within hospitals, the higher care demand may place greater strains on data input at the time of care, leading to a loss in fidelity.

Despite the richness of the ACC data, there are still areas within the data that limit its usefulness as an injury surveillance tool for organised community cricket. In the same way that hospital data is limited, the ACC data cannot identify accurately the level of formality of the sport played (i.e. organised or recreational). This also extends to not being able to identify the setting of injury, such as match or training. Also the mechanism of injury is not directly available, but can only be inferred through the injury factor variables. The accuracy of these variables may be questioned in some cases as they may be filled out by the claimant, treatment provider or inferred later by registration staff (personal correspondence: Auren Xu, ACC Business Analyst). As previously mentioned, all of these points are important in terms of informing injury prevention measures (246).

10.1.11 Implications of the findings

Overall, this thesis has provided an unprecedented amount of detail on the injury profile of community level cricketers that has not previously be reported. The research has shown that the patterns of injury in cricket vary depending on several factors such as age, sex and the data source from which it was derived. There are also variations from the injury profiles compared to those reported at the elite level.

A difference in community level injuries when compared to the elite level is highlighted by the number of knee injuries reported in both the ACC and NCRPP data. Within the ACC data, many of the knee injuries specifically involved ligamentous damage while the NCRPP data were less detailed, but involved a large number of strain/sprain and rupture/tear injury natures. This would not be unexpected with insurance claims, as knee ligament injuries can result in the need for surgical repair and the potential for time off work. At the elite level, serious knee injuries appear to be less common. Orchard et al (47) noted ligamentous knee injuries were uncommon at elite levels and tended to be more associated with non-cricket related warm up drills. Knee injuries were the fifth most common injury location for elite domestic and international players in NZ, however they were the second highest injury location in terms of match days lost (67). Mount et al (248) noted, in an abstract from the International Olympic Committee (IOC) World Conference on Prevention of Injury & Illness in Sport, Monaco 2014, that non-time loss injuries to the ankle, knee and shoulder injuries were common in elite national players, but thigh strains and lower back injuries tended to be the most associated with time loss. The reasons for the propensity of knee injuries in community level cricket may be as much to do with the nature of the data collection as with likely skill and conditioning differences. The finding may be important from the long term injury burden aspect, where osteoarthritis is seen as a concern (82). Cricket Australia note also that hamstring injuries are typically the most common injury nature for their elite level players, however, over recent years there has been an increase in reported concussion injuries (68). The increase in concussion injuries matches the trends in head and intracranial injuries reported in the hospital data in

Chapter 4 and, as previously mentioned, are possibly associated with the Cricket Australia's introduction of head trauma and concussion policy (68).

Pace bowlers tend to be the most likely players to be injured at elite levels (67-69). Where activity was known, the ACC data reported bowling as the most common activity of injury onset, however the NCRPP data showed fielding was the most common activity of onset. Where activity was reported in prospectively collected injury literature, fielding was the most common activity at injury onset in three of the five cases (177, 178, 182) and in another case there was little difference in proportion between activities (174).

In terms of injury mechanism for batters, impact from the ball is an ever present danger, however the NCRPP data showed acute overexertion also appears to be a highly relevant factor. As with the knee injuries, technical and conditioning factors may play a part. Cricket Australia had noted the increase in hamstring injuries related to changes in the intensity of the game with the introduction of T20 during the early 2000s. Specific strength and running regimes were introduced and have helped reduce the incidence of hamstring injuries (68). Because these shorter formats with higher intensities are being played more at community level, perhaps there is a lag in effective fitness and conditioning that needs to be addressed if these formats are to be advanced.

The lack of data on female community cricket injury is highlighted in this thesis. Much of the injury profiles presented in this research focused on males, primarily because the lack of robust data for females at this stage. Female cricketers at the elite level have been shown to have a higher incidence of finger and hand fractures than their male counterparts (234). The ACC insurance data highlighted a significant difference in female dental injury compared to males and also a sharp rise in female claims in the 10 to 14 years old age group from 2012/13 which seemed likely linked with an increase in participation. Given both Cricket Australia and Cricket NZ report increases in female participation (8, 238), and with the increased media exposure of elite female cricket recently, injury to female community players is an important aspect that should be concomitantly identified and addressed.

Whilst the injury information presented in this thesis adds significantly to the understanding of community cricket injury, it is not without qualification. Most of the existing literature reviewed relates to TRIPP stage 1 only, but the coverage is not comprehensive, nor of overall high quality. Table 115 further demonstrates what information has been used in this thesis and how it populates the injury pyramid. From this, it is observed that the hospital cases fill the upper tiers of the pyramid. The ACC claims data helped fill some of the lower tiers of the pyramid. The ACC data also showed that 8% of claims were treated initially by hospitals, although it is not clear whether these are ED presentations only. This proportion is similar to the 9% of cases that were attributed to organised sport in a NSW population health survey in 2005 (84). The caveats for the study reporting 9% hospital treatment are that it represents only persons aged 16 years or older and it does not account for specific sports. Earlier studies have reported larger proportions 23% in QLD Australia (166) and 25% in the UK (167) respectively. The NCRPP data gave disparate numbers from each of the datasets investigated, due to different data collection. The pre-2007 dataset, using a standard insurance model, had hospital and other practitioner payments available. The proportion of hospital claims associated with hospitals was 23% and allied health 58%, compared with the post-2007 dataset 2.5% and 49% respectively. Three quarters of the existing published literature focusing on medical attention injuries were focused on ED presentations. Only six of these studies reported on at least one of injury nature, mechanism or body location injured (86, 104, 129, 138, 139, 144). Very few prospective or retrospective data studies provided information on where injuries were treated and severity was limited typically to match time loss.

The only potential sources of known organised cricket injury data were from the NCRPP and cricket specific prospectively and retrospectively collected injury studies. Importantly, there had been no in-depth reporting of these data for cricket injury prior to this thesis work. The ACC claims data did separate indoor from outdoor cricket, but much like hospital data, the assumption of organised cricket can only be a best guess by excluding obvious recreational formats via the place of injury. The types of outdoor formats played (i.e. multi-day, one day or 20/20) was generally only reported in prospective (171) or retrospective (185) data studies.

Measures of injury burden can be obtained through hospital data such as bed stay, threat to life or cost per case. Insurance data provides another dimension the injury burden with number of work days paid or weeks lost income paid. This additional information, as presented in this thesis, is quite useful for community levels as it is often the risk to work stability that is seen as a barrier to return to play post injury (7). However, the WDP or LOI information is still only a part of the story, because they represent 4% of claims in the ACC and 25% of claims in the NCRPP.

Table 115. Summary of new information presented in this thesis on numbers of cases, claims and studies related to positions in the sports injury pyramid for community cricket and additional information on level of organised cricket factors. Percentages represent proportions of overall number of cases/claims (n) in each column.

		ACC claims		NCRPP	Existing literature		
	Hospital data (n = 21,366)[1]	Place of sport & recreation (n = 62,776)	Subset activity[2] identified (n = 19,791)	(n = 5,249)	Medical attention studies (n = 13)[3]	Prospectively collected data studies (n = 2)	Retrospectively collected data studies (n = 1)[4]
Death				5 0.1%	1		
Hospital admissions	4,770 22%				4		1
ED presentations	16,596 78%	5,114 8%	872 4%	142[5] 2.5%	10	2	1
Sports medicine/Specialists		1,131 2%	330 2%		3		
Allied health		28,783 50%	13,612 69%	2,551[6] 49%			
GPs / nurses		27,712 44%	4,970 25%		2		1
Sports trainer/ first aid		62 0.1%	7 0.04%				
Pharmacy / self treatment							1
Information on organised level of cricket:							
Organised cricket identified	Partial	Partial	Partial	Yes	Partial	Yes	Partial
Indoor / outdoor formats identified	No	Yes	Yes	Yes	Partial	Yes	Partial
Outdoor formats (e.g. one day, 20/20, long) identified	No	No	No	No	No	Partial	Partial
Sex	M >> F	M >> F	M >> F	M >> F	M >> F	All male	M >> F
Age range (years)	≥ 5	≥ 5	≥ 5	≥ 5	≥ 5	U8 to 53[7]	5 to 38
Severity/burden	Bed stay	WDP	WDP	LOI	Bed stay	TL	TL

[1] Total hospitalised cases (ED presentations less those subsequently admitted), [2] Batting, bowling, fielding, wicket keeping, [3] Four studies covered several categories, [4] One study covered several categories, [5] Based on ambulance payment claims (there were 23% of claims hospital related in pre-2007 data), [6] Based on claims for physiotherapy, chiropractic and dentist (c/w pre-2007 data = 58%), [7] One study had an age range of 18-53 years, but the oldest injured participant was 43 years old. WDP = Work Days Paid, LOI = Loss of Income, TL = Time Loss

From the hospital data, cricket can be ranked in terms of injury frequency and cost relative to other sports. Table 116 shows data compiled from two reports, the first which represents the majority of the tabulated data, reported hospitalised sports injuries in Victoria from 2007/08 to 2009/10 (225). The second study, reporting hospitalised sports injuries throughout Australia in 2011/12 (225, 226), is used to provide additional information on the length of stay, threat to life and proportion of injured > 55 years of age. Cricket injury required a mean length of stay that varied from 0.91 to 1.4 days, placing it in a similar range to basketball, netball, hockey and even Australian football. The average cost per case, for cricket, was at the lower end of the scale compared to other sports at $3,582 and the threat to life was similar to most team sports, varying from 3% to 4% of cases being considered a 6% chance of being a threat to life.

Table 116. *Mean length of stay, cost and high threat to life measures for hospitalised sports injuries in Victoria (2007/08 - 2009/10) and Australia (2011/12). Data adapted from Cassell et al 2012 (225) and AIHW report 2014 (values in parentheses) (226).*

Sport	Frequency	Mean LOS [1]	Mean LOS Rank [2]	Mean cost	Cost Rank	High Threat to Life Cases [3]	% of Injured > 55 years [4]
Australian football	6,275	0.9 – (1.6)	5	$ 3,677	10	5% - (5%)	0.3% (0.1)
Soccer	1,662	1.3 – (1.8)	3	$ 4,187	5	4% - (3%)	1.2% (0.2)
Basketball	1,317	1.0 – (1.5)	6	$ 3,807	8	2% - (2%)	1.3% (0.1)
Netball	937	1.1 – (1.4)	=7	$ 4,351	3	1% - (0%)	2.0% (1.0)
Cricket	**832**	**0.9 – (1.4)**	**=7**	**$ 3,582**	**12**	**4% - (3%)**	**4.0% (2.0)**
Rugby league & union	420	1.0 – (1.7)	4	$ 3,652	11	6% - (5%)	0%
Tennis	336	1.6 – (1.9)	=2	$ 4,557	2	5% - (4%)	35.0% (17.0)
Hockey	287	0.7 – (1.3)	=8	$ 3,475	13	5% - (1%)	3.0% (0)
Baseball/softball	115	0.9	9	$ 3,944	6	4% - (3%)	1.0% (1.0)
Squash	98	1.0 – (1.9)	=2	$ 3,893	7	1% - (4%)	8.0% (2.0)
Volleyball	84	(1.3)	=8	$ 3,780	9	4%	6.0% (1.0)
Badminton	57	1.7 – (1.9)	=2	$ 4,326	4	5% - (4%)	18.0% (7.0)
Table tennis	40	2.7	1	$ 6,816	1	25%	60.0% (55.0)

1. LOS = Length of stay, numbers in parentheses are values from national figures for 2011/12.
2. Rank based on highest mean LOS.
3. Represents % of cases deemed with at least 6% chance of death. Values in parentheses from national figures for 2011/12.
4. Values in parentheses are % over 65 years old.

One of the issues with using either the mean length of stay or cost as a proxy for injury severity is illustrated in Table 116. Table tennis, which ranks number one for both, are shown to have a disproportionately high percentage of participants over 55 and even 65 years old. Using these measures out of context can lead to bias in conclusions due to the relative age of the cases (249). For example, older patients may take longer to recover or stabilise after admission to hospital, possibly due to comorbidities that can affect their health outcomes, or require more home support once discharged. Cricket appears to have a relatively even distribution of ages requiring hospital admittance for injury: 31% of ages 15-24 years, 31% of ages 25-34 years, 24% of ages 35-44 years and 14% 45 years or older. In the 15-34 year age group, compared to the higher frequency injury sports such as Australian football (91%), soccer (82%) and basketball (79%), cricket has a relatively low proportion of injured players (62%) (225). As noted previously, 18% of male participants were still playing cricket above 44 years of age (5). Cricket is arguably a less dynamic game which allows for players to play well beyond 34 years, particularly in the community context. One of the limitations of hospital data is that once a case has been discharged there is no trail of any additional treatment or lost time measures either from work or sport that can illuminate the true injury burden of the individual.

Given all of the above, and including what has been learned in this thesis around the quality of reporting and the completeness of the data investigated, some caution must be applied to the generalisability of the outcomes presented in this thesis. The generalisability of the outcomes presented is addressed further in Section 10.3 Strengths and limitations of the research.

10.2 Research question 2 and aim 2

The second research question of this thesis asked whether an insurance claims systems could be used for injury surveillance in community cricket. The aim was to examine the NCRPP insurance scheme for suitability as an injury surveillance tool for community cricket. In order to answer the research question, a scoping review was conducted to investigate how insurance claims systems have been used to report sport-related injury and identify any themes that would help inform the more specific analysis of the NCRPP system. With an understanding of how insurance systems have been used, their advantages and limitations, the NCRPP system was investigated in two steps: 1) reviewing the NCRPP claims form for data collection validity and potential completeness against the industry standards of the ASIDD and the cricket injury consensus statements, 2) analysing the actual data collected, as supplied by JLT-Sport/Marsh, for completeness and fidelity against the ASIDD and cricket injury consensus statements.

Injury surveillance is important in the overall public health goal of reducing and preventing injuries (12). From a sports injury point of view, injury surveillance helps identify priorities that allow organisational bodies to address issues demonstrating their commitment to improving the safety of the sport (250). Good quality injury surveillance is essential for injury prevention and is required at all stages of the TRIPP model (251).

Although the NCRPP scheme is not specifically designed as an injury surveillance system, the majority of this discussion focusses on the data completeness and quality. This section will use an adaption of various guidelines for the evaluation of injury surveillance systems (12, 210, 252) as a further basis for discussion.

10.2.1 Public health importance of the health event

For this thesis, the public health importance of the health event was limited to the community cricket population of Australia. However, the findings could be translated across countries with similar cricket participation demographics. The health event of interest here is an injury associated with the playing, training and/or organising of cricket or cricket-related events. The importance of the health event, in this context, is relative to several points of view: the sports bodies responsible for the administration of the game (i.e. from Cricket Australia and its State representatives to local associations and clubs), and the participants at the community level. From the point of view of Cricket Australia, associations and clubs, they would prefer community level players to be uninjured, so that they can continue to participate in cricket and be active and contributing members of local clubs and communities. There is also the desire to show that cricket is a safe sport, particularly in the light of the incident that triggered this PhD project (1). From the participant and/or parent/guardian point of view there are several factors that might restrict their future participation, such as concern over getting injured (5) and/or perceived likelihood of restriction of capacity to work and earn money (7).

10.2.2 Description of the NCRPP system

The NCRPP is an initiative from the governing sports body in Australia, Cricket Australia and its State bodies, that provides an economical cover for personal injury costs to community cricketers, volunteers and umpires throughout Australia. JLT-Sport/Marsh insurance provide the cover for the scheme and Figure 105 shows the general flow of a claim into the system. Personal injury cover includes non-Medicare[3] medical benefits, loss of income benefits and capital benefits if required.

The prime purpose of the NCRPP is to cover for personal injury costs to community cricketers and other members of the clubs and/or associations. The injury profile data collected is referred to, on the collection forms, as injury research data. While not specifically set up as an injury surveillance system, the injury data provided by the NCRPP, as demonstrated in Chapter 9, is able to provide information on injury trends and descriptive injury statistics on organised community cricket injury. In terms of the Evaluation Framework for Injury Surveillance Systems (EFISS) (252) the ability to provide information on injury trends would give the NCRPP system a high rating in the purpose and objectives category.

The data collection process, outlined in Figure 105, indicates there may be as few as three steps for injury data to be collated, or potentially up to seven. Three or fewer steps give the system a high to very high rating under the EFISS for data collection (252). Additional steps, such as following up claimants for subsequent information create opportunity for missing or inaccurate data with repeated handling of information. Conversely, this process may help reduce errors.

In terms of case definition, the NCRPP effectively covers any injury (including fatal injury), however, the legislative limits on claims such as only non-Medicare expenses may exclude certain injuries depending on where and how they are treated. This is discussed further under section 10.2.6 ‘Representativeness’.

The timeliness of the NCRPP system can only be addressed in terms of the data collection. The NCRPP system allows for claims to be submitted up to 270 days (~ 9 months) from the time of the incident. If all claims took the full 270 days to submit then the data would be limited in timeliness for obvious reasons given cricket seasons typically run for six months. From the analysis in Chapter 9, the average time to claim was 87 days (60 days for LOI claims). Because the NCRPP system is a trust and insurance system, some claims can be determined by the Trustees. As such, around 2.7% of claims exceed the 270 day time limit. Despite this the timeliness of claims can be considered to be within the annual timeframe considered to be a high rating under the EFISS (252).

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[3] Medicare is the universal healthcare system in Australia.

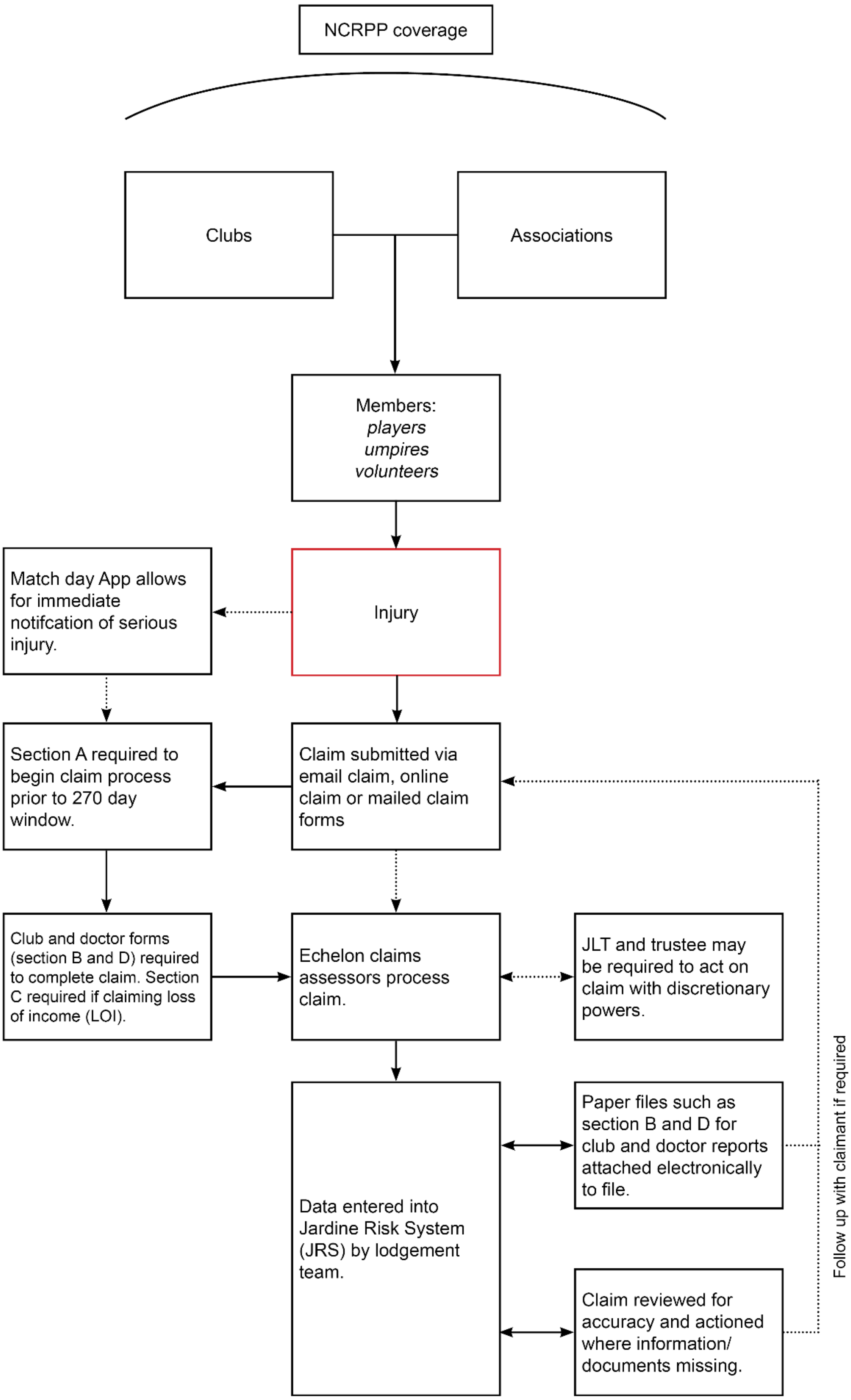

Figure 105. *Model of injury data flow in the NCRPP system as derived by the author of this thesis through personal correspondence (T. Mullen, JLT-Sport/Marsh).*

10.2.3 Data quality characteristics

The characteristics investigated in Chapter 8 related to the data completeness and validity. The data validity of the potential data items available was determined against the industry standards of the ASIDD (11) and the cricket injury surveillance consensus papers (13, 14).

In terms of the validity of the insurance claims data collected, the system compares relatively well in the core and recommended data items and slightly less in the strongly recommended items of the ASIDD. Two studies identified in Chapter 2, Åman et al (87) and Finch (88), also measured insurance systems data collection against the ASIDD. Both similarly reported over 90% of data items were present in some form and 100% of the core items were present in some form. This reflects the extensive scope of the data collection via the insurance claims forms. When the NCRPP data were analysed for completeness, the ASIDD core data items were shown to score the highest, showing a high fidelity of data transfer from insurance forms to data supplied. The post-July 2007 data had a higher fidelity than the pre-July 2007 data in both the core and strongly recommended items, but was marginally lower for the ASIDD recommended items. Importantly, the core ASIDD items were shown to have a high level of fidelity in the insurance data provided, lending support for the system's suitability as a sports injury surveillance tool at a fundamental level. The only area where the ASIDD core items were limited in completeness was the mechanism of injury. The injury mechanism was a particular data item amongst insurance claims data, shown in Chapter 2, as one in which there was an obvious lack of information. The absence of injury mechanism detail is perhaps not surprising as injury surveillance is not the primary focus of the insurance claims system.

Data completeness was also measured against the ASIDD and consensus statements, where data completeness is most often referred to as the amount of data that is missing, not known, other specified, unspecified, unknown or blank (252, 253). Overall the data supplied by JLT-Sport/Marsh for analysis was relatively complete with significantly more missing data in the post-July 2007 dataset than the pre-July 2007 dataset. This was largely driven by the weather and surface data items that were both just under half complete. It is unclear whether this is an artefact of data input into the system or whether the data fields were left blank on the form by the claimants. The presence of an online form may, in the future, allow data collection to be more consistent in this regard. Check boxes could be made compulsory in online forms to prevent claimants from skipping over data items deemed crucial for injury surveillance purposes.

In the analysis performed to identify injury mechanisms from the description of injury item, it was clear that there was not enough detail in the descriptions to be coded with sufficient accuracy as to be reliable. As noted in Chapter 7, the description of injury could be collected from several places in the insurance forms, including the claimants' own description and that of the attending physician. However, it is the details from the claimants' description that are inputted into the insurance system (personal correspondence: T. Mullen JLT-Sport/Marsh). The obvious issues with this are the claimants' ability to recall the inciting event and adequately describe it. The only guidance on the forms for the claimants is to 'describe the injury event and how it happened'. Given the potential variability of responses possible, it is perhaps surprising the level of injury mechanism information that was able to be extracted. The inter-coder reliability was relatively poor, suggesting the coding principles derived from the ASIDD were not entirely appropriate. Another possibility is that the injury mechanism coding items were too complex and/or detailed, allowing for more inter-operator interpretation.

The existing data system used by JLT-Sport/Marsh has a field for injury mechanism but it currently does not contain any information (personal correspondence: T. Mullen JLT-Sport/Marsh) (Figure 106). This does suggest flexibility within the system. The future possibility exists of being able to extract more detailed injury mechanism if appropriate mechanism check boxes were utilised in the data collection process in conjunction with the description of injury.

Figure 106. *Screen shot from JLT-Sport JRS data system indicating the injury mechanism option is not utilised. Screen shot supplied by JLT-Sport.*

Other areas where the NCRPP data completeness was limited was related to the cricket injury consensus items. All of the consensus items were potentially available in some form, however the fidelity of these was only 50%. Mode of onset and activity at onset are two items particularly necessary for informing injury prevention measures. Mode of onset was derived from the injury mechanism coding and as such was subject to the same accuracy issues noted above. The activity at onset completeness was derived from the player position variable in the insurance data provided. The player position variable had around three times the missing data in the post-July 2007 dataset as compared to the pre-July 2007 dataset. Because of this, an analysis was run to observe any patterns in the missing data. The majority of the missing data in the player position data field seemed to occur in a spike over the 2014/15 timeframe. Several possible reasons for this may include: 1) data missing from insurance forms; 2) data input omission; 3) change in administrative process. It is unlikely that this level of information was missing from the insurance claims forms filled in by claimants. It is more likely that options 2) and 3) involved. From the changeover of the insurance scheme in July 2007, the system ran on an annual basis from 1 September to 31 August until the 2014/15 period, where it was shortened to the 30 June 2015, and subsequently continued from 1 July, 2015 to June 30, 2016 etc. henceforth (personal communication: T. Mullen JLT-Sport/Marsh). Therefore, the 2014/15 period was two months shorter than typical, however this does not readily explain the large amount of missing data in the previous year. A process system upgrade occurred in 2012, where a new 'front end' was created and operating system improvements were made. Again the timing of this does not match the period of missing data, however, the upgrade may have inadvertently lead to some fields being confused or not converted (personal communication: T. Mullen JLT-Sport/Marsh).

One of the key features of an injury surveillance system is that it is ongoing and the data is continuous (250). Changes in administrative procedures and data input need to be carefully managed to prevent such large batches of missing data that can seriously hamper surveillance, which in turn can hamper any injury trend identification and/or preventative measure effects. Quality assurance was raised as an issue in one study (126) reported in Chapter 2. It is likely that insurance companies would have quality assurance processes above and beyond their statutory and legal data collection requirements, but this may not be as rigorous, or present, for data collected for research purposes, i.e. purposes other than direct day to day running of the insurance system.

Using CDC guidelines for assessment of injury surveillance systems (210), additional attributes used to assess the NCRPP system are:

- Usefulness
- Flexibility
- Acceptability
- Representativeness
- Timeliness
- Stability

Note: other attributes such as system sensitivity and predictive value positive were not able to be assessed in this thesis discussion because the NCRPP is not actually designed to be an injury surveillance system and there is also no gold standard community cricket injury surveillance data to compare it to.

10.2.4 Flexibility

The flexibility of an injury surveillance system can be assessed by its ability to take on changing information requirements or sources, operating conditions, new or varied injury definitions and so forth (210). The NCRPP system has adapted to changes in injury research data needs on claims forms over the years as noted in Figure 107 and outlined in Chapter 7.

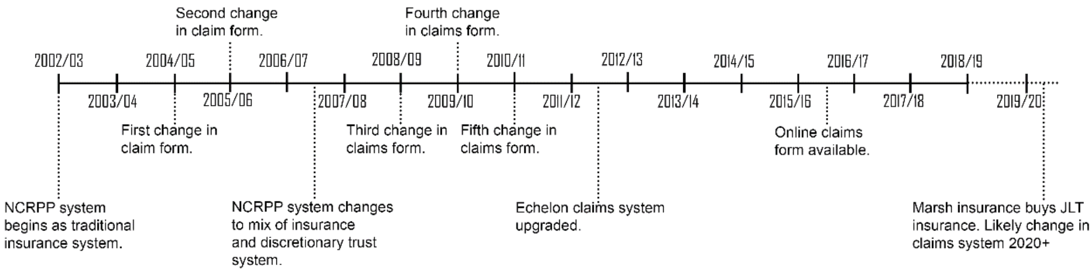

Figure 107. *Timeline of NCRPP system and claim form changes over time derived from claims form information and personal correspondence (T.Mullen, JLT-Sport/Marsh).*

There was also a necessary adaptation to the change in structure from a standard insurance system to a combined discretionary trust and insurance system in 2007. Analysis of the data collection forms and completeness/fidelity of the data were performed on the information collected either side of this milestone. It was shown that there was an additional two data items collected post-2007 era and also an almost nine-fold increase in missing data. The increase in missing data, however was mainly attributable to three data items: postcode of incident, weather and surface. It is not clear whether this data gap is due to forms not being filled out fully or data entry error. Despite the increase in missing data, these items were outside the core data items of the ASIDD and the fidelity (amount of potential data translated from forms to actual collection) of the data still increased from 84% pre-2007 to 97% post-2007. Similarly, the fidelity of the ASIDD strongly recommended items increased from 30%, pre-2007, to 37% post-2007. The ASIDD recommended items remained relatively constant between eras. On this basis, the system has appeared to have improved its ability to capture core and strongly recommended data items from the ASIDD over time.

10.2.5 Acceptability

The acceptability of a surveillance system is a measure of the inclination of individuals, such as members of the community cricket network and organisations such as Cricket Australia, to participate and utilise the system (210). A survey by Cricket Australia in 2017, found that 85% of clubs/associations were aware of the insurance coverage under the NCRPP (personal correspondence: D. James, Cricket Australia, 2018). Therefore, there is possibly 15% of clubs/associations without coverage and hence would not be represented in the injury profile data collected. There may also be circumstances where potential claimants are unaware they are covered by their club or association (122). The implications for this reflects on the representativeness of the data overall.

10.2.6 Representativeness

Representativeness is defined in the EFISS as the ability of the data collected to provide an accurate representation of the key characteristics of the target population (252). The CDC also describes representativeness as the system's ability to accurately describe the occurrence of injury over time and its distribution in the population by location and person (210). Additionally, the CDC recognises that the quality of the data is a major part of its representativeness (210).

Apart from the quality aspects discussed above (validity and completeness), other factors, such as information bias, can have an influence on the representativeness of the surveillance data. The NCRPP system, like most insurance systems, is essentially limited to medical attended injuries. Each claimant must see a medical practitioner or approved allied health practitioner to validate their injury. Unlike NZs ACC insurance scheme, the NCRPP can only provide compensation for claims that are not covered by Australia's national public health coverage under Medicare. The Medicare system pays for much of the emergency level care such as hospitals and a portion of primary care such as general practitioners. This could preclude collection of injury information at both ends of the sports injury pyramid such as acute level trauma injuries that are hospitalised, and those more minor injuries seen by the local GP. A similar public health system also occurs in Sweden, but does not appear to have lessened the effectiveness of an insurance claims injury data collection (114). A major limitation of insurance claims systems from the studies reviewed in Chapter 2 was that minor/minimal injuries would be under-reported for similar reasons as above. Some insurance systems require claimants to go through their private insurance for treatment cost recovery first, which may exclude those injuries from surveillance detection. Claimant's may decide it is not worth the effort to proceed or their recovery is sufficiently covered and there is no further need to claim through the sports insurance system (117). Anecdotally, around 10% of claims in the NCRPP which are lodged with JLT-Sport, were deemed not eligible for coverage and these were most likely due to having already been covered by Medicare (personal correspondence: T. Mullen and J. Taylor, JLT-Sport). A limitation of several insurance systems in the USA was that claimants may have chosen to use their private insurance over the sports insurance (100, 108). In Australia, just over half of the population has private health insurance (254). Again, it is possible that for some of the more minor injuries, members may not bother submitting a claim if their private health already insurance covers an acceptable amount of the cost of treatment. Chronic injuries are another injury type that may be under represented in insurance claims due to either being not eligible under the insurance scheme (91, 111) or not reported by the system (109, 128). The NCRPP data appeared to contain injuries that were chronic, i.e. not acute trauma, however it was not possible to determine the true extent of these injuries due to the lack of accurate injury mechanism data.

Another form of information bias can occur through inadequate or inappropriately designation of an injury definition. As with hospital data, where each case represents an episode of care rather than a single injury, each claim in the NCRPP could represent more than one injury. There were 446 claims (8.5%) where multiple injuries were reported and 45 claims with multiple locations reported for body location of injury. The use of multiple injuries as an injury nature can affect the fidelity of the injury surveillance system. If, for example, the system is aimed at detecting head injuries and concussions, then having the category of multiple injuries may be detrimental to the sensitivity of the system picking up the correct number of these injuries, and in turn any changes in trends.

Recall bias is another form of information bias that is likely to be present in insurance claims data. The fact that a claim may be submitted up to 270 days post injury can lead to an increase in recall bias. Recall bias can also be an issue with most insurance systems requiring claimants or proxies such as parents and or physicians to fill out forms. As with the NCRPP, most insurance claims systems require a medical assessment leading to possible accuracy issues with the diagnosis. Diagnosis accuracy can be an issue for an injury claims database where the claims form is submitted with a provisional or working diagnosis and is not later updated. A lack of follow up reporting from the initial diagnosis, or the relative experience or interpretation of the initial medical assessor can also be a factor (94, 95, 111). As for the NCRPP, other insurance schemes such as the ACC, allow a broad cross section of medical and allied health assessors to provide the initial diagnosis (121).

There may also be some gender bias depending on the injury nature. One study found that moderate to serious injury claims for several sports in New Zealand was proportionally higher in females and suggested that females may have a greater propensity to report injury than males (98).

The accuracy of the injury diagnosis can also affect the representativeness of the collected data. Within the NCRPP only 37% of the injury nature and 83% of injured body location could be matched to the description of injury event. Therefore, inclusion of the medical diagnosis required on the claims form (Section D) into the data stored/reported would allow for more accurate cross checking and improve confidence in the injury data.

In terms of population characteristics, Table 117 shows the age group proportions as reported by Cricket Australia for the 2016/17 season. From the NCRPP claims, the 19+ year old age group is overrepresented in injuries, whilst the junior age groups appear to be underrepresented. The lower proportions of younger age groups (i.e. under 19 years of age), is reflected in the limited evidence of prospectively collected injuries in junior cricketers in Australia, where 8.5% of injuries were advised to seek or required medical attention (174). The overrepresentation of claims in the 19 years or older group may be in part associated with the greater likelihood of claims seeking loss of income benefits. Table 118 shows the relative proportions of males and females participants reported by Cricket Australia from 2016/17. The NCRPP claims indicate an overrepresentation of males. The NCRPP proportions were similar to those found in the ACC and hospital data. The relatively low proportion of female claims could reflect the majority of female participation is in the developmental and junior forms of the sport at younger age groups (70%), not including school competitions (personal communication: A. Hepburn, Cricket Australia).

Table 117. *Comparison of age group proportions by Cricket Australia (CA) participation and NCRPP claims for year 2016/17.*

Source 2016/17 year	5 to 12 years old	13 to 18 years old	19+ years old
CA participation	30%	23%	47%
NCRPP claims	3%	13%	84%

Table 118. *Comparison of proportions of male and female Cricket Australia (CA) participants and NCRPP claims for year 2016/17.*

Source 2016/17 year	Male	Female
CA participation	73%	27%
NCRPP claims	97%	3%

In terms of actual numbers, Soomro et al reported 86 injuries, from 408 cricketers, in the Sydney area over the 2015/16 season (171). The number of NCRPP claims received from the metro NSW region over the same time period was 80 or 93% of the prospectively collected injuries. The similarity is encouraging, however it is not known how many of the prospectively collected injuries were claimed through the NCRPP. Also, the Soomro et al (171) study only looked at the premier competition in Sydney, precluding other lower grades, and therefore may not be fully representative of community cricket in Sydney or Australia. When the NCRPP data were queried further, just for NSW premier cricket (also previously known as Sydney Grade Cricket), 165 claims were received from that association in the entire 12 year period, amounting to 17% of all NSW metro claims.

In terms of injury severity, the NCRPP can be used to estimate loss of income (LOI) measures (as outline in Chapter 9) or cost measures, but neither may be representative of the true injury burden to community cricketers. The claims forms do ask for club representatives to identify when a claimant has returned to training or playing, and the medical section also requests an estimated time to return to play. It is likely that the majority of these items would not be filled out accurately, as forms may be submitted before full resolution of the injury. More so, these items are not transferred the Jardine Risk System (JRS) and so are not readily available for analysis (personal communication: T. Mullins, JLT/Marsh insurance).

10.2.7 Usefulness

The CDC definition of the usefulness of an injury surveillance system is if it “contributes to the prevention and control of adverse health events, including an improved understanding of the public health implications of such events. A surveillance system can also be useful if it helps to determine that an adverse health event previously thought to be unimportant is actually important” (no page no.) (210).

Because the NCRPP has not been officially used as an injury surveillance system, its usefulness can only be judged on the potential for it to be those things described above. As the CDC also note, the usefulness will depend on the objectives of a surveillance system (210). As these are yet to be formally determined by the stakeholders, the potential of the data repository can only be assessed against six of the seven items suggested by the CDC (210), adapted and summarised in Table 119.

From Table 119, one of the six questions is adequately addressed and in accordance with the CDC guidelines for evaluating an injury surveillance system (210), deeming the NCRPP system useful by CDC measures. The potential for improvement can be seen by the fact that the NCRPP system is able to at least partially answer the remaining questions. Some additional recommendations are suggested for future improvements in order to enhance the usefulness of the NCRPP as potential injury surveillance system for community level cricket.

Table 119. Capacity and or potential for NCRPP against CDC usefulness guidelines in evaluating injury surveillance systems.

Usefulness comparator. Does the system:	Capacity and or potential of NCRPP	Future improvement
Detect trends signalling changes in occurrence of injury?	Yes. Chapter 9 showed the NCRPP data to be suitable for detecting trends in injury occurrence.	Improvement around participation identification, especially in younger and older age groups to better identify age-related trends
Provide estimates of the magnitude of morbidity and mortality related to the health problem under surveillance?	Partial. The NCRPP system was shown in Chapter 9 to have the potential to identify morbidity aspects through LOI claims, however the true representativeness of this is unknown. The system has the capacity to record fatalities, however the circumstances around the cause were found to be limited, something also seen in other sports with a similar data collection (96). Cricket is yet to formally include death as a documented outcome within their injury consensus (215).	Potential improvement in linkage between MyCricket App and JRS to identify time of return to match play. This will enable a more consensus orientated time loss assessment.
Stimulate epidemiological research likely to lead to control or prevention?	Partial. The data currently can be used to generate descriptive statistical reports, such as described in Chapter 9, however some improvements and additional data would be required to facilitate injury prevention measures.	Improve injury mechanism capture to enable identification of injury risk and protective factors (212). Addition of protective equipment identification/usage in data collection.
Identify risk factors associated with injury occurrence?	Partial. There is some ability to identify injury mechanism with the existing data, however, as shown in Chapter 8, this data is unreliable in its accuracy.	Improve injury mechanism capture to enable identification of injury risk and protective factors (212).
Permit assessment of the effects of control measures?	Partial. Broad based, injury numbers and trends could be identified with the current data. More accurate identification of injury risks/mechanisms would be needed to facilitate stages 2 and 6 of the TRIPP model (10).	Improve injury mechanism capture to enable identification of injury risk and protective factors (212). Addition of protective equipment identification/usage in data collection.
Lead to improved clinical practice by the health-care providers who are the constituents of the surveillance system?	Partial. There is limited knowledge on who the clinical providers are within the data. The system could be better used to identify which types of injuries are seen by which practitioners, similar to the ACC system as reported in Chapter 5.	Addition of data collection for first health practitioner seen data collection.

10.2.8 Recommendations for the NCRPP in future injury surveillance

The following recommendations are made for improving the NCRPP injury data collection system in order to enhance the usefulness of the system as a future injury surveillance tool for community cricket.

1. Addition of medical diagnosis/history into the JRS system, from section D of the claims form, will help verify and validate injury nature and body location (as per the cricket injury consensus item 2 (13)).
2. Inclusion of injury side (e.g. left, right, bilateral, central) as per cricket injury consensus item 3 (13) may help with specific injury monitoring, particularly in bowlers, where repetitive movements are predominant. This information would also facilitate examination of subsequent and multiple injuries (255).
3. Inclusion of whether the injury is recurrent or new (as per cricket injury consensus item 4 (13)), which may help in understanding injury profiles over time and whether appropriate rehabilitation is being undertaken.
4. Allowance for multiple injuries to be recorded separately. This is important in helping understand the injury risks associated with each injury (255) and improves the sensitivity of the surveillance system.
5. Rationalisation of the injury nature terms such as tear/rupture and sprain/strain. Unless matched to a more detailed diagnosis code it would be simpler to use sprain/strain alone. Whilst tear/rupture can be more specific, it is only useful when describing the exact structure affected. For example, a tear/rupture of the Achilles tendon is self-explanatory, however a tear/rupture of the knee requires more information to be useful. Useful current guidance on this has recently been published in an international consensus statement on sport injury and illness surveillance (212).
6. Reintroduction of injury mechanisms options (refer to directions of future research section 10.4). This is paramount for future injury prevention measures.
7. Addition of protective equipment usage options. This should include helmets, batting and wicket keeping gloves, groin protectors, thigh guards (inner and outer thigh or outer thigh only), forearm guards, chest guards, batting and wicket keeping pads and eye protection. These could be expanded to understand not only what equipment was or was not used, but the brand and age of the equipment. It might be helpful to have photos of any damaged equipment used in the injury event, particularly for helmets and gloves, which could assist in understanding of the injury mechanism. This would be useful in the assessment of injury prevention measures and policy effectiveness.
8. Introduction of fielding position options for injuries associated with fielding. As required by the cricket injury consensus statement and demonstrated with indirect analysis (233), the likelihood and method of being exposed to contact with the ball, depends on the position in the field. For simplicity, positions may be collected into

fielding regions such as: catching behind wicket/batter (i.e. slips and gully), catching close in (e.g. short leg, silly mid-off, or within seven metres of the bat, where helmets are typically mandated), in-fielding (i.e. within 30 metres of the batter), and out-fielding (i.e. beyond the 30 metre infield margin). Knowing this exposure factor may assist in injury prevention policy, such as designated catching fielders being allowed to wear some form of finger protection.

9. The movement towards a predominantly online claims form system allows for more flexibility with tick/check box type selections for claimants. It also allows for items to collect more extensive information where appropriate and less requirements for 'other' or 'unknown' options (12). Forms can also be designed to prevent claimants from not selecting an option and hence improve the completeness of data collection.

These recommendations have been identified around the predominantly musculoskeletal injury data collected. Potential future aspects that might be address include other areas such as systemic injury (e.g. cardiovascular, exertional heat injury) and illness.

10.3 Strengths and limitations of the research

The overall strength of this thesis is that it provides the most comprehensive collection and analysis of injuries to community level cricketers to date. The research has gathered injury profile information from four separate and diverse sources from existing literature, hospital data, public and private insurance claims systems. The latter are highly important due to the insufficient depth of injury data apparent from the literature review, and thereby add substantial knowledge to the community cricket field.

This thesis also provides the first known, broad analysis of insurance claims systems and their sports injury surveillance features through a review of the existing literature and mapping to external standards. With a broad understanding of the advantages and limitations of insurance systems in mind, an in-depth analysis of an existing private insurance system that collects injury profile data on community cricket injuries was undertaken. From this research, recommendations have been made to improve the NCRPP system for the future purpose of ongoing injury surveillance at the community level with the potential to monitor injury prevention strategies and policies on a national level. There is strong potential for the lessons learnt from this research to be applied to other community sports under similar insurance schemes.

Each study within the different Chapters of this thesis has its own strengths and limitations. The following sections discus these in turn.

Chapter 2 investigated the use of insurance claims systems in the reporting of sports related injury in general. The Chapter was a scoping review based on a systematic search of the literature. **The strength of the study is that is the first such review looking at how insurance**

claims systems have been used and how they compared to the ASIDD in terms of core data items collected. The Chapter provided an overview of the advantages and common limitations of insurance systems in the collection and surveillance of sports injury. The review is limited in that while the search was done systematically, the study eligibility and data extraction was only done performed by one person and as such there may have been some studies or data extraction missed in the process. This review also only looked at studies in the English language.

Chapter 3 presented a systematic review that aimed to collate all the injury outcomes and reporting quality of the existing literature on injuries in community cricket. **The strength of this Chapter was that it provided a comprehensive summary of community level cricket injuries in the published literature, across different forms of data collection avenues**. Notwithstanding the limitations of the data and outcomes presented, previously discussed in Section 10.1 of this thesis, there are several other potential limitations of this review. Firstly, the search was limited to publications in English and it is possible (but relatively unlikely) that other countries with high cricket participation, such as those in the South Asian region, may have national published research in local languages. Instead, almost all the studies in this review were produced out of Australia or South Africa and therefore, these results can only be generalised to these countries. Secondly, the definition used for community-level cricket may have excluded articles that had community-level players within their cohorts but with data that were not separable from other sports or other levels of play. There were at least two studies where this was identified (229, 256) and they were excluded, and it is unlikely that the addition of the data would change the conclusions of this review. Separating out injury data for community-level players in future research is recommended as it appears the injuries differ and certainly the ability to collect information on these injuries differs.

The use of a self-designed tool for quality assessment, and the choice of items for determining risk of bias, was required to meet the aims of the study and efforts were made to trial and review its application for this purpose. However, this tool was not formally validated and may have unintentionally over- or under-estimated the quality of the included studies.

Chapter 4 used hospital data to provide descriptive statistical analysis of male acute medically attended injury related to cricket over a 15 year period in Victoria. **The strengths of this Chapter are that it presents a complete capture from Victorian public emergency departments and all public and private acute hospital admissions, so is highly representative of acute cricket-related medical attention injuries in males, in Victoria**. It is also the largest time period of data consistently collated and reported on for cricket-related injury. A major limitation for interpretation of the data, however, is that the denominator for the injury rates was restricted to population data. There is a scarcity of continuous, reliable participation data publically available for cricket at the community level, particularly over as long a timeline as this study investigated. Previous studies have reported similar issues (136).

Without accurate participation data it is difficult ascertain whether an increase in injuries is due to increased participation alone or to other factors, such as age, policy, rule or equipment changes and such, which are critical to meaningful trend and injury risk analysis.

Other limitations of the material in Chapter 4 are due to the nature of the data collection and coding:

- There is only one activity code within the International Classification of Diseases (10th edition-Australia modification) (ICD-10-AM) for cricket (U51.1), which prevents separation of indoor and outdoor forms of the game. This is important as up to 25% of the participants in Australia play indoor cricket (8).
- Incomplete data items such as ‘place of activity’ in hospital admissions and ‘specific cause of injury’ in ED presentations may lead to an overestimate of the number of organised cricket cases in the former for this Chapter and an underestimation of true cases in the later (245).

A change in hospital admissions policy at July 1, 2012, had the effect of reducing the hospital admissions recorded post 2012/13 financial year (257). A likely effect in this dataset is seen in the universal dips in the IIRs for admissions in each age group (Figures 11, 12, 14, 16, and 18) in 2012/13. The VISU makes every attempt to allow for this in the provision of their data, but the artefact on any trends remains difficult to assess (257).

Chapter 5 used existing data from a longstanding national insurance scheme in NZ, run by the ACC, to analyse cricket-related injury in both male and females over a 12 year period. **The strength of this Chapter is the nationwide capture of cricket injury claims for NZ of all ages and sex**. The depth of the data provides an unprecedented examination of cricket-related injury in NZ, the majority of which is community based and not previously reported.

Limitations of the ACC data include:

- Whether the data provides a true reflection of the organised community level injury profile is not fully known. Whilst the majority of the data associated with the ACC cricket injury claims was associated with a place of recreation or sports, this does not preclude casual or informal cricket. However, in order to maximise the likelihood of organised cricket injury being examined, this study identified those claims which specifically related to the activities of cricket (batting, bowling, fielding and wicket keeping) from the description of injury, particularly when looking at injury mechanism. Future inclusion of the level of formality of the cricket or sport played when injured would facilitate better injury surveillance.
- Issues identified in Chapter 2 are potentially also present in the ACC data. Recall bias is a possible factor with regard to the description of injury event which was used to

identify the activity associated with injury. Also the accuracy of the diagnosis is an unknown because there may not be an update on the original, possibly provisional, diagnosis made on the initial visit in which the claim was submitted (121). Some effect of this might be seen in the relatively large number of knee and shoulder injuries classified as 'knee sprains' and 'shoulder sprains' rather than stating a specific structure or tissue involved. The experience of the healthcare provider may also influence this process (121). Differences were observed in the relative amount of non-specific diagnoses of the knee provided across the three main injury providers: physiotherapist had 79% of knee diagnoses either generic 'sprain of knee and leg' or 'knee sprain not otherwise specified', hospitals had 26% and GPs 21%. This does not necessarily indicate a difference in accuracy of diagnosis, but does indicate a greater likelihood of more provisional diagnoses being made by physiotherapists.

- The recording of injury factors within the ACC system is relatively detailed and designed to cover a broad spectrum of accidental injury in NZ society. It has not been specifically designed for sports injury surveillance. The result of this was some loss of resolution in the ability to examine, in depth, the injury mechanism with a great degree of confidence.
- Another common issue with insurance claims data identified in Chapter 2 was present in the ACC dataset. There was no indication as to whether the injury occurred during a match or during practice. It may be possible to identify this, at least in part, from the injury description variable, however this was not investigated in this Chapter. Because the injury description variable is a non-compulsory field, due to the no-fault system adopted, it remains unknown how much detail could be extracted from the current data. Given that the activity of onset could only be derived from 31% of claims, it is likely that the setting information would be less, or at best the same, as this value. Future inclusion of this variable in the data collection would be advantages to cricket and sports injury surveillance.
- A confounding factor for injury severity analysis is the fact that WDP was used as a proxy. The type of injury and the determination of whether time off work is required is dependent on the type of work the claimant performs. For example, a stress fracture of the lower back will likely restrict a person who is required to do manual labour, but much less likely restrict a person with a sedentary occupation. However, the stress fracture will equally restrict each person from playing cricket, especially bowling. The assumption that while a claimant is unable to work, they will likely be unable to play cricket is a reasonable one, however there are many more injury claims that did not require WDP that would potentially restrict a claimant from playing cricket. Also, using WDP eliminates the younger age brackets from severity assessment as it cannot give any information around the severity of injuries in these groups. Therefore, the WDP

severity measure is a useful indicative measure of injury severity, but does not reveal the full extent of the injury burden.

Chapter 6 analysed the validity of the data collected by prospective community cricket injury studies compared to the core items of the ASIDD and the cricket injury consensus. The VISU hospital and ACC insurance claims data were also assessed for completeness against the core items of the ASIDD and the cricket injury consensus. **The strength of this Chapter was that it is the first to assess existing community cricket studies for the validity of their outcome reporting against industry standards**. In doing so, the study was able to highlight deficiencies in outcome reporting that ultimately hinder development of injury prevention measures. A limitation of the analysis done on the prospectively collected injury data studies is that it included some studies in which injuries were an outcome but the primary aim of the study was a specific biomechanical query. Therefore, it might not be surprising that the collected injury data component would not necessarily meet gold standard epidemiological guidelines. As suggested for other sports, stronger collaboration with injury epidemiologists can support improved injury data methods to answer the important questions posed by other relevant professionals and clinicians (258). The timeframes for inclusion of studies in this review pre-dated the development of the first international cricket injury surveillance consensus statement, which could also unfairly bias these studies as there was no documented 'best practice' at the time. However, the eight studies that collected data after the consensus statement was published had lower overall completeness ratings than did the studies that collected data prior to the consensus statement, perhaps reflecting difficulties in adopting its recommendations.

A limitation of the analysis of data completeness for the VISU and ACC data was the fact that the data were supplied in aggregate form and specific interrogation of the initial unit record dataset was able to be not undertaken for ethical and privacy reasons. For example, the description of injury variable in the ACC data were searched by the data providers and not accessible. Similarly, for the hospital data, information in the free text fields is not accessible to the public. Additional information, particularly relating to the injury consensus statement may have been, at least partially available, in addition to the information provided by the ACC. However, the additional, case-level, information would have been subject to a more stringent ethics approval and may not have been released. It is therefore likely that the assessment of the two datasets may be unfairly graded against the cricket injury consensus statements.

Chapters 7 and 8 investigated the validity, completeness and fidelity of community cricket injury data in the NCRPP system from the inception of the scheme. **The strengths of this research is it the first in depth assessment of an insurance system to determine it suitability for injury surveillance in community cricket**. A limitation in the assessment of the validity of the data collected, in Chapter 7, is that it relied largely on the ASIDD. The ASIDD is one of the most referred to systems for sports injury data collection, analysis, tool development and reference in the last 20 years, and is the summation of best practice from Australian and international injury surveillance systems (15). However, the ASIDD and the best practices it was derived from are now over 20 years old and likely need updating. The other limitation in the validity assessment was the measure against the cricket injury consensus statements (13, 14). The original consensus statement was designed with elite, international cricket, in mind (13). The 2016 update gave some attention to community level cricket, but was essentially still focused on elite levels (14).

In Chapter 8, the limitations of the analysis of data completeness and fidelity firstly lie within the insurance data provided. There were four ASIDD items, two within the strongly recommended items (date of presentation, advice given to injured person) and two within the recommended items (time of injury, reason for presentation), that were present on the insurance claims forms that did not have any data associated in the dataset provided. There was also one cricket injury consensus statement item (new/recurrent injury) that was present on the insurance claims forms that did not have any data associated with it in the dataset provided. It is likely this information exists within the paper files of JLT-Sport/Marsh, but does not get translated into the electronic JLS system (personal correspondence: T. Mullen JLT-Sport/Marsh).

The injury mechanism coding was limited by the adoption of a non-validated system as it was only trialled on the NCRPP data. It was adapted from an industry standard sports injury surveillance guide in the ASIDD (11). Second and third coders were used to see if a consensus could be reached, to help validate the process. This approach served to reinforce the conclusion that the information provided in the description of injury is insufficient to fully accurately and consistently code for injury mechanism.

Chapter 9 used the data supplied by the NCRPP system to provide a descriptive statistical analysis of, predominantly male, community cricket injury in Australia over a 12 year period. **The strengths of this Chapter are that it is a comprehensive profile of organised community cricket injury in Australia. This study is also the first to report, on the burden of injury to community level cricketers in Australia**.

The limitations of the data collected in the NCRPP for cricket injury surveillance largely revolve around the lack of collection of information on the mechanism of injury. Additional limitations parallel the ACC data:

- Recall bias will have some part in the accuracy of the description of injury event, particularly given there is a 270 day claim window available. However, this point is largely moot, given Chapter 8 showed that the description of injury event variable was unreliable for accurate classification of injury mechanism. Nonetheless, this variable is still a strongly recommended item in the ASIDD and as such injuries should be reported as early as possible to limit any recall bias.

- The use of LOI for approximating injury burden is limited because not all injuries are equal for different individuals. Similar to the arguments made around WDP in Chapter 5, injury burden will depend upon the occupation of the claimant requiring LOI support. Because the NCRPP has a cap of $500 per week LOI payment, the occupation is less about the amount the claimant earns and more about their work related duties relative to their injury. Using LOI also excludes burden analysis of younger age groups who are not yet working.
- An unknown factor in the NCRPP data is whether it is a truly representative sample of the injury profile at the organised community level. Being an insurance scheme, there are limitations on what can be claimed and hence included in the dataset, some of which is driven by legislative requirements based on the health system in Australia. The ACC, on the other hand, is a no-fault insurance system, which automatically generates a claim when an injury is reported to a specified health practitioner. By definition, both the NCRPP and the ACC systems report medically attended injuries. However, it appears that for the NCRPP system, claiming is driven more by the need for LOI support, with a greater proportion of claims generating LOI support for more than six months than seen in the NZ system. As such, it is possible that many lower severity injuries may not enter the NCRPP system as they are largely covered by the existing public and private healthcare systems and insurances and not the cricket insurance scheme.
- Another point, in keeping with the above, is the extent to which how many registered players in Australia are fully aware of the NCRPP. A Cricket Australia survey, done in 2017, reported that only 85% of clubs/associations, from the 90% that responded, were aware of the automatic insurance cover under the NCRPP (personal correspondence, D. James, CA, 2018). This suggests that not every player at each club/association is aware of this coverage.
- The period 2013/14 had a large amount of missing information (9.3%) on the activity of injury onset (i.e. batting, bowling, fielding, wicket keeping, etc.) may have had an effect on the results. There was no obvious reason for this anomaly (personal correspondence: T. Mullen, JLT-Sport), however further investigation was not undertaken. Nonetheless, given that the missing data applied to all activities it is less likely to affect the overall profile of injury claims.
- Missing information can affect the ability to detect and analyse trends accurately. Additionally, the potential lag time in claims being registered (up to 270 days allowed), may affect the interpretation of trends. The overall average time to claim was found to be 87 days, or roughly three months. A possible effect of this may be seen in the 2018/19 season where there was a dip in claims for both males and females after both had been trending upward (Figure 79, Chapter 9). Retrospective analysis should take the time lag for submitting claims into account for future research.

10.4 Directions of future research

10.4.1 Prospective injury surveillance

The findings from Chapters 3 and 6, in particular, highlight some of the major hurdles in conducting injury surveillance at community level, especially in regard to prospective injury data collection. The updated consensus statement (14) for cricket injury surveillance was published in an effort to broaden applicability, including for community level cricket with the following recommendations:

- Player reported injuries only, where there are no trained medical staff available.
- Region diagnosis only, e.g. knee, shoulder etc.
- Broad mode of onset, e.g. batting, bowling, or fielding.

There were a total of 15 prospective cohort studies specific to cricket identified in the systematic review in Chapter 3. The majority of these studies (n = 11) were performed prior to the publication of the updated consensus statement. There were only four studies (171, 177, 178, 182) post-consensus update (2016), two of which reported injuries secondary to a primary aim of movement screening investigations, and did not reference the consensus statement (177, 178). Less than half (40%) of the cricket specific studies reported regional diagnosis in broad categories such as head, neck or face, upper limb, trunk and back or lower limb, and only five (33%) prospective studies reported broad areas of onset such as batting, bowling or fielding.

The majority of studies were found to have an unclear likelihood of bias because necessary detail was not reported in the papers. One study was rated as having a high risk of bias and this was largely attributable to the lack of clarity around recruitment and data collection. The remaining studies that were unclear were found to have issues around the description of cohort recruitment and in the case of one study there was potential of selection bias with coaches asked to recruit players for the study. There was a general lack of reporting around missing data, whether existing or not. Whilst in most cases this was deemed to be a reporting deficit only, there is scope for improved reporting practices to ensure a statement around this information is present, particularly when log books or questionnaires are relied upon for data collection.

For injury surveillance in sport, prospective data collection, at least at the elite levels, is generally considered to be more reliable than retrospective methods and captures a greater volume of injury data (72). A study of elite Norwegian football injuries showed that even at that level 19% of injuries were not recorded by medical staff (243). However, it was also shown that 30% of recorded injuries were not recalled correctly by players three months after they occurred (243). At the community level of sport, a study reporting on Australian football injuries comparing recall of injuries at the 12 month mark, found 39% of players were not able to recall injury information in any detail useful for injury prevention measures (244). As much as retrospective studies may be inefficient from a data accuracy and completeness point of view, prospective methods are clearly not perfect either.

It has been argued that prospective studies at the community level of sport pose prohibitive problems with cost, privacy and lack of seasonal continuity issues, particularly in the case of cricket (48). The alternative is a national sports injury surveillance system, such as the ACC insurance system in NZ (259). However, as this thesis has shown, the ACC and the NCRPP, as national insurance systems, have limitations which prevent an accurate and representative sample to be known. Therefore, there exists room for well-designed prospective injury studies to help validate these existing systems. It may be argued that the cost and privacy issues are more problematic when viewed through an elite lens and if well designed studies can be funded within the context of community cricket they may become more practical (81).

10.4.2 Measures for exposure

Collection of appropriate exposure data is a particularly challenging issue for cricket. There may be inherent difficulties in accessing accurate population and particularly participation data, especially over long time periods and when captured in retrospect (260). Despite these challenges, exposure data is essential for reporting injury incidence rates that are important for assessing changes over time or comparison between settings. The difficulties around measuring exposure in cricket are well documented (13, 14, 261). The nature of the game, by having 11 players on one side fielding, one of whom is bowling at any one time, and only two players from the other side batting at any one time, makes exposure measurements notoriously difficult. Further, all players may be required to bat depending on the game type and match situation, but only certain players specialise as bowlers and typically only one player is a specialist wicket keeper. The relative exposures to different aspects of the game will also vary from match to match, depending on the nature of the match (one day, twenty20 or longer format) and again during training or practice sessions. Several studies reported in this review demonstrated the various methods for exposure. For example, Finch et al (174) used number of participations in batting, fielding and bowling as a unit of exposure, while Twomey et al (172) and Gamage et al (182) used match exposures as their unit. Despite the existence of cricket injury consensus statements, there were few studies (171) that referred to them or used the same exposure measures, such as player hours, or overs bowled or balls faced.

Again, the context of community level cricket needs to be taken into account if designing uniform exposure measures for this cohort. For example, in younger junior grades and development cricket, encouraging participation in all activities of the game are the primary aim (174), whereas, older junior cricketers are exposed to the more competitive standard cricket match settings. Whilst finding unified measures of exposure is difficult at all levels of cricket, at community level, future research should identify the relative amounts of cricket played by junior level players in both junior and senior grades. It is important to identify any additional injury risks associated with junior players playing across grades, not just from a workload perspective (as has been accounted for in bowlers), but also from an intensity of play.

10.4.3 Activity specific details

Overall, there was a lack of prospective injury surveillance studies that provided information on all player activities/positions. While it is evident from the bowling-only studies that injuries to the lower back, and in particular, stress fractures of the lower back, are of concern, two studies suggest that fielding is also a high-risk activity for bowlers at the community level (177, 178). Of the four studies that reported on injury in all activities of the game (46, 174, 177, 178), three were published six years prior to when the search for this review was conducted, using data collected at least four years prior to that. Only one of these studies collected data over multiple seasons (46) and while the injury reporting was lacking in specificity on activity at onset and injury nature, the resultant finding of fewer head injuries to batters following mandatory helmet regulations demonstrated the benefits of longitudinal surveillance.

One reason for the lack of clear guidance for injury prevention from the published studies is the distinct player roles that need to be considered: batting, bowling and fielding, as well as sub-specialisations within each of these, such as pace/spin bowling or wicket-keeping. Each of these roles has their own risk profiles for injury and exposure (194). Traditionally, research in elite players have reported bowling as having the highest proportion of injuries (48, 65, 67, 262) and there has subsequently been a focus on numerous biomechanical and workload studies (263-266). A relatively large number of the prospective community-level studies has also investigated injury in bowlers and these have also shown a relatively high proportion of stress fractures to the lower back when compared to strains and sprains (51, 173, 175). Most cricket teams will have four to five specialist bowlers in the side at any one time, although it is more likely at community levels that more players will be considered all-rounders, and (as noted previously) at junior levels it is encouraged for players to be given opportunities in all facets of the game. Further, specialised bowlers also have other roles in cricket: when not bowling they are fielding, and also may be required to bat depending on match circumstance.

It is important for future research to not only identify what the primary skill of the participant is, but also the activity in which they were injured. The additional layer of information will help assess injury risks by player skill and activity and in turn provide useful information for injury prevention measures.

10.4.4 Injury mechanism

Injury mechanism was poorly elucidated in most studies reviewed and not available at all in others. The cricket injury consensus update provided advice on how to report the onset of injury, with categories of impact, sudden onset non-contact, gradual onset, insidious onset (without known cause) and illness. The cricket injury consensus update also stated that the mechanism of injury should be described to assist in classification of the injury (14). However, the consensus does not give guidance on methods to describe the mechanism of injury. The ASIDD provides a detailed injury mechanism guideline, which was adapted for use in determining the injury mechanism of the NCRPP data. However, the adapted method remained limited in accurately determining injury mechanism, at a finer detail. Reasons for this were largely due to the limitations and variability of the description of injury event data. Another reason could be due to the general injury mechanism system provided within the ASIDD not being specific enough to the sport of cricket.

The recent International Olympic Committee (IOC) consensus statement on recording and reporting injury has suggested three distinct, broad mechanisms of injury: direct contact, indirect contact, and non-contact mechanisms (212). This has left the development of any sport-specific detailed mechanism classification up to individual sports (212). Cricket Australia has a standard list of injury mechanisms which it applies to its elite Athlete Management System (AMS) (69):

- Ball collision
- Bowling delivery
- Catching
- Diving
- Fall/slip/lunge/change direction
- Insidious
- Player collision
- Throwing
- Running

However, even the AMS has some shortcomings. For example, players may collide whilst attempting to field or catch the ball. A batter may collide with the other batter, the bowler or wicket keeper when running between wickets. A fielder may have an impact onset mode of injury when diving for a catch, but the injury was caused by his/her finger impacting the ground. In each of these cases a compromise must be made when coding to align the instance to one of the options. Clearly, there is no one perfect system for all sports. The level of detail appropriate for determining the mechanism of injury must lend itself to the application of preventative measures. At the elite level, Cricket Australia would have access to video replay of most injury incidents that would avail far more detail on the injury mechanism, down to the biomechanical level. These options are largely impractical at community level and the NCRPP system offers a potential avenue of injury mechanism data capture, if an appropriate set of data items collected were agreed upon. There is a potential limitation with data based on player recall that may limit development of preventative measures. However, further research into the best method of defining injury mechanism for ease of player use, such as on the NCRPP claim forms, could help identify specific preventative measures (267).

10.4.5 Variations of the game

There have been reports of increases in injury amongst elite level cricketers (261) and higher injury rates for community level players (171) due to the advent of shorter formats of the game, such as 20/20 cricket. As much as the introduction of 20/20 cricket has changed the number of matches and potential workloads for elite level cricketers, the same may exist at the community level, with most associations also hosting 20/20 competitions within their normal playing season. The addition of a match type option on the NCRPP injury data collection form is a recommendation reported in section 11.2.

Given the variety of forms of cricket (indoor, outdoor (one day, 20/20 and long format)), and the variety of skill levels that occur across the spectrum of age levels and levels of play in community cricket, there is a need to more specifically tailor injury surveillance methods in the community context (81). Whilst tailoring surveillance methods can limit the comparison on injury data across levels of participation (72), at the junior level this would not be major issue given the differing match formats and degrees of participation as mentioned earlier.

Indoor cricket requires attention as a standalone format. Whilst the basic principles of the game require bowlers, batters, fielders and a wicket keeper, the game is contained within an enclosed netted area. The enclosed space increases the risk of contact with the ball and other players due to potential rebounding and limited space. The NCRPP does not cover indoor cricket competition injuries and the hospital data does not discriminate between indoor and outdoor formats. An estimate might be that around 12% of hospital cases are due to indoor cricket when looking at the ACC claims data from Chapter 5. There has been little research done on indoor cricket specifically since the late 1980s (141) and early 1990s (149-151), and none where all injuries are assessed since 1988 (141). If a current understanding is desired for this form of the game, then new data sources and/or specific activity codes within existing datasets would be required.

10.4.6 Age groups

There is a lack of information about injuries to adult cricketers at community levels with the average age range of cricket specific studies, reviewed in Chapter 3, being from 15 to 24 years. Only one prospectively collected injury data study included players whose ages were over 40, however, they do not provide a breakdown of age with injury (171). There were relatively few reports of injury to players under the age of 12 (46, 174). The age group of 12 to 17 years seems to be a more susceptible age group for injury, and increasingly so with increasing age (188). The increase in incidence of injury with age may be due to workloads changes, as Stretch noted, many South African schoolboy players will train with both junior and senior groups and often play matches for each level (185). Anecdotally, from the experience of this author, this occurs regularly at community club levels in Australia as well. Perhaps the focus should be on potential points of transition, where younger players move from one grade or age group to another, and especially as junior players step up into more senior formats and training routines.

It is known from existing studies on hospital data (136) that 40% of the cricket-related injuries presenting to emergency departments in Victoria, Australia, occur in the 25 to 44 year old age group. This was reflected in the study on male cricket-related hospital treated injuries in Chapter 4, where 41% of ED presentation cases were in 25 to 44 years old age group, while 51% of the admissions were in that age group. This relative difference between ED presentations and admissions was also seen in 45+ year olds with 8% seen in ED presentations and 11% in admissions. Also, for the 45 to 64 years old age group, there was a significant increase in the IIR for admissions over the 15 year period, as well as a non-significant rise in IIR for ED presentations. From the existing literature, NZ insurance claims data shows a higher proportion (56%) of 25 to 44 year olds claiming for cricket-related injury (104). However, when the ACC claims data were examined in Chapter 5, 44% of the claims were found to be in the 25 to 44 years old age group. The disparity may be explained by the data in Chapter 5 being restricted to cricket related injury at a place of recreation or sports in order to be more likely representative of organised cricket. Older ages (45 to 64 years old) make up 11% to 14% of the community cricket-related injury derived from the insurance claims data from the ACC and NCRPP respectively. These age groups appear to be overrepresented when compared to the SPORTAUS participation numbers which reported 25 to 44 year olds represent 10%-19% and 45 to 64 year olds represent 4%-8% of the participants in organised cricket (5). The possible overrepresentation may be due to older age groups having a higher injury risk which may be driven by attitudes to personal protective equipment. Anecdotally, older players are more resistant to wearing helmets while batting (personal communication: A. Kountouris, Cricket Australia) and the author of this thesis has repeatedly seen evidence of this while playing community level cricket. The increased risk is illustrated in Figure 108, where over half of the known head injury claims in age groups between 40-59 years old, occurred while batting.

As important as it is to know the injury pattern and injury risks in junior cricketers, future research needs to include older age groups as the injury risks may be different to those of younger age groups. The analysis adopted by Quarrie et al (121) would help identify the relative risk of community cricket injury by age group.

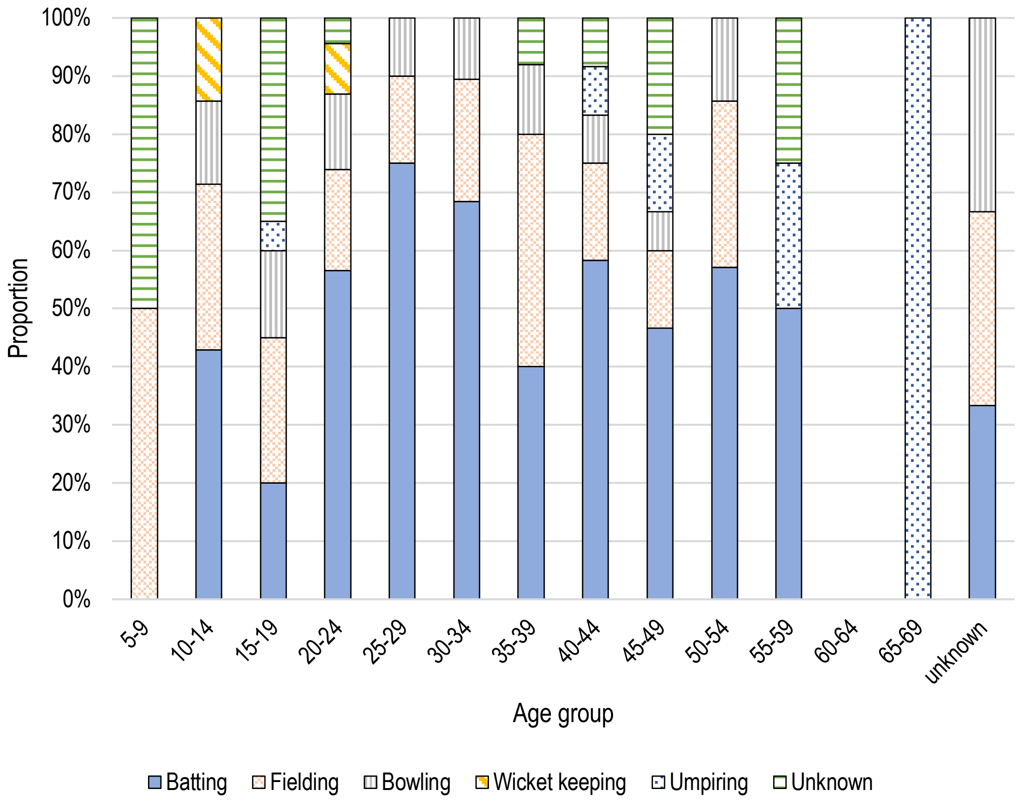

Figure 108. *Proportion of NCRPP head injury claims by age group and activity of injury onset in males (n = 159) (2007/08 – 2018/19).*

10.4.7 Injury burden

Community level sport, in general, could be considered less about the competitive aspects and more strongly associated with the social and enjoyment aspects (81). A recent SportAus survey cited the prime reasons for participation in community level cricket as fun/enjoyment (58%), social reasons (44%), physical health/fitness (25%), with performance and competition a relatively small amount at 7%. These responses were consistent for all age groups except for the 15-17 year old age group which had performance/competition ranked third (5). The vast majority of players of working age would likely have some employment and hence reliant on income. For these players, time loss has a different meaning. Although missing games might be disappointing, it is more likely to be of concern if an injury requires them to miss work. A study by Andrew et al (7) highlighted this, suggesting return to physical activity after an injury was governed more by the injury's impact on work potential than the degree of injury severity, and this applied more significantly in the trade and manual occupations. Injury is also a concern for dropping out of cricket participation at the community level, highlighted in the SportAus report (5). Poor health or injury (15%) was the second most common reason for dropping out of sport and fear of injury (6%) was another notable result (5). At the junior level of the game, performance factors such as the number of wickets taken and runs scored by players was positively correlated with increased retention in the game (268) and any injury preventing performance and/or play would conceivably have an effect on retention rates through this measure.

Risk of injury in sport is inherently tied with the nature of the sport and eliminating all the risks is not only difficult but likely to be resisted on a cultural basis, particularly at the elite/professional levels (269). Community sport differs from elite level sport in terms of intensity and competitive drivers. There are different motivations and drivers as indicated in the SportAus report (5), but nevertheless stripping back all the risk could be said to eradicate the opportunity to express the full range of humanity observed in sporting interactions (269). As such, sport provides an important outlet for human interaction and expression of health, and as Fuller (270) noted, the inherent risks provide some people's reason to participate. Whilst it may be impossible and impractical to remove all risk from sport, understanding these risks and ensuring they are minimised is an achievable goal.

A reduction in human function can be attributed to loss of intrinsic capacity (e.g. physiological factors) or non-intrinsic capacity (e.g. environmental and social factors) (271). This is certainly true within community level sport and cricket in particular. For example, it is not uncommon for junior players to be playing at least two sports concurrently (e.g. cricket and basketball). This can be a confounding factor in injury surveillance for community cricket, as there may be some predisposing factor from a basketball match carried over into cricket. Similarly, for adults and juniors alike, Australian football or soccer might be the sport of choice through winter, which again could provide an injury history that is carried into the summer cricket season. In fact, in many communities, the local football and netball season finals run right up to the start of the cricket season. So a cricket player may go from playing football one week to cricket the next without a break or much specific cricket pre-season training.

Specific measures of injury outcomes for sports and active recreation populations are limited (272). Insurance claims that provide income replacement benefits provide one option, however, they limit the scope of burden analysis to those claimants who qualify for this. Lost income measure is clearly an ineffective method of burden analysis for younger age groups. Any waiting period associated with lost income replacement may also preclude less severe injuries being captured, which in turn, could limit the ability of identifying subsequent injury patterns.

Future research needs to identify suitable measures of injury burden. For example, where children are involved then information on any lost time from education or the costs and time spent by parents/guardians in the duty as a carer.

10.4.8 Recommendations for future research

Given the preceding discussion the following recommendations for community level cricket injury research are provided:

1. Prospective injury data collection is the preferred data collection method where possible. Improvements in reporting methods, especially with recruitment/selection of participants are required and it is suggested that the new STROBE-SIIS (Sports Injury and Illness) statement 1.0 be utilised when conducting future community cricket research (212).
2. Where biomechanical analysis is the primary aim of a study, but injury data is collected as a part of the study, then this information should be presented in line with the current consensus statements and core items of the ASIDD. The injury information can be presented in the appendices of such studies where there is insufficient room in the main article.
3. Inclusion of older age groups in future studies is necessary to fill the gaps in knowledge identified in Chapter 3. Longitudinal studies of all age groups would help validate the NCRPP system as an injury surveillance tool for community level cricket in Australia.

There have been calls for a national sports injury surveillance in Australia since the mid-1990s (15). Some have suggested a system similar to the ACC in NZ, would be a good model to follow (259). Chapter 5 and the above discussion has indicated some of the potential shortcomings of the ACC system with regard to community cricket injury surveillance. However, should a similar, sport specific, system be desired then it could be designed more appropriately from the outset, using the findings from this research and lessons learned from systems such as the ACC.

A community level injury consensus statement to provide general guidance would be of great benefit to researchers moving forward. Such a consensus statement could help address the issues around exposure measures, injury mechanism and injury burden. Any consensus would need to be founded on solid understanding of the needs of community level cricket and potential barriers relating to injury data and its collection, for it to be successful (81).

Conclusions

This thesis represents the first research to collate and report, in detail, on injuries in community level cricket over time. Acute medical treated injuries, requiring hospital attendance, were mostly fractures. Injuries to the wrist/hand and head were also the most common body regions requiring acute medical treatment. Acute head injury was more common in children under 15 years old. Other medically treated injuries were commonly soft tissue injuries (muscle and joint) to the knee, lower back and shoulder.

The majority of injury information is based on male cricketers due to the relatively low number of female participants. Also, much of the existing literature focuses on bowlers and junior to adolescent age groups. There was evidence of some differences in injury profile between sexes such as higher proportions of dental injury and concussions in females and an over-representation of injury in younger females under 15 years of age. Additional research is needed to fully quantify these findings, especially given the growth in female participation in recent years.

The JLT-Sport/Marsh insurance data for injuries claimed through the NCRPP was shown to be highly valid in comparison to the ASIDD. The data completeness and fidelity is high within the ASIDD core data items, but reduces with the strongly recommended and recommended ASIDD data items. The insurance data also has a moderate fidelity with regard to the cricket injury consensus statement. This indicates that the JLT-Sport/Marsh database is likely to be a useful source of organised community cricket injury data. However, injury mechanism and injury factors/details are two areas that require improvement to improve future injury surveillance and particularly injury prevention needs. Also, if the intention of stakeholders is to use the NCRPP system as a national community cricket injury surveillance tool, then further research to evaluate the representativeness of the NCRPP data is suggested.

The quality and reporting completeness of existing studies in community cricket makes it difficult to apply findings to identify and prioritise suitable injury prevention measures. The current cricket injury consensus statement is still too focused on elite level injury surveillance and lacks broad applicability to community levels. If there is to be no nationally agreed community sports injury surveillance system, then a community context, cricket injury consensus statement would help researchers provide consistent, applicable outcomes measures. Additionally, within any injury consensus, it is recommended that appropriate measures of injury burden should be created for community level cricket (and sport in general) and be relevant for all stakeholders; policy makers, participants, clubs, associations and governing bodies.

Findings of this research have been shared with the primary stakeholders of this project, Cricket Australia and JLT-Sport/Marsh insurance, and through publications (Appendix F). In line with the aims of this research, injury in community cricket can be seen as an inherent risk in the sport, however, the most severe injuries are relatively rare. The absolute and relative risks of injury in community cricket are, at this stage, still not fully known and future research and guidance is required to understand them. The stakeholders possess a potential injury surveillance system that, with the application of the recommendations contained within this thesis, can aid in the addressing of the above issues. Given the industry's drive to increase participation within community cricket, the pursuit of appropriate injury surveillance guidelines and injury surveillance at this level is a worthy endeavour.

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Appendices

Appendix A – Data items within the Australian Sports Injury Data Dictionary (ASIDD)

Table 120. Data items with the Australian Sports Injury Data Dictionary.

No	Data Item	Category[1]
	Administrative Items	
1	Person recording case information	SR
2	Immediate source of injury record	SR
3	Date of injury	C
4	Time of injury	R
5	Date of injury record	R
	Demographics	
6	Age	C
7	Gender	C
8	Area of usual residence	SR
	Place of Injury Occurrence	
9	Name of injury place – text	SR
10	Place of injury – type	SR
11	Sport and recreational places - specific	SR
12	Part of specific injury place	R
	Activity When Injured	
13	Activity when injured – broad areas	C
14	Activity when injured – name of sport/activity	SR
15	Phase or aspect of involvement in activity or event	R
16	Activity when injured – grade or level	R
	Major Injury Factors	
17	Injury factors	SR
18	Equipment used with intent to protect against injury	SR
	Mechanism of injury	
19	Mechanism of injury	C
20	Narrative of mechanism of injury	SR
	Injury Site	
21	Body region and body chart	C
22	Specific structure injured	R
	Nature of Injury – Pathology	
23	Nature of injury	C
24	Provisional diagnosis text	O
	Treatment Factors	
25	Date of presentation	SR
26	Time of presentation	R
27	Reason for presentation	R
	Treatment	
28	Treatment	SR
29	Advice given to injured person	SR
30	Referral	SR
31	Treating person	SR

[1] C = Core data item, SR = Strongly recommended data item, R = Recommended data item, O = Optional data item

Appendix B – A description of the game of cricket

Traditional cricket is played by two teams of 11 players, typically on a grassed oval with a delineated boundary. A match requires each side to bat and field/bowl, alternatively, at least once. The side which is batting has two players (batters) on the field, while the fielding or bowling side has all 11 players on the field. The game is played on a pitch which is traditionally a firm rolled grass section (pitch) 20.12 metres long and 3.05 metres wide. Three timber stumps, loosely joined by timber bails at the top, form the wickets at each end of the pitch. The ball used is a stitched leather encased sphere of no less than 22.4 cm and no greater than 22.9 cm in circumference and weighing at least 156 grams, but no more than 163 grams. Traditionally, the core consists of a cork centre and wound flax inner region. The Marylebone Cricket Club are custodians of the laws of the game (273)

During play, a player on the fielding side will bowl the ball at one of the batters (striker). The batter's aim is to defend the wickets and score runs by hitting the ball with a wooden bat. Runs are scored by both batters physically running between the wickets of the pitch, or when the ball reaches or is hit over the boundary. The bowler's aim is to dismiss the batter in one of the 10 ways available. The most common modes of dismissal are being caught by a fielder or wicket keeper, where the ball has been hit in the air; being bowled, where the bowler's delivery hits the batters stumps and dislodges at least one bail; and leg before wicket (LBW), where the ball strikes the batter's legs essentially in front of the wicket. The remaining fielders aim is to stop or catch the ball after the batter has hit it. There are typical fielding positions that are used the most often as shown by the red dots on Figure 109. However, fielders can, within the rules of the various forms of the game, station themselves anywhere off the pitch.

All players may be required to bat during a match. All players (except in shorter formats of the game) can bowl if required, however, there are generally four or five specialist bowlers in a side. These bowlers may be classified as medium to fast pace bowlers who can deliver the ball at speeds of up to 150 km/h, and slow or spin bowlers who bowl at slower speeds, but impart various manners of revolutions on the ball aiming to deceive the batters with deviation of the ball off the pitch. A single player will also be the wicket keeper, who stands behind the batter's wickets, at varying distances depending on the pace of the bowler. The wicket keeper is the only fielder allowed to wear hand protection.

There are two main formats to the game of cricket: the long format, which at the highest level is known as test cricket and is currently played over a maximum of five days with two batting innings allowed per side; and the short format, which is played within a single day and each side can bat for a limited number of overs (50 overs – known as one day cricket and 20 overs – known as Twenty20 or 20/20 cricket).

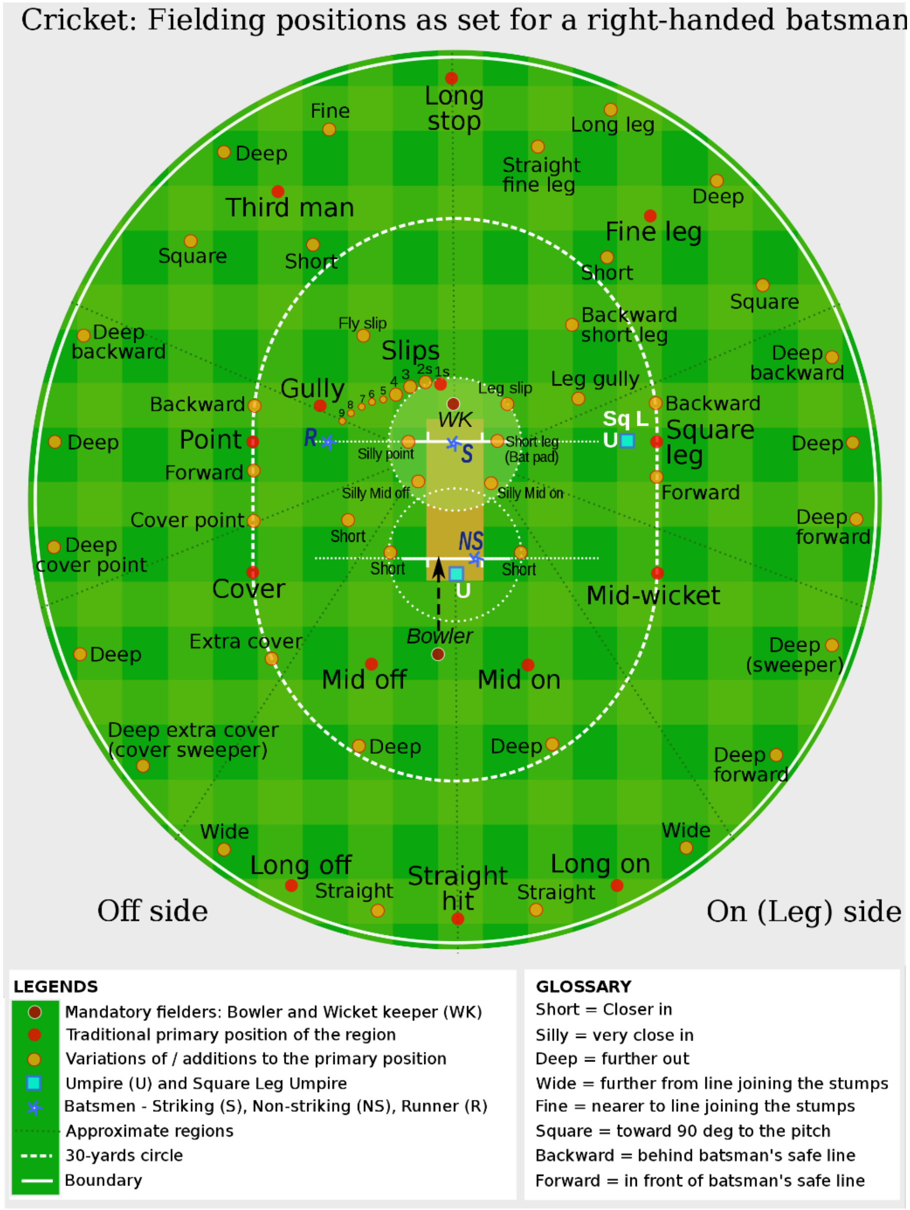


Figure 109. *Diagram of a cricket field and common fielding positions. Creative Commons Attribution 2.5 Generic: Miljoshi, https://commons.wikimedia.org/wiki/File:Cricket_fielding_positions.svg#filelinks*

Appendix C – Critical appraisal tool outline and explanation

Critical Appraisal Tool

Table 121. *Critical appraisal tool adopted for Chapter 3 systematic review.*

	Question	Y[1]	P[1]	N[1]	N/A[1]	Comments	Risk of Bias L/U/H[2]
1	Were the study aims and design described adequately and are they compatible?						
2	Was the study setting, subjects, source, target population and size described adequately?						
3	Was the method of data collection described adequately and did it seek to minimise information bias?						
4	Has there been appropriate reporting of attrition of subjects or missing data?						
5	Was there an injury definition and or injury severity measure/definition provided and were they suitable for the study design?						
6	Were the injury outcomes and exposure measures reported in a standardised, justified and reasonable manner?						
7	Were limitations to the study discussed adequately?						
8	Is there a summary of key results and do they and any conclusions match the aims and/or reflect the limitations of the study?						
9	Does the study explain any ethics requirements, author conflicts of interest and or funding arrangements?						

[1] Y = Yes, P = Partial, N = No, N/A = Not Applicable
[2] L = Low risk of bias, U = Unknown/Unclear risk of bias, H = High risk of bias.

Within the realms of the particular study type:

Answers: **Yes** if criteria has been met, **Partially** if criteria has been addressed but not to the fullest extent, **No** If there is no clear addressing of the criteria and **Not Applicable** (**N/A**) if the criteria is not relevant to the particular study type.

Where Partially, No or N/A are selected then an explanation detailing the reasons shall be provided.

Summary of Bias:

The critical appraisal tool looks at three domains of bias:

1. Selection bias (external validity) – via question 2
2. Information bias (internal validity) – via question 3
3. Attrition bias (external validity) – via question 4

Based on author's judgment for the key domains an overall risk of bias was determined using an adapted approach similar to that described in The Cochrane Handbook for Systematic Reviews of Interventions for assessing risk of bias (133).

Table 122. Approach to assigning summary risk of bias for studies (adapted from Higgins et al (133))

Risk of Bias	Interpretation	Within the Trial
Low risk	If bias is present it is unlikely to alter the results seriously	Low risk of bias in all key domains
Unclear risk	There may be a risk of bias that raises some doubt about the results	Low or unclear risk of bias for all key domains
High risk	Likely bias that may alter the results seriously	High risk of bias for one or more key domains

Critical appraisal explanation (for co-author use):

1. Were the study aims and design described adequately and are they compatible?

   What are they aiming to do and how are they aiming to do it? Is the study aim or objectives clearly stated? Does the study method suit the research aim?

2. Was the study setting, subjects, source, target population and size described adequately?

   Were recruitment sites and or sources detailed? Are the subject characteristics detailed? Is there a reasonable attempt to ensure the subjects are representative of the target population? Do the authors explain how many potential subjects were contacted from the source population? Was there a reasonable attempt to justify the study size used (more specific to cohort studies)?

   The target population refers to the group of people to which the results of the study will be generalised. The source population is the group of people drawn from the target population. In hospital based studies for example, is there description of the overall numbers of patients from which the sport-related patients are taken? E.g. "Over the period of 1989-1993, 51,203 children and 46,837 adults were reported as attending an NISU emergency department for the treatment of an injury sustained during sport or active recreation. This corresponds to 20% of all child and 18% of all adult injury presentations to these emergency departments over this period." (139)

3. Was the method of data collection described adequately and did it seek to minimise information bias?

   Could the method of data collection be replicated? Were data collectors appropriately trained, questionnaires/surveys piloted and standardised/validated, appropriate medically trained personal involved in diagnosis etc.? Were the data collected directly from the subjects rather than a proxy? Was there adequate description of the timeline of data collection?

   E.g. If survey tool is validated and eligible subjects are interviewed or respond individually then the response is YES. If the survey asks a representative of a household to respond on behalf of other household members then the answer is NO. If a hospital study indicates the information has come from medical or patient records but does not indicate if this is from ICD, or equivalent, codes or from text narrative then indicate a PARTIAL only.

4. Has there been appropriate handling and reporting of attrition of subjects or missing data?

   Has any missing data been accounted for in analysis? Has there been adequate description of missing data or losses to follow up? Is there a description of participant flow through the study identifying stages of drop out? If there is no attrition or missing data and this is noted then indicate YES. For hospital/clinic and or insurance data there should be some indication of the number of overall cases searched and the number of (if any) poorly or miss-coded items and how they were handled. If there is no statement or discussion that would indicate there was no errant data then record a PARTIAL as this is indeterminate. If there is survey data with reported response rates, has there been any analysis or reporting of the significance of the non-response?

5. Was there an injury definition and or injury severity measure/definition provided and were they suitable for the study design?

   Was there a clear definition of an injury? Was there some measure of injury severity? For case-series or cross-sectional studies using hospital data, descriptions of the relevant ICD (or equivalent) codes would indicate a YES if they also measure severity in a reasonable manner (E.g. ICISS measures, time in hospital, time off work etc). For cases-series studies that are looking at a specific body location (e.g. eye injuries, finger injuries or lower back injuries) then it would also be indicate a YES. If severity measures are not discussed then indicate a PARTIAL. Where cricket specific studies are reviewed, was the injury definition relevant to the consensus statements on injury surveillance in cricket from 2005 and or the 2016 update?

6. Were the injury outcomes and exposure measures reported in a standardised, justified and reasonable manner?

   Was the exposure measure defined? Where exposure measures could not be defined, were outcomes presented as frequencies only? Were appropriate numerator and denominator parameters used? Where used, were appropriate statistical analysis performed and outcomes reported with confidence intervals?

7. Were limitations to the study discussed adequately?

   Does the discussion take into account sources of potential bias or imprecision and discuss the direction and magnitude of these? For example: Self-reported questionnaire data should always be reported as a limitation due to recall-bias, even if the questionnaire was validated etc. If there has been some discussion about limitations, but not covering all potential identified limitations then answer PARTIAL.

8. Is there a summary of key results, their potential generalisability and whether they and any conclusions match the aims and/or reflect the limitations of the study?

   Key results are summarised with reference to objectives/aims and cautious interpretation given considering the limitations, other similar studies and relevant evidence. Where a study does not have a specific conclusion section but does summarise key results and their potential generalisability then it can still be indicated as a YES, but if this is unclear then indicate a NO.

9. Does the study explain any ethics requirements, author conflicts of interest and or funding arrangements?

   Is there an ethics statement around approval of the human subjects and or data studied? Is there any source of conflict or funding and the role of the funders for the study? If only one or other of these is indicated then indicate a PARTIAL.

Initial pilot testing of the critical appraisal tool was carried out on four selected studies in the review that represented the different study types retrieved. The initial agreement score (kappa) was moderate (Table 123). After discussion and revision of the explanations for each question, the revised agreement score was high (Table 124).

Table 123. *Initial pilot test kappa score for critical appraisal tool used in systematic review in Chapter 3.*

		Assessor 1				
		Yes	Partial	No	N/A	**Total**
Assessor 2	Yes	17	3	0	0	**20**
	Partial	5	4	1	0	**10**
	No	0	2	3	1	**6**
	N/A	0	0	0	0	**0**
	Total	**22**	**9**	**4**	**1**	**36**
	Agreement	17	4	3	0	24
	By chance[1]	12.2	2.5	0.7	0	15.4
	Kappa[2]	**0.42**				

Table 124. *Subsequent pilot test kappa score for critical appraisal tool used in systematic review in Chapter 3.*

		Assessor 1				
		Yes	Partial	No	N/A	**Total**
Assessor 2	Yes	20	1	0	0	**21**
	Partial	0	9	1	0	**10**
	No	0	1	3	0	**4**
	N/A	0	0	0	1	**1**
	Total	**20**	**11**	**4**	**1**	**36**
	Agreement	20	9	3	1	33
	By chance[1]	11.7	3.1	0.4	0.03	15.2
	Kappa[2]	**0.86**				

[1] $Chance = \frac{(n_{col_i} \times n_{row_i})}{Total}$ [2] $Kappa = \frac{(\Sigma n_{agree} - \Sigma n_{chance})}{(n_{total} - \Sigma n_{chance})}$

Appendix D – Ethics approvals

Initial ethics approval at Federation University Australia:

Approval to Use Existing Data

Human Research Ethics Committee

Federation UNIVERSITY•AUSTRALIA

Principal Researcher:	Dr Damian Morgan
Other/Student Researcher/s:	Geordie McLeod Dr Lauren Fortington Professor Caroline Finch
School/Section:	**Business / ACRISP**
Project Number:	**C17-026**
Project Title:	**The Epidemiology of Injuries Sustained in Community Cricket.**
For the period:	20/11/2017 **to** 31/07/2020

Quote the Project No: C17-026 in all correspondence regarding this application.

Approval has been granted to undertake this project for the period listed above.
It is the responsibility of the Principal Researcher to ensure the Ethics Office is contacted immediately regarding any proposed change to the project.

Maintaining Ethics Approval is contingent upon adherence to all Standard Conditions of Approval as listed on the final page of this notification, including submission of annual progress reports on the anniversary of the approval date and a final report within a month of completion of the project – regardless of whether automated reminders are forwarded as a courtesy.

COMPLIANCE REPORTING DATES TO HREC:

Annual project report:
20 November 2018
20 November 2019

Final project report:
31 August 2020

The combined annual/final report template is available at:
http://federation.edu.au/research-and-innovation/research-support/ethics/human-ethics/human-ethics3

[redacted]

Fiona Koop
Ethics Officer
20 November 2017
Please note the standard conditions of approval on Page 2:

CRICOS Provider No. 00103D V 2017 **Page 1 of 2**

Ethics approval extract from ECU (copy of email correspondence with Research Ethics on 16 July 2020):

RE: HREC - Executive Review
PROJECT NAME: The epidemiology and methods of surveillance of injuries sustained in community cricket
REMS NO: 2019-00144-FORTINGTON
FUNDING SOURCE: Unfunded

The ECU Human Research Ethics Committee (HREC) has reviewed your application and has granted ethics approval for your research project. The Committee noted that the project has previously been approved by Human Research Ethics Committee, Federation University Australia. In granting approval, the HREC has determined that the research project meets the requirements of the National Statement on Ethical Conduct in Human Research.

The approval period is from 01/04/2019 to 01/08/2020.

Please feel free to contact me if you require any further information.

Regards

Chair
Human Research Ethics Committee

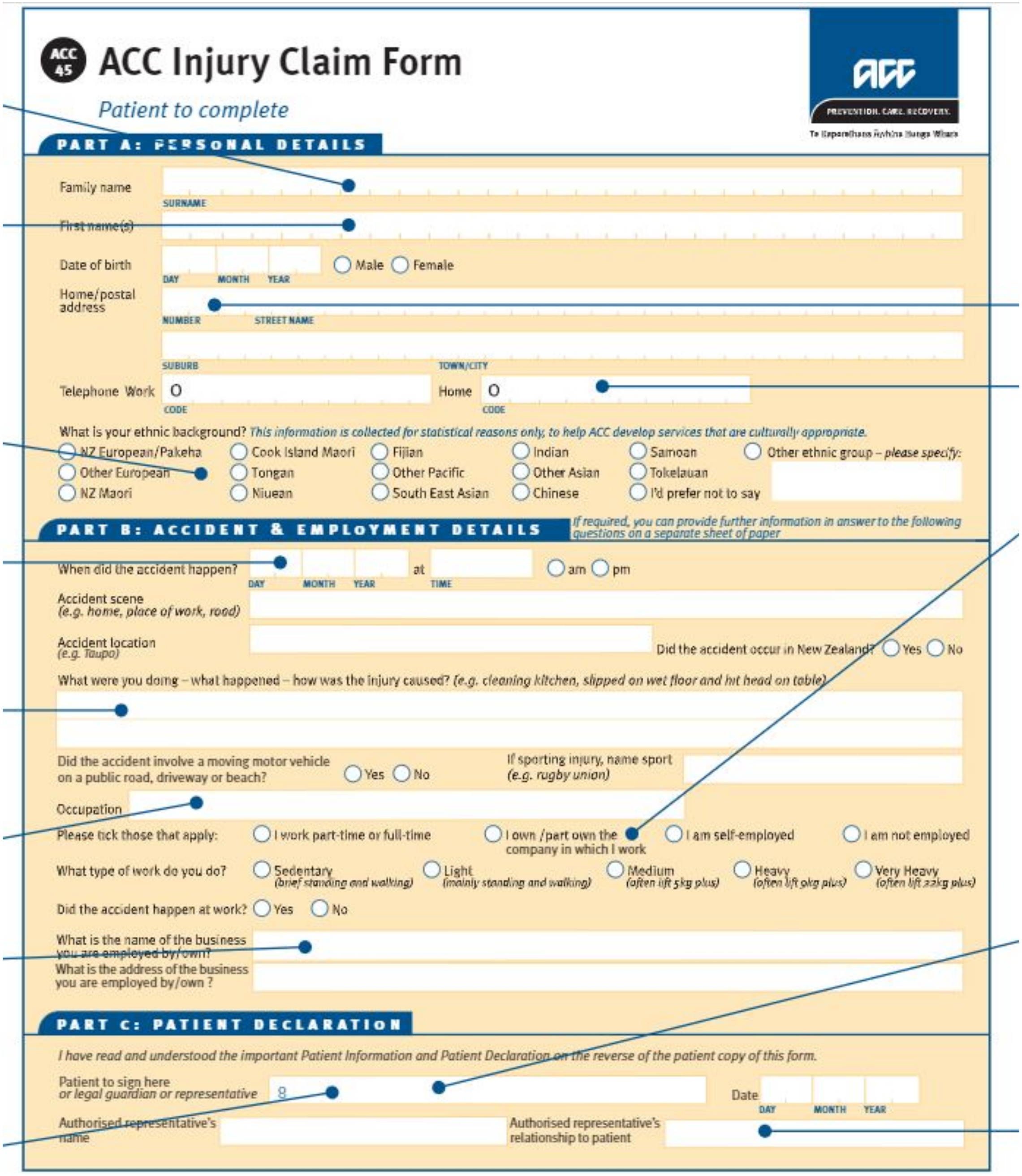
Appendix E – Reference data

Table 125. IIR with 95% CI, relating to Figure 11 in Chapter 4, for hospital admissions and ED presentations for Victorian males with cricket-related injury (2002/02 – 2016/17).

	Hospital admissions			ED presentations		
		95% CI			95% CI	
Year	IIR	Lower	Upper	IIR	Lower	Upper
2002/03	14.0	12.4	15.8	47.5	44.5	50.6
2003/04	12.0	10.5	13.6	45.8	42.8	48.9
2004/05	14.5	12.9	16.3	50.5	47.5	53.8
2005/06	13.3	11.8	15.0	62.2	58.8	65.7
2006/07	15.2	13.5	17.0	60.0	56.7	63.4
2007/08	16.0	14.3	17.8	54.4	51.2	57.7
2008/09	14.0	12.5	15.7	53.1	50.0	56.3
2009/10	12.7	11.3	14.3	55.4	52.2	58.6
2010/11	14.2	12.7	15.9	44.9	42.1	47.8
2011/12	15.2	13.6	16.9	51.5	48.5	54.6
2012/13	11.5	10.1	13.0	56.6	53.5	59.9
2013/14	15.0	13.4	16.7	56.9	53.8	60.2
2014/15	14.7	13.2	16.4	62.7	59.5	66.0
2015/16	15.9	14.3	17.6	62.6	59.4	66.0
2016/17	15.3	13.8	17.0	55.8	52.8	58.9

Appendix F – Sample ACC-45 Claims Form

This is an example of the ACC-45 claims form. Most ACC claims are processed with an online software package, filled out by the attending health practitioner, which allowed for much of the additional data analysed.



ACC 45 **ACC Injury Claim Form**

Patient to complete

ACC PREVENTION. CARE. RECOVERY.

Te Kaporeihana Āwhina Hunga Whara

PART A: PERSONAL DETAILS

Family name SURNAME

First name(s)

Date of birth DAY MONTH YEAR ◯ Male ◯ Female

Home/postal address NUMBER STREET NAME

SUBURB TOWN/CITY

Telephone Work 0 CODE Home 0 CODE

What is your ethnic background? *This information is collected for statistical reasons only, to help ACC develop services that are culturally appropriate.*

◯ NZ European/Pakeha ◯ Cook Island Maori ◯ Fijian ◯ Indian ◯ Samoan ◯ Other ethnic group – *please specify:*

◯ Other European ◯ Tongan ◯ Other Pacific ◯ Other Asian ◯ Tokelauan

◯ NZ Maori ◯ Niuean ◯ South East Asian ◯ Chinese ◯ I'd prefer not to say

PART B: ACCIDENT & EMPLOYMENT DETAILS

If required, you can provide further information in answer to the following questions on a separate sheet of paper

When did the accident happen? DAY MONTH YEAR at TIME ◯ am ◯ pm

Accident scene *(e.g. home, place of work, road)*

Accident location *(e.g. Taupo)*

Did the accident occur in New Zealand? ◯ Yes ◯ No

What were you doing – what happened – how was the injury caused? *(e.g. cleaning kitchen, slipped on wet floor and hit head on table)*

Did the accident involve a moving motor vehicle on a public road, driveway or beach? ◯ Yes ◯ No

If sporting injury, name sport *(e.g. rugby union)*

Occupation

Please tick those that apply: ◯ I work part-time or full-time ◯ I own /part own the company in which I work ◯ I am self-employed ◯ I am not employed

What type of work do you do? ◯ Sedentary *(brief standing and walking)* ◯ Light *(mainly standing and walking)* ◯ Medium *(often lift 5kg plus)* ◯ Heavy *(often lift 9kg plus)* ◯ Very Heavy *(often lift 22kg plus)*

Did the accident happen at work? ◯ Yes ◯ No

What is the name of the business you are employed by/own?

What is the address of the business you are employed by/own ?

PART C: PATIENT DECLARATION

I have read and understood the important Patient Information and Patient Declaration on the reverse of the patient copy of this form.

Patient to sign here *or legal guardian or representative*

Date DAY MONTH YEAR

Authorised representative's name

Authorised representative's relationship to patient

Treatment Provider to complete

Note: ACC does not provide cover for illness or sickness.

XX12345

PART D: INJURY DIAGNOSIS AND ASSISTANCE

Patient's NHI no.

Diagnosis coding used if not READ CODES ○ ICD9 ○ ICD10

Diagnosis 1 Side: ○ Left ○ Right

Diagnosis 2 Side: ○ Left ○ Right

Diagnosis 3 Side: ○ Left ○ Right

Is this a Gradual Process Injury? ○ Yes ○ No

Additional injury comments to injury code entered above

Has the patient been admitted to hospital? ○ Yes ○ No

Is this claim for medical misadventure? ○ Yes ○ No

Referral information (type of Treatment Provider referred to)

REHABILITATION/ASSISTANCE REQUIRED *(e.g. case management or home help)*: ○ Yes ○ No

ACC should call me? ○ Yes ○ No

PART E: ABILITY TO WORK *Registered Medical Practitioner only to complete this part*

IS THE PATIENT ABLE TO CONTINUE NORMAL WORK? ○ Yes *(go to part F)* ○ No *(continue)*

RESTRICTED DUTIES: The patient is able to undertake restricted duties

for days, from DAY MONTH YEAR of the following type:

○ Sedentary *(brief standing and walking)* ○ Light *(mainly standing and walking)* ○ Medium *(often lift 5kg plus)* ○ Heavy *(often lift 9kg plus)*

Additional restrictions *(e.g. up to four hours per day; no lifting)*

FULLY UNFIT: The patient is unfit for work for days, from DAY MONTH YEAR

(Maximum 14 days using this form)

REVIEW/RETURN TO WORK: Based on this medical assessment

○ a review is required on, or

○ the patient should be fit to return to normal work on: DAY MONTH YEAR

PART F: TREATMENT PROVIDER DECLARATION

I certify that, on the date shown, I have personally provided the services as specified above and that in my opinion the condition is the result of an accident.

ACC PROVIDER NUMBER

National Provider Index PROVIDER ID FACILITY AGENCY

Treatment provider name *(print)* or stamp

Treatment provider signature 8 Date DAY MONTH YEAR

ACC or Accredited Employer copy: please return this form when completed to your ACC Service Centre or to the Accredited Employer (check www.acc.co.nz). 03/03

Appendix G – JLT-Sport claim forms

Form versions in order of appearance:

- 2003
- 2004/05
- 2005/06
- 2008/09
- 2009/10
- 2010/11
- 2016 online version (with extracts of drop down menus for injury factors)

JLT Sport

PO Box 7170 Hutt St, ADELAIDE SA 5000
Telephone: (08) 8235 6444
Facsimile: (08) 8235 6448
Toll Free 1800 640 009

Claim Number : ....

CRICKET CLAIM FORM

Non-Medicare Cover and/or Loss of Income

IMPORTANT INFORMATION: PLEASE READ CAREFULLY

Non-Medicare Cover: We do not provide cover for Surgeons, Anaesthetists, Doctors, X-Rays or other accounts which are partly covered by Medicare. The Australian Health Insurance Act does not permit us to contribute to any charges covered by Medicare (including the Medicare Gap).

We will pay a percentage of the amount, as indicated in the Policy schedule, for private hospital, dental, ambulance (if not otherwise covered), chiropractic, physiotherapy, osteopath, naturopath, massage and pay for orthotics prescribed by a surgeon to aid recovery.

Subject to the Insurance Contracts Act 1984 any treatment rendered necessary by injury must be completed within 12 calendar months from the date of such injury occurring.

- Medical treatment must be certified necessary by the attending Physician, ie. Doctor, Surgeon, Physiotherapist, Dental Surgeon.
- Failure to complete all sections of this form properly may delay settlement of your claim.
- Please refer to your Club or JLT Sport for Benefits, Excess and Special Conditions/Exclusions.
- JLT Sport should be notified of a claim within 30 days of injury.
- Please send original receipts (unless retained by your Health Fund). Hospital claims must be accompanied by an itemised receipt.
- If treatment is covered by your Private Health Fund please send their rebate advice with a copy of the relevant account.
- Only one claim form (per injury) is required. We will advise you of your claim number which should be quoted with all future correspondence.

HOW TO CLAIM MEDICAL ONLY CLAIMS

When claiming for reimbursement of non-Medicare medical expenses you must complete Section A and have Section B completed and signed by your club official. Medical treatment must be certified necessary by AN ATTENDING PHYSICIAN and incurred within Australia. THE ATTENDING PHYSICIANS REPORT MUST BE FULLY COMPLETED PRIOR TO SUBMITTING A CLAIM. (An attending physician includes a general practitioner, physiotherapist, chiropractor, dentist.)

CLAIMS INVOLVING LOSS OF INCOME

PLEASE NOTE: **THIS IS AN OPTIONAL SECTION. TO CHECK IF THE POLICY INCLUDES THIS COVER PLEASE REFER TO YOUR CLUB OR TO JLT SPORT.**

(a) If claiming for Loss of Income Benefit you must complete Section A and B, and have Section C completed by your Employer;

(b) Have your Attending Physician complete the “Attending Physicians Report” as attached;

(c) Have a Doctor complete the “Incapacity to Work Statement”. (This **MUST** be completed by a General Practitioner, a Surgeon or a Specialist). It will **not** be accepted if completed by a Physiotherapist, Chiropractor etc.)

CLAIM NO: ………………………………………

SECTION A. TO BE COMPLETED BY THE PLAYER

PLEASE PRINT - If there is insufficient space to answer a question, please attach additional sheets.

1. PLAYER'S SURNAME GIVEN NAME SEX:	**NAME OF CLUB** **NAME OF ASSOCIATION/LEAGUE**

2. ADDRESS STATE POSTCODE

3. DATE OF BIRTH / /	4. OCCUPATION	TELEPHONE HOME ( )	WORK ( )

4. DATE OF INJURY: ……..…./………./………… TIME OF INJURY: am/pm

5. DESCRIBE YOUR INJURY & HOW IT HAPPENED? ....

....

....

6. a. PLAYING SURFACES:

INDOOR ❒ TURF ❒
SYNTHETIC ❒ MATTING ❒
OTHER ❒ ……………………………..

b. WEATHER CONDITIONS:

DRY ❒ WET ❒

c. STATE THE NAME OF A WITNESS TO THE INJURY:

…………………………………………………………

…….…………………………………………………….

d. PERSON TO WHOM INCIDENT REPORTED:

………………………………………………………..

………………………………………………………..

DATE……./………../………

TIME REPORTED…….. AM/PM

e. PLAYING POSITION AT TIME OF INJURY

- ❒ Fielding
- ❒ Batting
- ❒ Wicket Keeping
- ❒ Bowling
- ❒ Umpiring
- ❒ Other ……………………………………..

f. UNDER WHAT CIRCUMSTANCES?

- ❒ Officially organised competition
- ❒ Officially organised practice
- ❒ Social or private competition
- ❒ Social or private practice
- ❒ Travelling
- ❒ Other (Please state what you were doing)

……………………………………………………………….

……………………………………………………………….

g. CRICKET GRADE

……………………………………………………………...

7. DID YOU CEASE TRAINING / PLAYING IMMEDIATELY AS A RESULT OF THE INJURY? ❒ YES ❒ NO

If no, please provide reason. ....

....

....

8. WHEN DO YOU EXPECT TO RESUME

WORK: ………/……../……… TRAINING: ………/………/………. PLAYING: ……../ ……../…….

This section MUST be completed, if exact dates not known please provide approximate dates.

9. WHEN DID YOU FIRST SEEK MEDICAL TREATMENT?……../…………./………..

WERE YOU ADMITTED TO HOSPITAL? ❐ YES ❐ NO If yes, please provide:

HOSPITAL NAME: ………………………………..………….ADDRESS: ……………………………..………………..

ADMITTANCE DATE: …………/……………/……….... DISCHARGE DATE: ……………/…………/……..……

10. HAVE YOU HAD A SIMILAR INJURY BEFORE TREATMENT YES ❐ NO ❐

If yes, please provide details of injury:

………..…...
………..……

DATE WHEN OCCURRED ……../……..…/……..….

NAME & ADDRESS OF TREATING DOCTOR ……………………………………………………………………………..

11A. DO YOU HAVE PRIVATE MEDICAL INSURANCE? YES ❐ NO ❐

NAME OF FUND ………………………………………………………………………………………………………

DOES YOUR COVER INCLUDE:

i.	HOSPITAL COSTS	YES	❐	NO	❐
ii.	DENTAL AND PHYSIO COSTS	YES	❐	NO	❐
iii.	AMBULANCE	YES	❐	NO	❐

B. ARE YOU A MEMBER OF THE AMBULANCE SERVICE YES ❐ NO ❐

13. **Signature of Claimant**

I hereby authorise any hospital, physician or other person who has attended me or any employer, to furnish JLT Sport or its representatives any and all information with respect to any sickness or injury, medical history, consultation, prescriptions, or treatment, copies of all hospital or medical records and copies of all records of employers. I agree that a Photostat copy of this authorisation shall be considered as effective and valid as the original. I do solemnly and sincerely declare that the foregoing particulars are true and correct in every detail and I agree that if I have made, or in any further declaration in respect of the said injury or sickness shall make any false or fraudulent statements or suppress or conceal or falsely state any material fact whatsoever, the Policy shall be void and all rights to recover there under in respect of past or future injuries or sickness shall be forfeited.

In accordance with the Insurance (Agents and Brokers) Act 1984 JLT Sport gives notice that in dealing with or settling this claim they will be acting under an authority given to them by the Insurer named in the Certificate of Insurance and that they will be dealing with or settling the claim as agent of the named Insurer and not as an agent of the Insured.

SIGNED: ………………………………………………. DATED: ……………………………………………………
(Claimant)

SECTION B. TO BE COMPLETED BY YOUR CLUB/ASSOCIATION

DECLARATION (Please advise the claimant of the Policy coverage as per your Schedule of Insurance)

REFERENCE NO: ………………………………………

I, …………………………………………………………………………… of ………..………………………...…………………………………..
(OFFICIAL) (NAME OF CLUB/ASSOCIATION)

Hereby Certify that ….………………………………………………. sustained the injuries resulting in this claim on………/…..……/……..
(Player's Name) (Date)

At …………………………………am/pm whilst playing / training for ……………..…………………………………………..…………against

…..…………………………………………………………………… Place of Game: …………………………………………………………

Signed: ……………………………………………………………………………..… Dated: ……………/…..………/………..……
(Official)

Official's Position at Club/Association: …………………………………………………. Contact Phone Number: …………………….……

SECTION C. LOSS OF INCOME

1.	Can compensation be claimed under worker's compensation or any other insurance including Loss of Income?	Yes ❐ No ❐
2.	Have you ever made any previous claims in respect to personal accident insurance?	Yes ❐ No ❐
3.	Have you engaged in any other income earning employment since you have been injured?	Yes ❐ No ❐

The following section must be completed by your employer/salary officer (not player). If self employed, please have your accountant complete these details.

NAME OF EMPLOYER

ADDRESS OF EMPLOYER
………………………………………………………………………..
………………………………………………………………………..

PHONE (……) ……………………………………
FACSIMILE (…….) ………………………………

DATE CEASED WORK
DUE TO INJURY …………../…………/……………

DATE EXPECTED TO
RESUME NORMAL DUTIES …………/…………/……….

EMPLOYEE WEEKLY SALARY AS AT DATE OF INJURY

NET $…………………………GROSS $ ………………………
(If self employed, provide average weekly salary based on 12 month period directly prior to injury)

DATE COMMENCED EMPLOYMENT
WITH COMPANY …………/…………/…………

INCOME DEFINITION:	Self Employed ❐	Full Time ❐	Part Time ❐	Casual ❐

During the period of incapacity has the employee received a salary? Yes ❐ No ❐

If Yes: $……………………….. Period…………../…………/……….. to …………/…………/…………../

Net of business expenses, personal deductions and income tax; excludes bonuses, commissions, and other allowances; and excluding income derived from playing sport.

A. (If employed) SALARY OFFICER'S NAME…………………………………………… PHONE NUMBER……………………………

(If employed) SALARY OFFICER'S SIGNATURE………………………………………….. DATE…………/……….…/……………
COMPANY STAMP

B. (If self employed) ACCOUNTANT'S NAME……………………………………………PHONE NUMBER…………………………..

(If self employed) ACCOUNTANT'S SIGNATURE……………………………………………DATE…………/…………../…………
ACCOUNTANT'S STAMP

All questions relating to this claim must be completed, failure to complete all relevant sections will cause delays in the settlement of the claim

JLT Sport

PO Box 7170 Hutt St, ADELAIDE SA 5000
Telephone: (08) 8235 6444
Facsimile: (08) 8235 6448

SPORTS INJURY ATTENDING PHYSICIAN'S REPORT

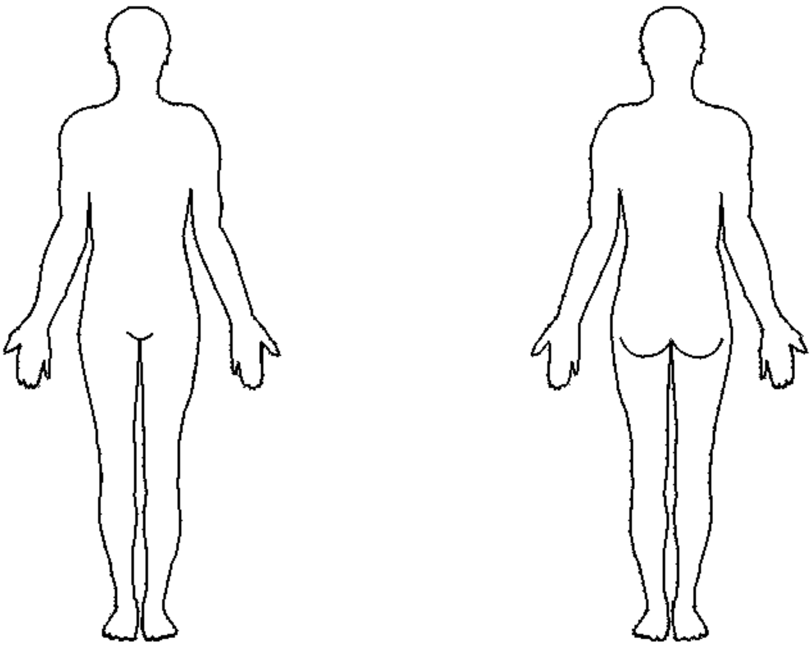
CLAIM NUMBER:...

Surname:	....
Given Names:	....
Injury Date:	....

TO BE COMPLETED BY THE ATTENDING PHYSICIAN

THIS FORM MUST BE COMPLETED WITHOUT EXPENSE TO JLT SPORT

1. Diagnosis / History of Injury: ....
....
....



- ❐ Concussion
- ❐ Cut or Abrasion
- ❐ Dislocation
- ❐ Fracture
- ❐ Twist
- ❐ Sprain
- ❐ Strain
- ❐ Impact Contusion
- ❐ Other
  Please Specify

2. When did the patient first receive medical attention for the above? ……………/…………./…………..
   By Whom?
   Name: ....
   Address: ....
   .... PostCode: ………………….

(Continued: See over.)

3. Do you consider the Patient's injury to be a new injury? Yes ❐ No ❐
   Recurrence of an old injury? Yes ❐ No ❐
   If recurrence please give details and describe: ………………………………………………………………………………
   ………

4. Does the patient have any congenital defects or chronic diseases? Yes ❐ No ❐
   If yes, please give dates, name of treating doctor and describe: …………………………………………………………………
   ………

5. Have you referred the patient to any other services or treatment? Please specify the approximate number of treatments required: ❒ Physiotherapy .... ❒ Chiropractic .... ❒ Surgery (Please specify details) .... ❒ Other	
6. Has the patient been able to do any work since the injury?	Yes ❒ No ❒
7. What date do you advise the patient to return to the sport, training ………/………/……… playing ………/………/………	
8. SIGNATURE OF TREATING PHYSICIAN: …………………………………………….	Date:…………../…………/……………

** If You have been unable to work as a result of the injury, and you are wishing to claim for Loss of Income (and your club's Policy provides this cover) please arrange for the following to be completed :-

INCAPACITY TO WORK STATEMENT

(TO BE COMPLETED IF CLAIMING FOR LOSS OF INCOME. IF CONTINUING, A NEW STATEMENT MUST BE FORWARDED FOR EACH PERIOD ABSENT FROM EMPLOYMENT)

CERTIFICATION BY GENERAL PRACTITIONER, SURGEON, SPECIALIST

I examined the person named overleaf on………../………/…………

In my opinion this person is/has been unfit for work from ………../…………/………. To ………/………../……….. inclusive.

Are there any further remarks or comments you can make to assist in assessing this condition?

....

....

....

DOCTOR'S NAME……………………………………………………………………………………………………….

ADDRESS…………………….………………………………………………………………………………..

……………………………………………………………………………………………………….

…………………………………………………………Postcode: ……………………………………

Telephone Number (…..)…………………………………..Facsimile (…..)…………………………………….

DOCTOR'S SIGNATURE …………………………………………………DATED …………../…………… /………………

JARDINE LLOYD THOMPSON PTY LTD

ABN 69 009 098 864

COLLECTION STATEMENT UNDER PRIVACY ACT 1988

In accordance with the Privacy Act 1988 (and subsequent amendments), we, Jardine Lloyd Thompson Pty Ltd (and our subsidiaries and related entities) (JLT) draw your attention to the following:

- We may collect personal information about you by means of the enclosed document.
- We are collecting the information principally for the purpose of approaching the (re)insurance market, placing insurance, assessing and advising you on your insurance needs, claims handling or risk management (depending on your requirements). Other purposes include providing you with information about other JLT products or services. If you are proposing for or renewing insurance, the information is required pursuant to your duty of disclosure under the Insurance Contracts Act 1984, the Marine Insurance Act 1909 or at common law.
- The information we collect may be disclosed to third parties including but not limited to (re)insurers, insurance intermediaries, service providers, finance providers, advisers, agents and JLT related Group companies.
- By providing the information requested in the attached document, you agree to us collecting, using and disclosing your personal information as outlined in this Collection Statement.
- If you do not provide all or part of the information requested, we may be unable to process your application or provide other required services, your application for insurance may be declined or you may prejudice your insurance cover.
- You have the right to request access to, and correct, any personal information that we hold about you, subject to the provisions of the Privacy Act 1988.
- To assist us in maintaining correct records we ask you to inform us of any changes in your personal information provided, as they occur.
- If you provide us with personal information about other individuals, you must ensure that those persons have been made aware of the above matters. Where the information collected relates to health, criminal record or other sensitive information as defined in the Privacy Act 1988, you must obtain it with the individual's consent.
- Our Privacy Policy can be made available on request or can be accessed on our website (www.jlta.com.au).
- For further information contact your account executive or the JLT Privacy Officer:

  Jardine Lloyd Thompson Pty Ltd, 66 Clarence Street, SYDNEY NSW 2000
  Telephone: (02) 9290 8000

JLT Sport

PO Box 7170 Hutt Street SA 5000
Telephone: 1800 640 009
Facsimile: (08) 8235 6450

Cricket Claim Form

Non Medicare Cover and/or Loss of Income

IMPORTANT INFORMATION: PLEASE READ CAREFULLY

Non Medicare Cover: We do not provide cover for Surgeons, Anaesthetists, Doctors, X-Rays or other accounts which are partly covered by Medicare. The Australian Health Insurance Act does not permit us to contribute to any charges covered by Medicare (including the Medicare Gap).

We will pay a percentage of the amount, as indicated in the Policy schedule, for private hospital, dental, ambulance (if not otherwise covered), chiropractic, physiotherapy, osteopath, naturopath, massage and pay for orthotics prescribed by a surgeon to aid recovery.

Subject to the Insurance Contracts Act 1984 any treatment rendered necessary by injury must be completed within 12 calendar months from the date of such injury occurring.

- Medical treatment must be certified necessary by the attending Physician, ie. Doctor, Surgeon, Physiotherapist, Dental Surgeon.
- Failure to complete all sections of this form properly may delay settlement of your claim.
- Please refer to your Club or JLT Sport for Benefits, Excess and Special Conditions/Exclusions.
- Please endeavour to submit your claim form as soon as possible. Undue delay may affect your claim settlement.
- Please send original receipts (unless retained by your Health Fund). Hospital claims must be accompanied by an itemised receipt.
- If treatment is covered by your Private Health Fund please send their rebate advice with a copy of the relevant account.
- Only one claim form (per injury) is required. We will advise you of your claim number which should be quoted with all future correspondence.

How To Claim Medical Only Claims

When claiming for reimbursement of Non Medicare medical expenses you must complete Section A and have Section B completed and signed by your club official. Medical treatment must be certified necessary by AN ATTENDING PHYSICIAN and incurred within Australia. THE ATTENDING PHYSICIANS REPORT MUST BE FULLY COMPLETED PRIOR TO SUBMITTING A CLAIM. (An attending physician includes a general practitioner, physiotherapist, chiropractor, dentist.)

Claims Involving Loss Of Income

(a) If claiming for Loss of Income Benefit you must complete Section A and B, and have Section C completed by your Employer;

(b) Have your Attending Physician complete the “Attending Physicians Report” as attached;

(c) Have a Doctor complete the “Incapacity to Work Statement”. (This **MUST** be completed by a General Practitioner, a Surgeon or a Specialist). It will **not** be accepted if completed by a Physiotherapist, Chiropractor etc.)

Section A. To Be Completed By The Player

PLEASE PRINT - If there is insufficient space to answer a question, please attach additional sheets.

1. PLAYER'S SURNAME

GIVEN NAME SEX:

NAME OF CLUB

NAME OF ASSOCIATION/LEAGUE

2. ADDRESS STATE POSTCODE

3. DATE OF BIRTH / /

4. OCCUPATION

TELEPHONE
HOME ( )

WORK ( )

4. DATE OF INJURY: ………..…/………./…………

TIME OF INJURY: am/pm

5. DESCRIBE YOUR INJURY & HOW IT HAPPENED? ……………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

6. a. PLAYING SURFACES:

INDOOR ❐ TURF ❐

SYNTHETIC ❐ MATTING ❐

OTHER ❐ ……………………………

b. WEATHER CONDITIONS:

DRY ❐ WET ❐

c. STATE THE NAME OF A WITNESS TO THE INJURY:

……………………………………………………………

……………………………………………………………

d. PERSON TO WHOM INCIDENT REPORTED:

……………………………………………………………

……………………………………………………………

DATE……./………../………

TIME REPORTED…….. AM/PM

e. PLAYING POSITION AT TIME OF INJURY

❐ Fielding

❐ Batting

❐ Wicket Keeping

❐ Bowling

❐ Umpiring

❐ Other ………………………………………………….

f. UNDER WHAT CIRCUMSTANCES?

❐ Officially organised competition

❐ Officially organised practice

❐ Social or private competition

❐ Social or private practice

❐ Travelling

❐ Other (Please state what you were doing)

……………………………………………………………

……………………………………………………………

g. CRICKET GRADE

……………………………………………………………...

7. DID YOU CEASE TRAINING / PLAYING IMMEDIATELY AS A RESULT OF THE INJURY? ❒ YES ❒ NO

If no, please provide reason. ....

....

8. WHEN DO YOU EXPECT TO RESUME

WORK: ………/……../……… TRAINING: ………/………/………. PLAYING: ……..../ ……../…….

This section MUST be completed, if exact dates not known please provide approximate dates.

9. WHEN DID YOU FIRST SEEK MEDICAL TREATMENT?…..…/…………./………..

WERE YOU ADMITTED TO HOSPITAL? ❒ YES ❒ NO If yes, please provide:

HOSPITAL NAME: ………………………………..………….ADDRESS: ………………………………..………………..

ADMITTANCE DATE: …………/……………/……….... DISCHARGE DATE: ……………/…………/……..……

10. HAVE YOU HAD A SIMILAR INJURY BEFORE TREATMENT YES ❒ NO ❒

If yes, please provide details of injury:

……..…...
……..……

DATE WHEN OCCURRED ……../……..…./……..….

NAME & ADDRESS OF TREATING DOCTOR ………………………………………………………………………………..

11A. DO YOU HAVE PRIVATE MEDICAL INSURANCE? YES ❒ NO ❒

NAME OF FUND ……

DOES YOUR COVER INCLUDE:

i.	HOSPITAL COSTS	YES	❒	NO	❒
ii.	DENTAL AND PHYSIO COSTS	YES	❒	NO	❒
iii.	AMBULANCE	YES	❒	NO	❒

B. ARE YOU A MEMBER OF THE AMBULANCE SERVICE YES ❒ NO ❒

Signature of Claimant

I hereby authorise any hospital, physician or other person who has attended me or any employer, to furnish JLT Sport or its representatives any and all information with respect to any sickness or injury, medical history, consultation, prescriptions, or treatment, copies of all hospital or medical records and copies of all records of employers. I agree that a Photostat/electronic copy of this authorisation shall be considered as effective and valid as the original. I do solemnly and sincerely declare that the foregoing particulars are true and correct in every detail and I agree that if I have made, or in any further declaration in respect of the said injury or sickness shall make any false or fraudulent statements or suppress or conceal or falsely state any material fact whatsoever, the claim shall be void and all rights to recover there under in respect of past or future injuries or sickness by me shall be forfeited.

In accordance with the Insurance (Agents and Brokers) Act 1984 JLT Sport gives notice that in dealing with or settling this claim they will be acting under an authority given to them by the Insurer named in the Certificate of Insurance and that they will be dealing with or settling the claim as agent of the named Insurer and not as an agent of the Insured.

SIGNED: ………………………………………………. DATED: ……………………………………………………
(Claimant)

SECTION B. TO BE COMPLETED BY YOUR CLUB / ASSOCIATION

DECLARATION (Please advise the claimant of the Policy coverage as per your Schedule of Insurance)

I, …………………………………………………………………………… of ………..…………………………..…………………………………..
(OFFICIAL) (NAME OF CLUB/ASSOCIATION)

Hereby Certify that ………………………………………………….. sustained the injuries resulting in this claim on………/…..……/……..
(Player's Name) (Date)

At ………………………………….am/pm whilst playing / training for ……………..…………………………………………..…………against

…..………………………………………………………………………… Place of Game: ………………………………………………………….

Signed: ……………………………………………………….………………………..… Dated: ………………/….……………/………..…….
(Official)

Official's Position at Club/Association: ……………………………………………………. Contact Phone Number: …………………………..…

SECTION C. LOSS OF INCOME

1.	Can compensation be claimed under worker's compensation or any other insurance including Loss of Income?	Yes ❒ No ❒
2.	Have you ever made any previous claims in respect to personal accident insurance?	Yes ❒ No ❒
3.	Have you engaged in any other income earning employment since you have been injured?	Yes ❒ No ❒

The following section must be completed by your employer/salary officer (not player). If self employed, please have your accountant complete these details.

NAME OF EMPLOYER				
ADDRESS OF EMPLOYER …………………………………………………………………………….. ……………………………………………………………………………..		PHONE (……) ……………………………………. FACSIMILE (…….) ………………………………		
DATE CEASED WORK DUE TO INJURY …………./………../……………		DATE EXPECTED TO RESUME NORMAL DUTIES …………/…………/……….		
EMPLOYEE WEEKLY SALARY AS AT DATE OF INJURY NET $…………………………GROSS $ ……………………… (If self employed, provide average weekly salary based on 12 month period directly prior to injury)		DATE COMMENCED EMPLOYMENT WITH COMPANY …………/…………/…………		
INCOME DEFINITION:	Self Employed ❒	Full Time ❒	Part Time ❒	Casual ❒
During the period of incapacity has the employee received a salary? Yes ❒ No ❒ If Yes: $……………………….. Period…………./…………/……….. to …………/…………/…………./ Net of business expenses, personal deductions and income tax; excludes bonuses, commissions, and other allowances; and excluding income derived from playing sport.				
A. (If employed) SALARY OFFICER'S NAME…………………………………………… PHONE NUMBER…………………………… (If employed) SALARY OFFICER'S SIGNATURE………………………………………….. DATE…………/…………/…………… ABN/ACN ……………………………………………				
B. (If self employed) ACCOUNTANT'S NAME……………………………………………PHONE NUMBER…………………………….. (If self employed) ACCOUNTANT'S SIGNATURE………………………………………….DATE…………/…………../………… ACCOUNTANT'S STAMP				

All questions relating to this claim must be completed.
Failure to complete all relevant sections will cause delays in the settlement of the claim

JLT Sport

PO Box 7170 Hutt Street, SA 5000
Telephone: 1800 640 009
Facsimile: (08) 8235 6450

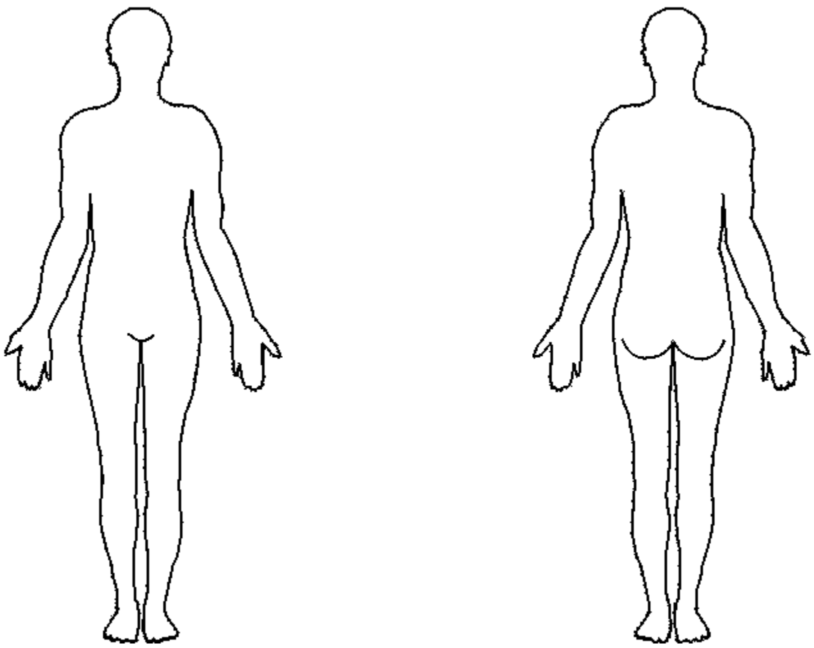
SPORTS INJURY ATTENDING PHYSICIAN'S REPORT

Surname:	....
Given Names:	....
Injury Date:	....

TO BE COMPLETED BY THE ATTENDING PHYSICIAN

THIS FORM MUST BE COMPLETED WITHOUT EXPENSE TO JLT SPORT

1. Diagnosis / History of Injury: ....
....
....



❐ Concussion
❐ Cut or Abrasion
❐ Dislocation
❐ Fracture
❐ Twist
❐ Sprain
❐ Strain
❐ Impact Contusion
❐ Other
Please Specify

2. When did the patient first receive medical attention for the above? ……………/…………./…………..

By Whom?

Name: ....

Address: ....

.... PostCode: ………………….

(Continued: See over.)

3. Do you consider the Patient's injury to be a new injury? Yes ❐ No ❐

Recurrence of an old injury? Yes ❐ No ❐

If recurrence please give details and describe: ……………………………………………………………………………………

………

4. Does the patient have any congenital defects or chronic diseases? Yes ❐ No ❐

If yes, please give dates, name of treating doctor and describe: ……………………………………………………………………

………..

5. Have you referred the patient to any other services or treatment?

Please specify the approximate number of treatments required:

❐ Physiotherapy ……………………………………………………………………………………………………

❐ Chiropractic ……………………………………………………………………………………………………

❐ Surgery (Please specify details) …………………………………………………………………………

❐ Other ……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

6. Has the patient been able to do any work since the injury? Yes ❐ No ❐

7. What date do you advise the patient to return to Cricket, training ………/………/……… playing ………/………/………

8. SIGNATURE OF TREATING PHYSICIAN: …………………………………………… Date:…………../…………/……………

** If You have been unable to work as a result of the injury, and you are wishing to claim for Loss of Income please arrange for the following to be completed :-

INCAPACITY TO WORK STATEMENT

(TO BE COMPLETED IF CLAIMING FOR LOSS OF INCOME. IF CONTINUING, A NEW STATEMENT MUST BE FORWARDED FOR EACH PERIOD ABSENT FROM EMPLOYMENT)

CERTIFICATION BY GENERAL PRACTITIONER, SURGEON, SPECIALIST

I examined the person named overleaf on………../………/…………

In my opinion this person is/has been unfit for work from ………../…………/………. To ………/………../……….. inclusive.

Are there any further remarks or comments you can make to assist in assessing this condition?

………

………

………

DOCTOR'S NAME………

ADDRESS……

………

……………………………………………………………………………….Postcode: ……………………………………

Telephone Number (…..)…………………………………..Facsimile (…..)……………………………………

DOCTOR'S SIGNATURE …………………………………………………DATED …………./…………… /……………….

JARDINE LLOYD THOMPSON PTY LTD

ABN 69 009 098 864

COLLECTION STATEMENT UNDER PRIVACY ACT 1988

In accordance with the Privacy Act 1988 (and subsequent amendments), we, Jardine Lloyd Thompson Pty Ltd (and our subsidiaries and related entities) (JLT) draw your attention to the following:

- We may collect personal information about you by means of the enclosed document.
- We are collecting the information principally for the purpose of approaching the (re)insurance market, placing insurance, assessing and advising you on your insurance needs, claims handling or risk management (depending on your requirements). Other purposes include providing you with information about other JLT products or services. If you are proposing for or renewing insurance, the information is required pursuant to your duty of disclosure under the Insurance Contracts Act 1984, the Marine Insurance Act 1909 or at common law.
- The information we collect may be disclosed to third parties including but not limited to (re)insurers, insurance intermediaries, service providers, finance providers, advisers, agents and JLT related Group companies.
- By providing the information requested in the attached document, you agree to us collecting, using and disclosing your personal information as outlined in this Collection Statement.
- If you do not provide all or part of the information requested, we may be unable to process your application or provide other required services, your application for insurance may be declined or you may prejudice your insurance cover.
- You have the right to request access to, and correct, any personal information that we hold about you, subject to the provisions of the Privacy Act 1988.
- To assist us in maintaining correct records we ask you to inform us of any changes in your personal information provided, as they occur.
- If you provide us with personal information about other individuals, you must ensure that those persons have been made aware of the above matters. Where the information collected relates to health, criminal record or other sensitive information as defined in the Privacy Act 1988, you must obtain it with the individual's consent.
- Our Privacy Policy can be made available on request or can be accessed on our website (www.jlta.com.au).
- For further information contact your account executive or the JLT Privacy Officer:

  Jardine Lloyd Thompson Pty Ltd, 66 Clarence Street, SYDNEY NSW 2000
  Telephone: (02) 9290 8000

To access a claim form please go to www.jltsport.com.au or call JLT Sport on 1300 655 684

JLT Sport

a division of Jardine Lloyd Thompson
ABN 009 098 864   AFSL 226824

PO Box 7170 Hutt Street SA 5000
Toll Free: 1800 640 009
Telephone: (08) 8235 6444
Facsimile: (08) 8235 6450

PERSONAL INJURY CLAIM FORM
(FOR INJURIES SUSTAINED BETWEEN 15.8.05 AND 30.9.06)

AUSTRALIAN CRICKET NATIONAL CLUB INSURANCE PROGRAM

Non Medicare Medical Expenses and/or Loss of Income

IMPORTANT INFORMATION: PLEASE READ CAREFULLY

Non Medicare Medical Expenses: The insurer does not provide cover for treatment from a Doctor, Surgeon, Anaesthetist or Surgeon's Assistant or other accounts which are partly covered by Medicare such as X-ray, some MRI Scans and Public Hospital costs. The Health Insurance Act (Cth) 1973 does not permit the insurer to contribute to any charges covered by Medicare (including the Medicare Gap).

The insurer will pay a percentage of the amount, as indicated in the Policy schedule, for private hospital, dental, ambulance (if not otherwise covered), chiropractic, physiotherapy, osteopath, naturopath, massage and pay for orthotics prescribed by a surgeon to aid recovery.

Subject to the Insurance Contracts Act (Cth) 1984 any treatment rendered necessary by injury must be completed within 12 calendar months from the date of such injury occurring.

- Medical treatment must be certified necessary by the attending Physician, i.e. Doctor, Surgeon, Physiotherapist, Dental Surgeon.
- Failure to complete all sections of this form properly may delay settlement of your claim.
- Please refer to JLT Sport for information and advice on Benefits, Excess and Special Conditions/Exclusions.
- Please endeavour to submit your claim form as soon as possible. Undue delay may affect your claim settlement.
- Please send original receipts (unless retained by your Health Fund). Hospital claims must be accompanied by an itemised receipt.
- If treatment is covered by your Private Health Fund please send their rebate advice with a copy of the relevant account.
- Only one claim form (per injury) is required. We will advise You of your claim number which should be quoted with all future correspondence.

HOW TO CLAIM NON-MEDICARE MEDICAL EXPENSES ONLY

When claiming for reimbursement of Non Medicare medical expenses You must complete Section A and have Section B completed and signed by your club official. Medical treatment must be certified necessary by an attending physician and incurred within Australia. The ATTENDING PHYSICIANS REPORT must be fully completed prior to submitting a claim. An attending physician includes a general practitioner, physiotherapist, chiropractor, dentist.

CLAIMS INVOLVING LOSS OF INCOME

(a) If claiming for Loss of Income Benefit You must complete Section A and B, and have Section C completed by your Employer;

(b) Have your Attending Physician complete the "Attending Physicians Report" as attached;

(c) Have a Doctor complete the "Incapacity to Work Statement". (This **MUST** be completed by a General Practitioner, Surgeon or a Specialist). It will **not** be accepted if completed by a Physiotherapist, Chiropractor etc.)

SECTION A. **TO BE COMPLETED BY CLAIMANT OR LEGAL GUARDIAN IF UNDER 18 YEARS OF AGE.**
PLEASE PRINT - If there is insufficient space to answer a question, please attach additional sheets.

1. NAME OF CLUB NAME OF TEAM / GRADE	NAME OF ASSOCIATION	
2. CLAIMANTS SURNAME	GIVEN NAME	SEX
3. ADDRESS	STATE	POSTCODE

4. DATE OF BIRTH / /	5. OCCUPATION	TELEPHONE HOME ( )	WORK ( )
6. **DATE OF INJURY**: / /		TIME OF INJURY: am / pm	

7. (a) Describe your injury and how it happened (continue on separate page if needed)

....

....

....

(b) Are there any other factors which contributed to your injury? (If yes, detail)

....

....

....

NOTE: Information required for cricket injury research

8. a) Where did your injury occur?	❒ Indoor	❒ Outdoor		
b) Surface at point of injury?	❒ Grass	❒ Indoor Area	❒ Concrete (Pitch)	❒ Turf (Pitch)
	❒ Matting (Pitch)	❒ Synthetic (Pitch)	❒ Other?…………….	
c) Weather conditions?	❒ Fine	❒ Showers	❒ Extreme Heat	❒ Extreme Cold
d) Surface conditions?	❒ Dry	❒ Wet	❒ Other? …………...	
e) Injury session?	❒ Playing (match)	❒ Training	❒ Travelling	❒ Other? …………..
f) Playing position injured?	❒ Batting	❒ Bowling	❒ Fielding	❒ Wicket Keeping
	❒ Umpiring	❒ Other? …………..…		
g) Injury circumstance	❒ Struck by ball	❒ Surface Impact	❒ Other?……………	

NOTE: This section must be completed! If exact dates not known please provide approximates.

9. When do you expect to resume:

Work: ………/……../………   Training: ………/………/……….   Playing: ……../ ……../…….

NOTE: This section must be completed!

10. a) Do you have Private Medical Insurance? ❐ Yes ❐ No

Name of Fund ……

Does your cover include:			
	i. Hospital costs?	Yes ❐	No ❐
	ii. Dental and physio costs?	Yes ❐	No ❐
	iii. Ambulance?	Yes ❐	No ❐

b) Are you a member of the Ambulance Service? Yes ❐ No ❐

Signature of Claimant

I hereby authorise any hospital, physician or other person who has attended me or any employer, to furnish JLT Sport or its representatives any and all information with respect to any sickness or injury, medical history, consultation, prescriptions, or treatment, copies of all hospital or medical records and copies of all records of employers. I agree that a Photostat/electronic copy of this authorisation shall be considered as effective and valid as the original. I do solemnly and sincerely declare that the foregoing particulars are true and correct in every detail and I agree that if I have made, or in any further declaration in respect of the said injury or sickness shall make any false or fraudulent statements or suppress or conceal or falsely state any material fact whatsoever, the claim shall be void and all rights to recover there under in respect of past or future injuries or sickness by me shall be forfeited.

JLT Sport gives notice that in dealing with or settling this claim they will be acting under an authority given to them by the Insurer named in the Certificate of Insurance and the policy document and that they will be dealing with or settling the claim as agent of the named Insurer and not as an agent of the Insured.

Claimants Signature: ……………………………………………….   Date: …………………………………………………

SECTION B. TO BE COMPLETED BY YOUR CLUB

CLUB DECLARATION (Please advise the claimant of the Policy coverage as per your Schedule of Insurance)

I, ………………………………………………………… (club official) of ………………………..……………………..…… (name of club)

hereby Certify that ………………………………………………… (claimants name) sustained the injuries resulting in this claim on

…….…/…..……/…….. at …………………am/pm whilst playing / training for ……...…………………………………………...……………

against …..…………………………………………………………………   Place of Game: ……………………………………………

Signed: ……………………………………………………….……… (club official)   Date: ………………/…..…………/……….……

Official’s Position at Club: ……………………………………………………   Contact Phone Number: …………………….……………

Has the injured person returned to playing cricket? Yes ❐ No ❐ If Yes, on which date? ……………………..

SECTION C. ONLY COMPLETE THIS SECTION IF YOU ARE CLAIMING FOR LOSS OF INCOME

1.	Can compensation be claimed under worker's compensation or any other insurance including Loss of Income?	Yes ❒ No ❒
2.	Have you ever made any previous claims in respect to personal accident insurance?	Yes ❒ No ❒
3.	Have you engaged in any other income earning employment since you have been injured?	Yes ❒ No ❒

The following section must be completed by your employer/salary officer (not player).
If self employed, please have your accountant complete these details.

NAME OF EMPLOYER

ADDRESS OF EMPLOYER ………………………………………………………………………….. …………………………………………………………………………..	PHONE ( ) …………………………………… FACSIMILE ( ) ……………………………………
DATE CEASED WORK DUE TO INJURY …………../…………/……………	DATE EXPECTED TO RESUME NORMAL DUTIES …………/…………/……….
EMPLOYEE WEEKLY SALARY AS AT DATE OF INJURY NET $…………………………GROSS $ ……………………… *(If self employed, provide average weekly salary based on 12 month period directly prior to injury)*	DATE COMMENCED EMPLOYMENT WITH COMPANY …………/…………/…………

INCOME DEFINITION: Self Employed ❒ Full Time ❒ Part Time ❒ Casual ❒

During the period of incapacity has the employee received a salary? Yes ❒ No ❒

Has the injured person returned to work? Yes ❒ No ❒ If Yes, on which date? ……………………..

$……………………….. Period…………../…………/……….. to …………/…………/…………../

Net of business expenses, personal deductions and income tax; excludes bonuses, commissions, and other allowances; and excluding income derived from playing sport.

A. (If employed) Salary Officer's Name: ………………………………………………… Phone No. ………………………………

(If employed) Salary Officer's Signature: …………………………………………… Date …………/…………/……………

ABN/ACN ……………………………………………

B. (If self employed) Accountant's Name: ……………………………………………… Phone No. ……………………………..

(If self employed) Accountant's Signature: …………………………………………… Date …………/…………../…………

Accountant's Stamp

All questions relating to this claim must be completed.
Failure to complete all relevant sections will cause delays in the settlement of the claim

JLT Sport
a division of Jardine Lloyd Thompson
ABN 009 098 864 AFSL 226827

PO Box 7170 Hutt Street SA 5000
Toll Free: 1800 640 009
Telephone: (08) 8235 6444
Facsimile: (08) 8235 6450

SPORTS INJURY ATTENDING PHYSICIAN'S REPORT

Claimants Surname: ....

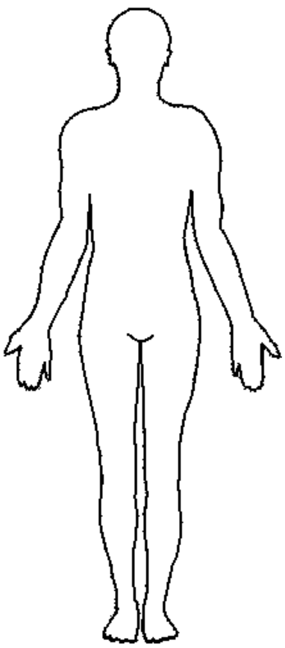
Claimants Given Name: ....

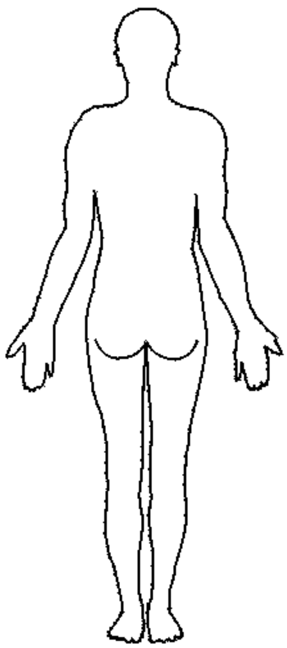
Claimants Injury Date: ....

TO BE COMPLETED BY THE ATTENDING PHYSICIAN

THIS FORM MUST BE COMPLETED WITHOUT EXPENSE TO JLT SPORT

1. Diagnosis / History of Injury: ....
....
....





- ❒ Concussion
- ❒ Cut or Abrasion
- ❒ Dislocation
- ❒ Dental
- ❒ Fracture
- ❒ Sprain (Ligament)
- ❒ Rupture (Internal Organs)
- ❒ Strain (Muscle/Tendon)
- ❒ Bruise
- ❒ Other (please specify)

2. When did the patient first receive medical attention for the above? ……………/…………/…………..

By Whom?

Name: ....

Address: ....

.... PostCode: …………………

(Continued over page)

3. Do you consider the Patient's injury to be a new injury? Yes ❐ No ❐

Recurrence of an old injury? Yes ❐ No ❐

If recurrence please give details and describe: ……………………………………………………………………………………

………

4. Does the patient have any congenital defects or chronic diseases? Yes ❐ No ❐

If yes, please give dates, name of treating doctor and describe: ………………………………………………………………………..

………

5. Have you referred the patient to any other services or treatment? Yes ❐ No ❐

Please specify the approximate number of treatments required:

❐ Physiotherapy ....

❐ Chiropractic ....

❐ Surgery (please specify details) ....

❐ Other ....

....

6. Has the patient been able to do any work since the injury? Yes ❐ No ❐

7. What date do you advise the patient to return to cricket? ……………………………………………………………………………

8. Signature of Treating Physician: …………………………………………… Date: …………./………../……………

** If You have been unable to work as a result of the injury, and you are wishing to claim for Loss of Income please arrange for the following to be completed :-

INCAPACITY TO WORK STATEMENT

(To be completed if claiming for loss of income. If continuing, a new statement must be forwarded for each period absent from employment)

CERTIFICATION BY GENERAL PRACTITIONER, SURGEON, SPECIALIST

I examined the person named overleaf on ………./………/…………

In my opinion this person is/has been unfit for work from ………./…………/………. to ………/………./……….. inclusive.

Are there any further remarks or comments you can make to assist in assessing this condition?

....

....

Doctor's Name ……

Address ……..

…… Postcode: ………………….

Telephone Number ( ) ………………………………….. Facsimile ( ) ……………………………………...

Doctor's Signature ……………………………………………… Date ……..……../……………. /………………

JARDINE LLOYD THOMPSON PTY LTD

ABN 69 009 098 864

COLLECTION STATEMENT UNDER PRIVACY ACT 1988

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- The information we collect may be disclosed to third parties including but not limited to (re)insurers, insurance intermediaries, service providers, finance providers, advisers, agents and JLT related Group companies.
- By providing the information requested in the attached document, you agree to us collecting, using and disclosing your personal information as outlined in this Collection Statement.
- If you do not provide all or part of the information requested, we may be unable to process your application or provide other required services, your application for insurance may be declined or you may prejudice your insurance cover.
- You have the right to request access to, and correct, any personal information that we hold about you, subject to the provisions of the Privacy Act 1988.
- To assist us in maintaining correct records we ask you to inform us of any changes in your personal information provided, as they occur.
- If you provide us with personal information about other individuals, you must ensure that those persons have been made aware of the above matters. Where the information collected relates to health, criminal record or other sensitive information as defined in the Privacy Act 1988, you must obtain it with the individual's consent.
- Our Privacy Policy can be made available on request or can be accessed on our website (www.jlta.com.au).
- For further information contact your account executive or the JLT Privacy Officer:

  Jardine Lloyd Thompson Pty Ltd, 66 Clarence Street, SYDNEY NSW 2000
  Telephone: (02) 9290 8000

JLT SPORT

2008/09 CRICKET AUSTRALIA NATIONAL CLUB RISK PROTECTION PROGRAMME

PERSONAL INJURY CLAIM FORM

CRICKET AUSTRALIA

FOR INJURIES SUSTAINED BETWEEN 31ST AUGUST 2008 AND 31ST AUGUST 2009

NON-MEDICARE MEDICAL AND LOSS OF INCOME CLAIMS ONLY

For Policy Wordings, Summary of Cover and other information relating to Personal Injury claims, please refer to:

www.jltsport.com.au/cricketaustralia

Claims Enquiries: 1800 640 009

Please send your completed claim form and attachments to:

Echelon Claims Services PO Box 7170, Hutt Street, SA 5000	OR	Fax: (08) 8235 6450

General Enquiries: 1300 655 684

HOW TO LODGE A PERSONAL INJURY CLAIM:

Step 1: **Access a *current* claim form via www.jltsport.com.au/cricketaustralia or call Echelon on 1800 640 009**

Step 2: **Complete *all* relevant sections of the claim form.**
- Your claim form may be returned if there is important information missing
- For assistance contact Echelon on 1800 640 009

Step 3: **Send your claim form to Echelon *as soon as possible* within *180 days* from the date of injury.**
- Do not wait for all treatments to be completed before sending your claim form.
- Treatments may continue even after you have submitted your claim form.

Step 4: **Echelon will confirm receipt of your claim or make contact with you should they require more information.**
- Please contact Echelon directly if you have not received confirmation of your claim within 2 weeks from the date of lodgement.

IMPORTANT INFORMATION REGARDING PERSONAL INJURY CLAIMS: *Please read the following information carefully*

Who is Echelon?
Echelon Australia Pty Ltd (Echelon) is a wholly owned subsidiary of Jardine Lloyd Thompson Pty Ltd. Echelon is the appointed claims management group for all Personal Injury claims on behalf of the Insurer and the Trustee of the National Risk Protection Program.

We legally can not reimburse you for Medicare-related costs:
The Health Insurance Act (Cth) 1973 does not permit the Insurer or the Trustee to reimburse you for any costs associated with medical treatments registered with Medicare (this includes the Medicare Gap).

Only Non-Medicare Medical Treatments can be reimbursed (as per the Policy Wording):
- All treatments must be certified as "necessary" by your physician. i.e. Doctor, physiotherapist, etc
- Please refer to JLT Sport's web site (www.jltsport.com.au/cricketaustralia) for benefits, excesses and special conditions/exclusions

Attach Original Receipts:
- Send original receipts with your claim form (unless retained by your private health fund).

If you have Private Health Cover:
- Claim on your private health fund first and attach a copy of their rebate advice to this form.

Privacy of your personal details:
- We collect, store and use your personal details in-line with the Privacy Act (Cth) 1988. For a copy of our Privacy Statement please contact JLT Sport on 1300 130 373 or view it online www.jltsport.com.au

Examples of items covered by Medicare.
We can not reimburse you for these costs.
- Doctor
- Surgeon
- Surgeon's Assistant
- Anaesthetist
- X-rays
- MRI Scans*
- Public Hospitals

Examples of Non-Medicare items.
Claimable as per the Policy Wording.
- Ambulance
- Physiotherapist
- Dental
- Private Hospital Accommodation
- Chiropractor
- MRI Scans*

PLEASE NOTE:
** MRI scans are generally claimable through Medicare, however please check with your referrer and/or provider to confirm if this is the case prior to lodging your claim.*

LOSS OF INCOME CLAIMS:

Loss of Income Cover provides reimbursement for either 85% of the injured person's net weekly income or $500 per week – whichever is the lesser. A 14 day elimination period applies – this means the injured person must lose 14 days income as a result of the injury sustained before the claim is payable.

CLAIM FORM CHECKLIST: *Please use the checklist below to ensure ALL sections are completed as required.*

SECTION A:	SECTION B:	SECTION C:*	SECTION D:
❑ Claimant's details	❑ Club declaration	❑ Confirmation of Loss of Income Cover	❑ Injury details
❑ Injury details	❑ Signed by authorised club representative	❑ Employment Details	❑ Signed by your physician
❑ Injury research		❑ Signed by Employer	
❑ Signed by Claimant			

* Section C must be completed only when claiming for Loss of Income.

2008/09 CRICKET AUSTRALIA NATIONAL CLUB RISK PROTECTION PROGRAMME

JLT SPORT

CRICKET AUSTRALIA

CLAIM FORM SECTION A:

THIS SECTION MUST BE COMPLETED IN FULL BY THE CLAIMANT OR A LEGAL GUARDIAN IF THE CLAIMANT IS UNDER 18 YEARS OF AGE.

PLEASE PRINT - If there is insufficient space to answer a question, please attach additional sheets.

1 ______________________ Claimant's Surname
2 ______________________ Claimant's First Name
3 Male / Female Gender
4 ____/____/______ Date of Birth (DD/MM/YYYY)

5 ______________________ Claimant's Personal Mailing Address ________ State ________ Post Code
6 (   ) ______________ Contact Phone Number

7 ______________________ Claimant's Occupation (if applicable)
8 (   ) ______________ Work Phone Number
9 ____/____/______ Date of Injury (DD/MM/YYYY)
10 ________:________am/pm Approx. Time of Injury (HH:MM)

11 ______________________ Club Name
12 ______________________ Association Name

13 Describe the injury and how it happened (please use additional pages if required).

14 Describe any other factors that may have contributed to your injury (leave blank if not applicable).

15 Where did the injury occur? ❑ Indoor ❑ Outdoor

16 Weather conditions? ❑ Fine ❑ Showers ❑ Extreme heat ❑ Extreme cold ❑ Other__________ Please specify

17 Surface conditions? ❑ Wet ❑ Dry ❑ Muddy ❑ Hard ❑ Other__________ Please specify

18 Surface type? ❑ Indoor *(Area)* ❑ Grass ❑ Concrete *(Pitch)* ❑ Synthetic *(Pitch)* ❑ Matting *(Pitch)* ❑ Other__________ Please specify

19 Circumstances at the time of injury? ❑ Playing ❑ Training ❑ Travelling ❑ Other__________ Please specify

20 Playing position at time of injury? ❑ Batting ❑ Bowling ❑ Fielding ❑ W/Keeping | ❑ Umpiring | ❑ Other_____ Please specify

21 How did the injury occur? ❑ Trip/Fall ❑ Hit by ball ❑ Collision ❑ Overuse ❑ Other_____ Please specify

22 Please indicate when you intend to resume the following activities. If exact dates are not known, please provide approximates.

_______/_______/_______ ❑ N/A When will you resume WORK?
_______/_______/_______ When will you resume TRAINING?
_______/_______/_______ When will you resume PLAYING?

23 Do you have private health cover? ❑ YES ❑ NO

24 If yes, what is the name of your private health fund? ______________________

25 Please indicate the covers offered by your private health fund ❑ Dental costs ❑ Physiotherapy costs ❑ Ambulance ❑ Hospital costs

26 Are you a member of the Ambulance Service? ❑ YES ❑ NO

27 Please indicate to whom re-imbursement cheques are to be made payable for this claim:

❑ Myself ❑ Other

Contact Person ______________ Cheque made payable to ______________

Address ______________ State ______ Post code ______

I, the undersigned, hereby acknowledge and agree to the information contained herein (including personal information) being shared with the other authorised members of the JLT Sport (Cricket Australia National Club Risk Protection Programme) Discretionary Trust Arrangement. I allow this information to be used as part of the Trust's risk management processes and reporting criteria. I authorise any hospital, physician or other person who has attended me or any employer, to furnish JLT Sport or its representatives any and all information with respect to any sickness or injury, medical history, consultation, prescriptions, treatments, copies of all hospital or medical records and copies of all records of employers. I agree that a Photostat copy of this authorisation shall be considered as effective and valid as the original. I do solemnly and sincerely declare that the forgoing particulars are true and correct in every detail. I agree that if I have made, or shall make in any further declaration in respect to said injury, any false or fraudulent statements or suppress or conceal or falsely state any material fact whatsoever, the covers shall be void and all rights to recover there under in respect to past or future injuries shall be forfeited.

28 **Claimant's signature (or Parent/Guardian if under 18 years)**

_______/_______/_______ **Date**

JLT SPORT

CRICKET AUSTRALIA

CLAIM FORM SECTION B: CLUB/ASSOCIATION DECLARATION

THIS SECTION MUST BE COMPLETED IN FULL BY AN AUTHORISED CLUB OR LEAGUE REPRESENTATIVE

I, the undersigned, as authorised representative of ______________________ hereby declare that
Name of Club/Association

______________________ sustained the injuries outlined on this claim form on ____/____/______
Name of Claimant Date of Injury

at ____________ whilst ❑ Playing ❑ Training for ______________________ ❑ Home team ❑ Away team
Time of Injury Select one Name of Claimant's Club/Team

at ______________________ against ______________________
Name of Ground/Place of Injury Name of Opposition Club/Team (if applicable)

I confirm that our Club/Association has completed all registration requirements for the 2008/09 National Club Risk Protection Programme, including the compulsory online Risk Management Education Program via JLT Sport's Web Site (www.jltsport.com.au/cricketaustralia).

I confirm that the Claimant
❑ Has not returned to playing/training.
❑ Returned to playing/training on: ________/________/________
Date Claimant returned

CLUB/ASSOCIATION DECLARATION. *This must be signed by an authorised Club/Association Representative. If blank, your claim may be delayed.*

____
Authorised Club/Association Representative's name (please print)

____
Authorised Club/Association Representative's Title/Position

____
Authorised Club/Association Representative's Signature

________/________/________
Date

____
Authorised Club/Association Representative's contact email

____
Authorised Club/Association Representative's contact number

CLAIM FORM SECTION C: LOSS OF INCOME BENEFITS

THIS SECTION MUST BE COMPLETED ONLY IF YOU ARE CLAIMING LOSS OF INCOME BENEFITS.

PLEASE NOTE A 14 DAY ELIMINATION PERIOD APPLIES FOR ALL LOSS OF INCOME CLAIMS.

1 – 4 to be completed by the Claimant.

1 Do you wish to claim for Loss of Income Benefits? ❑ YES ❑ NO *If NO, please proceed to Section D*

2 Can you claim compensation under Worker's Compensation or any other policy that includes loss of income benefits? ❑ YES ❑ NO

3 Have you ever made any previous claims in respect to a personal accident insurance policy or plan? ❑ YES ❑ NO

4 Have you engaged in any other income earning employment since you became injured? ❑ YES ❑ NO

5 – 18 to be completed by the Employer*.

5 ______________________________ Name of Employer (Business Name)

6 ______________________________ Name of Contact Person

7 ______________________________ Employer's address ____________ State ____________ Post Code

8 (   ) ____________________ Employer's Phone Number

9 (   ) ____________________ Employer's Facsimile Number

10 ________/_______/___________ Date Employee commenced with the organisation

11 $ ____________________ Employee's NET weekly salary as at date of injury

12 $ ____________________ Employee's GROSS weekly salary as at date of injury

If self employed, please provide average weekly salary based on 12 month period directly prior to injury.

13 What is the Employee's income definition ❑ Full Time ❑ Part Time ❑ Casual ❑ Self Employed

14 _______/_______/__________ Date Employee ceased work due to injury

15 _______/_______/__________ Date expected to resume normal duties

16 Has the Employee returned to work? ❑ YES ❑ NO If YES, what date? ________/_______/___________

17 During the period of incapacity has the employee received a salary? ❑ YES ❑ NO If YES, What for?

❑ Sick leave Salary received from ______/_______/_______ to ________/_______/_______

❑ Annual leave Salary received from ______/_______/_______ to ________/_______/_______

❑ Other Salary received from ______/_______/_______ to ________/_______/_______

Net of business expenses, personal deductions and income tax; excludes bonuses, commissions, and other allowances; and excluding income derived from playing sport.

18 ______________________________ **If Employed - Salary Officer's Name (please print)**

______________________________ **Salary Officer's Phone Number**

______________________________ **If Employed - Salary Officer's signature**

________/_______/_______ **Date**

______________________________ **If SELF EMPLOYED - Accountant's name (please print)**

______________________________ **Accountant's Phone Number**

______________________________ **If SELF EMPLOYED - Accountant's signature**

________/_______/_______ **Date**

*Please note: If you are SELF EMPLOYED, please have your Accountant complete this section.

2008/09 CRICKET AUSTRALIA NATIONAL CLUB RISK PROTECTION PROGRAMME

JLT SPORT

CRICKET AUSTRALIA

CLAIM FORM SECTION D: PHYSICIAN'S REPORT

THIS SECTION MUST BE COMPLETED IN FULL BY YOUR TREATING PHYSICIAN AND WITHOUT EXPENSE TO JLT SPORT.

1 ______________________ Claimant's Surname

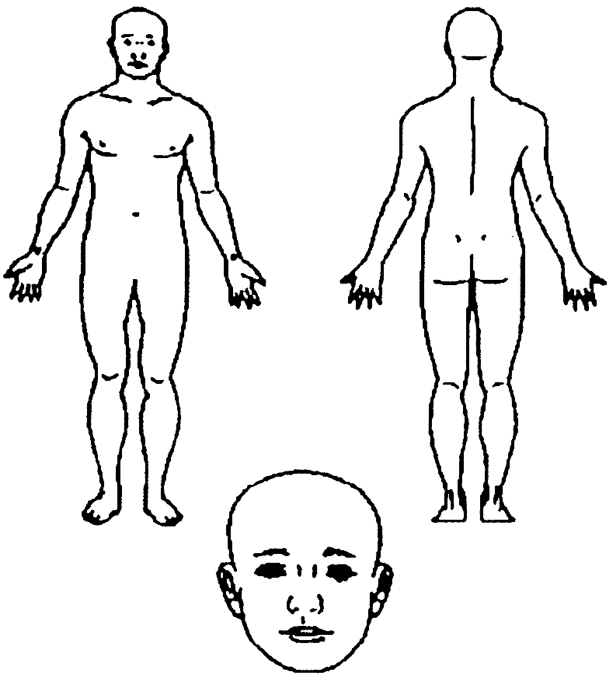
2 ______________________ Claimant's First Name

3 ______________________ Claimant's Injury Date

4 ______________________ Treating Physician's Name (Please Print)

5 Diagnosis / History of Injury

6 Injury location



Please CIRCLE and NAME the area of the body where the injury is located.

7 Injury type

- ❑ Bruising
- ❑ Concussion
- ❑ Cut
- ❑ Dental
- ❑ Dislocation
- ❑ Fracture
- ❑ Multiple
- ❑ Rupture (Internal Organs)
- ❑ Sprain (ligament)
- ❑ Strain (muscle/tendon)

8 When did the patient first receive medical treatment for the above injury?

_______/_________/___________

Date of treatment

Name of attending physician

Address

State

Post code

9 Do you consider the Patient's injury to be a NEW injury? ❑ Yes ❑ NO

10 Do you consider the Patient's injury to be a RECURRENCE of a previous injury? ❑ Yes ❑ NO

11 If you consider this injury to be a recurrence from an old injury, please provide details and a description.

13 Does the Patient have any congenital defects or chronic diseases? ❑ Yes ❑ NO

14 If YES, please provide details (including dates, name of treating doctor and description).

Please continue to page 6.

JLT SPORT

2008/09 CRICKET AUSTRALIA NATIONAL CLUB RISK PROTECTION PROGRAMME

CRICKET AUSTRALIA

CLAIM FORM SECTION D: PHYSICIAN'S REPORT (CONTINUED)

15 Have you referred the patient to any other services or treatment? ❑ Yes ❑ NO

16 If YES, please specify the approximate number of treatments required.

❑ Physiotherapy ____________ Treatments required

❑ Chiropractics ____________ Treatments required

❑ Surgery ____________ Treatments required ____________ Please provide surgery details

❑ Other ____________ Treatments required ____________ Please provide details

17 Has the patient been able to do any work since the injury occurred? ❑ Yes ❑ NO

18 What date do you advise the patient to return to playing cricket? ________/_________/___________ Date advised to return to cricket

I, the undersigned, declare that I have examined the Claimant's injury as described on this form. I hereby declare that all information I have provided on this form is true and accurate as at the date of examination.

19 ____________________ **Physician's name (please print)** ____________________ **Physician's Phone Number**

____________________ **Physician's signature** ________/_______/_______ **Date**

Incapacity to Work Statement

Only complete this section if claiming for Loss of Income.

Incapacity to Work Statement must be completed by a Medical Practitioner (i.e. a General Practitioner, Surgeon or a Specialist).
It will not be accepted if completed by a Physiotherapist, Chiropractor etc.

I, ____________________ Medical Practitioner's name examined ____________________ Claimant's name on _____/_____/_____. Date of Examination

In my opinion, this person is/has been unfit for work from _____/_____/_____ First date of incapacity to work to _____/_____/_____ Last date of incapacity to work inclusive.

Please provide any further comments/remarks in regard to your assessment of this injury/condition.

____________________ **Medical Practitioner's Name** ____________________ **Medical Practitioner's Phone Number**

____________________ **Medical Practitioner's Address** __________ **State** __________ **Post Code**

____________________ **Medical Practitioner's Signature** ________/_______/_______ **Date**

JLT Sport Personal Injury Claim Form

Australian Cricket National Club Risk Protection Programme

Important Information

Who should use this claim form?

You should complete this form if:

☑ **Insured -** You are a player, umpire, official or volunteer (Insured Person) of an Association/Club (the Insured) covered within the Australian Cricket National Club Risk Protection Programme; and

☑ **Injured -** You sustained an accidental injury during the Policy Period whilst actually participating in a sanctioned cricket event/activity; and

☑ **Non-Medicare -** You are likely to incur or have incurred medical costs that are not listed on the Medicare Benefits Scheme

Before completing this form, ensure you are familiar with the Product Disclosure Statement (PDS) available on JLT Sport's web site www.jltsport.com.au/cricketaustralia.

What is covered?

The Australian Cricket National Club Risk Protection Programme's Personal Accident cover provides some reimbursement for Non-Medicare Medical Costs and/or Loss of Income cover for 12 months from the date of injury.

Commonwealth Legislation prevents reimbursement of Medicare costs including the Gap. Non-Medicare Medical Benefits are covered up to the limits outlined below.

Please refer to JLT Sport's web site for the Product Disclosure Statement (PDS).

How much can I claim?

The following table outlines the reimbursement capacity within the Australian Cricket National Club Risk Protection Programme.

Non-Medicare Medical Costs	Loss of Income
85% Reimbursement	85% Reimbursement
$5,000 maximum per claim	$500 maximum per week
$50 excess per claim	14 day elimination period

All clubs receive the above coverage at the commencement of each period of cover. Associations/Clubs may choose to upgrade the Loss of Income cover for an additional premium. Upgraded cover is valid only from the date of purchase.

What is NOT covered?

The following examples demonstrate some areas not covered by the Personal Accident cover:

☒ Medicare items (see below);

☒ the Medicare Gap (see below);

☒ Injuries sustained whilst playing against medical advice.

Please refer to JLT Sport's web site for the Product Disclosure Statement (PDS) for further details.

What does "Non-Medicare" mean?

Medicare is a Commonwealth Government programme that provides free or subsidised treatment from medical professionals such as doctors and specialists. The Medicare Benefits Scheme (MBS) lists the items that are eligible for a Medicare rebate.

Sometimes, your doctor or specialist may charge more than the Medicare rebate, which may leave you with out-of-pocket expenses. This is commonly called the "Medicare Gap".

Section 126 of The Health Insurance Act 1973 (Cth) does not permit the Insurer or the JLT Trustee to reimburse any part of a Medicare Item (this includes the Medicare Gap).

This means that if your treatment is listed on the Medicare Benefits Scheme, it is not claimable through the Australian Cricket National Club Risk Protection Programme. For further information about Medicare please visit www.health.gov.au or www.medicare.gov.au

Please note: Some Private Health Funds may offer Medicare Gap Insurance Cover. JLT Sport is not a Private Health Fund, nor do we offer Private Health Insurance.

WHAT'S COVERED?

NON-MEDICARE EXAMPLES:

Ambulance

Physiotherapist

Dental

Private Hospital Accom.

Chiropractor

WHAT'S NOT COVERED?

MEDICARE EXAMPLES:

Doctor

Surgeon

Surgeon's assistant

Anaesthetist

X-Rays

Public Hospitals

Send completed forms to:

ECHELON CLAIMS SERVICES

PO Box 7170,

Hutt Street, SA 5000

Or

Fax: (08) 8235 6450

Claims Enquiries:

Phone: 1800 640 009

www.jltsport.com.au

JLT Sport Personal Injury Claim Form

Australian Cricket National Club Risk Protection Programme

Claim Conditions

How to lodge a Personal Injury Claim:

1. Complete ALL sections of the Personal Injury Claim Form
   - Your claim form may be returned if there is important information missing
   - For assistance, please contact Echelon on 1800 640 009
2. Send your completed claim form to Echelon within 180 days from the date of injury
   - ***Do not*** wait until your treatments have concluded before you lodge your claim
   - You can lodge your claim even if you have no out of pocket expenses
3. Echelon will confirm receipt of your claim and provide you with a claim number, or contact you should they require further information
4. Once you have received your Claim Number, you can forward further Non-Medicare Medical receipts to Echelon as your treatment continues (for up to 12 months from the date of injury).

What should I send with my claim?

Receipts - If you have already undertaken treatments for your injury and incurred Non-Medicare Medical costs please submit your receipts to Echelon.

Retain a copy - Please submit only original receipts to Echelon. We recommend you retain a copy of all receipts and your Claim Form for your records.

Private Health Insurance (if applicable) – Please claim through your Private Health Fund first and then send Echelon a copy of your Private Health rebate advice.

Claims Conditions:

Written notice containing full particulars of your injury (as per this Claim Form) must be submitted to Echelon within 180 days from the date of injury.

Subject to the Trustee's discretion and/or the Insurance Contracts Act 1984, any treatment must be completed within 12 calendar months from the date of injury.

All certificates and evidence required by Echelon must be provided by you upon request and at your expense (if applicable).

Who is Echelon?

Echelon Australia Pty Ltd (Echelon) is a wholly owned subsidiary of JLT. Echelon is the appointed claims management group for all Personal Injury claims on behalf of the Insurer and the Trustee of the Australian Cricket National Club Risk Protection Programme.

Who is JLT Sport?

JLT Sport is the appointed broker for the Australian Cricket National Club Risk Protection Programme. As a division of Jardine Lloyd Thompson Pty Ltd, JLT Sport is Australia's leading provider of insurance and risk protection for the sport, recreation and fitness industries

Privacy:

We, JLT (including our subsidiaries and related entities), collect, store and use your personal details in accordance with the Privacy Act 1988 (and subsequent amendments).

We are collecting the information herein principally for the purpose of processing your Personal Injury Claim. Other purposes include providing risk management advice and statistical analyses to your sport.

By providing the information requested in this document, you agree to us collecting, using and disclosing your personal information as outlined in our Collection Statement available via www.jltsport.com.au

If you do not provide all or part of the information requested, we may not be unable to process your application or you may prejudice your insurance cover.

You have the right to request access to, and correct, any personal information that we hold about you, subject to the provisions of the Privacy Act 1988.

To assist us in maintaining correct records we ask you to inform us of any changes to in your personal information provided, as they occur.

If you provide us with personal information about other individuals, you must ensure that those persons have been made aware of the conditions herein. Where the information relates to health or other sensitive information as defined in the Privacy Act 1988, you must obtain it with the individual's consent.

Our Privacy Policy is available upon request or you can access it anytime via our web site **www.jltsport.com.au**

Complete ALL sections

Send within 180 Days

Don't wait for treatment

Retain copies of all receipts

Retain a copy of your claim

Send completed forms to:

ECHELON CLAIMS SERVICES

PO Box 7170,

Hutt Street, SA 5000

Or

Fax: (08) 8235 6450

Claims Enquiries:

Phone: 1800 640 009

www.jltsport.com.au

JLT Sport Personal Injury Claim Form

Australian Cricket National Club Risk Protection Programme

CRICKET AUSTRALIA

JLT

Section A: Claimant's Details

PERSONAL INFORMATION:

Claimant's Name: ______ First Name ______ Surname

Postal Address: ______ Street Address ______ State ______ Postcode

Occupation: ______

Contact Details: ______ Email Address ______ Phone Number (Bus. Hours)

Personal Details: / / Date of Birth ○ Male ○ Female Gender / / Date of Injury AM PM Time of Injury

Club Name: ______

Association Name: ______

Describe your injury and how it happened (please attached additional pages if required):

INJURY RESEARCH DATA:

Session:	○ Playing	○ Training	○ Travelling	○ Event	○ Other	○ Warm up/down
Location:	○ Indoor	○ Outdoor				
Injured Person	○ Player	○ Umpire	○ Official	○ Trainer	○ Other	
Grade:	○ Senior	○ Junior	○ Not Applicable			
Playing Position:	○ Batting	○ Bowling	○ Fielding	○ Umpiring	○ Wicket Keeping	
Surface Type:	○ Asphalt	○ Concrete	○ Grass	○ Indoor	○ Timber	○ Synthetic Grass
Weather Conditions:	○ Fine	○ Rain	○ Extreme Heat	○ Extreme Cold		
Surface Conditions:	○ Wet	○ Dry	○ Muddy	○ Indoor	○ Other	

Resumption date(s): / / When will you resume WORK? / / When will you resume TRAINING? / / When will you resume PLAYING?

Private Health Cover: ○ Yes ○ No — Do you have Private Health Insurance? ______ If YES, what is the name of your Private Health Insurance Provider?

Private Health Coverage: ○ Dental ○ Physiotherapy ○ Ambulance ○ Hospital

Ambulance Membership: ○ Yes ○ No

PAYMENT DETAILS:

Payee details: ○ Myself ○ Other — To whom should we make payment? ______ Payee Name

______ Payee Postal Address

CLAIMANT DECLARATION:

By signing the declaration below, you confirm and agree to the following:

A. The injury was sustained accidentally during a cricket activity and is not a pre-existing illness or condition.

B. You have viewed, read and understood the Product Disclosure Statement (PDS) at www.jltsport.com.au/cricketaustralia.

C. You understand that the Health Insurance Act 1973 (Cth) prohibits the Trustee and Insurer from reimbursing costs that are registered with Medicare (including the Medicare Gap).

D. You acknowledge and agree to the information contained herein (including personal information) being shared with authorised members of JLT, the insurer, the Trustee and the Claims Managers.

E. You authorise any hospital, physician or other person who has attended to your injury, or any employer, to furnish JLT's representatives with any and all information with respect to any sickness or injury, medical history, consultation, prescriptions, treatments, copies of all hospital or medical records and copies of employment records.

F. You agree that a photocopy or electronic version of this authorisation shall be considered as effective and valid as the original.

G. You declare that the forgoing particulars are true and accurate in every detail. You agree that if you have made, or shall make, in any further declaration regarding this injury, any false or fraudulent statements or suppress or conceal or falsely state any material whatsoever, the covers shall be void and all rights to recover there under for past or future injuries shall be forfeited.

Claimant's Signature* ______ Date: / /

*Parent or Guardian if under 18 years

Send completed forms to:

ECHELON CLAIMS SERVICES

PO Box 7170,

Hutt Street, SA 5000

Or

Fax: (08) 8235 6450

Claims Enquiries:

Phone: 1800 640 009

www.jltsport.com.au

JLT Sport Personal Injury Claim Form

Australian Cricket National Club Risk Protection Programme

Section B: Club Declaration

CLUB DETAILS:

Claimant's Name: First Name ____ Surname ____

Club Name: ____

Club Contact: Club Contact Person ____ Position within Club ____

Contact Details: Contact Phone Number ____ Email Address ____

Association Name: ____

Registration Details: ◯ Yes ◯ No
Is the Club Registered for this Period of Cover?

Loss of Income Cover: ◯ Yes ◯ No $ ____ Per week
If known > Has the Club purchased additional Loss of Income cover? *(above the $500 per week provided within the Programme)* If YES, what is the weekly limit purchased by the Club (if known)?

INJURY DETAILS:

Date/Time: / / Date of Injury ____ Time of Injury AM PM

Circumstances: ◯ Playing ◯ Training ◯ Travelling ◯ Other

Opposition Club Name: ____
If applicable

Ground/Location: ____
Where did the injury occur?

Resumption date(s): ◯ Yes ◯ No
Has the Claimant returned to TRAINING? / / If YES, date Claimant returned?

◯ Yes ◯ No
Has the Claimant returned to COMPETITION? / / If YES, date Claimant returned?

CLUB DECLARATION:

By signing the declaration below, you confirm and agree to the following:

A. You are an authorised representative of, and you are acting on behalf of, the Claimant's Club or Association (as above).

B. After reasonable inquiry, you confirm the injury details supplied herein are true and accurate.

C. You declare the Claimant's injury was sustained accidentally during the cricket activity noted above and is not a pre-existing illness or condition.

D. You understand that registering your club with JLT Sport is a requirement of the Australian Cricket National Club Risk Protection Programme for each Period of Cover.

E. You confirm the club's level of cover as per the details provided above.

Club Representative's Signature: ____ Date: / /

Please check your that your club has purchased Loss of Income Cover

Send completed forms to:
ECHELON CLAIMS SERVICES
PO Box 7170,
Hutt Street, SA 5000
Or
Fax: (08) 8235 6450
Claims Enquiries:
Phone: 1800 640 009

www.jltsport.com.au

JLT Sport Personal Injury Claim Form

Australian Cricket National Club Risk Protection Programme

CRICKET AUSTRALIA

JLT

Section C: Loss of Income

TO BE COMPLETED BY THE CLAIMANT:

Do you wish to claim Loss of Income Benefits? ◯ Yes ◯ No   If NO, proceed to SECTION D

If you are NOT claiming Loss of Income Benefits please do not complete this section. Please proceed to Section D.

Can you claim compensation from any other policy that includes loss of income benefits (such as Workers Compensation)? ◯ Yes ◯ No

Have you ever made previous claims in respect to a personal accident insurance policy or plan? ◯ Yes ◯ No

Have you engaged in any other income earning employment since you became injured? ◯ Yes ◯ No

TO BE COMPLETED BY THE CLAIMANT'S EMPLOYER (OR ACCOUNTANT IF SELF-EMPLOYED):

Claimant's Name: ______ First Name ______ Surname

Employer/Business: ______ Employer/Company Name ______ Contact Person

Postal Address: ______ Street Address ______ State ______ Postcode

Contact Details: ______ Email Address ______ Phone (Bus. Hours) ______ Mobile

Employment Status: ◯ Full Time ◯ Part Time ◯ Casual ◯ Self Employed

Employment Details: $ ______ Employee's NET weekly salary $ ______ Employee's GROSS week salary   / / Date Employee commenced with company.

If Self-Employed or Casual, please provide average weekly salary based on 12 month period directly prior to injury.

Injury Details: / / Date employee ceased work   / / Date expected to resume duties

Please check your that your club has purchased Loss of Income Cover

Returned to Work: ◯ Yes ◯ No   Has the Employee returned to work?   / / If YES, what date did the Employee return?

Salary Received: ◯ Yes ◯ No   If YES, what for?

During the period of incapacity, has the employee received a salary?

Sick Leave: ◯ Yes ◯ No from / / to / /

Annual Leave: ◯ Yes ◯ No from / / to / /

Other: ◯ Yes ◯ No from / / to / /

Net of business expenses, personal deductions and income tax; excludes bonuses, commissions and all other allowances. Excludes income derived from playing sport.

EMPLOYER'S DECLARATION:

By signing the declaration below, you confirm and agree to the following:

A. You are the Claimant's current employer (or accountant if the claimant is self-employed),

B. After reasonable inquiry, you confirm the employment and salary details supplied herein are true and accurate,

C. You will supply upon request any further information as required for the determination of this claim.

Employer's Signature: ______   Date: / /

** Accountant's signature (if claimant is self-employed)*

For more information, please refer to JLT Sport's web site:

www.jltsport.com.au/cricketaustralia

Send completed forms to:

ECHELON CLAIMS SERVICES

PO Box 7170,

Hutt Street, SA 5000

Or

Fax: (08) 8235 6450

Claims Enquiries:

Phone: 1800 640 009

www.jltsport.com.au

JLT Sport Personal Injury Claim Form

Australian Cricket National Club Risk Protection Programme

Section D: Physician's Report

Important Information

Claim Conditions

Section A: Claimant's Details

Section B: Club Declaration

Section C: Loss of Income

Section D: Physician's Report

This section must be completed (in full) by your attending physician.
An attending physician includes a general practitioner, physiotherapist, chiropractor or dentist.

THIS SECTION MUST BE COMPLETED WITHOUT EXPENSE TO JLT SPORT

PHYSICIAN'S REPORT

Claimant's Name: ____________________ ____________________
First Name Surname

Physician's Details: ____________________ ____________________
Physician's Name Phone Number

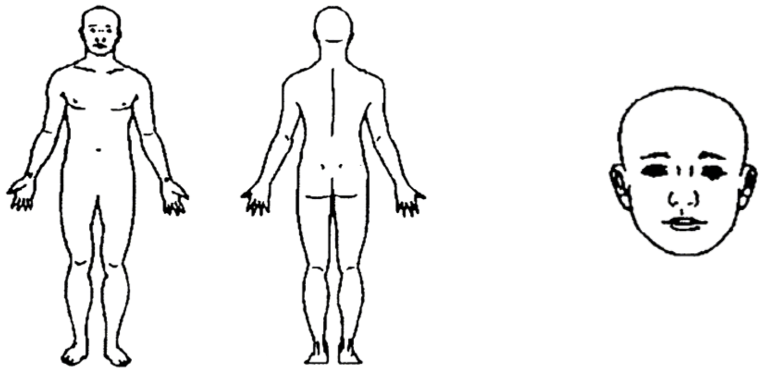
Injury Consultation: / / / /
Date of Injury Date of Consultation

Diagnosis/History of injury:

Injury Location:

○ Ankle	○ Arm	○ Dental	○ Facial	○ Foot
○ Hand	○ Head	○ Internal	○ Knee	○ Lower Leg
○ Shoulder	○ Spinal	○ Torso	○ Upper Leg	

Please mark (×) the anatomical location below:



Injury Type:

○ Amputation	○ Bruising	○ Concussion	○ Cut	○ Death
○ Dental	○ Dislocation	○ Fracture/Break	○ Rupture	○ Sprain
○ Strain	○ Fatigue/Debilitation			

First Medical Treatment: / / ____________________
Date of treatment Name of attending physician

Do you consider the Claimant's injury to be a NEW injury? ○ Yes ○ No

Do you consider the Claimant's injury to a recurrence of a previous injury? ○ Yes ○ No

If YES, please provide details and a description:

Does the Claimant have any congenital defects or chronic deases? ○ Yes ○ No

If YES, please provide details and a description (dates, name of treating doctor, etc):

Please continue to Page 7.

Send completed forms to:
ECHELON CLAIMS SERVICES
PO Box 7170,
Hutt Street, SA 5000
Or
Fax: (08) 8235 6450
Claims Enquiries:
Phone: 1800 640 009

www.jltsport.com.au

JLT Sport Personal Injury Claim Form

Australian Cricket National Club Risk Protection Programme

Section D: Physician's Report

PHYSICIAN'S REPORT (continued)

Have you referred the patient to any other services or treatment? ○ Yes ○ No

If YES, please provide details below:

Physiotherapy:	○ Yes	○ No	If YES, approx. number of treatments required.
Chiropractics:	○ Yes	○ No	If YES, approx. number of treatments required.
Surgery:	○ Yes	○ No	If YES, please provide details
Other:	○ Yes	○ No	If YES, please provide details

Has the Claimant been able to do any work since the injury occurred? ○ Yes ○ No

What date do you advise the Claimant to return to playing Cricket? / /

If YES, please provide details

PHYSICIAN'S DECLARATION:

By signing the declaration below, you confirm and agree to the following:

A. You have examined the Claimant's injury as described on this form;

B. You declare that all information provided by you and supplied herein is true and accurate.

Physician's Signature: Date: / /

LOSS OF INCOME CLAIMS ONLY

The following Incapacity to Work Statement must be completed by a qualified Medical Practitioner (i.e. General Practitioner, Surgeon or a Specialist). It will not be accepted if completed by a Physiotherapist, Chiropractor, etc.

INCAPACITY TO WORK STATEMENT:

I, ______ (Medical Practitioner's Name) examined ______ (Claimant's Name) on / / (Date of examination)

In my opinion, this person is/has been unfit to work from / / (First day of incapacity) to / / (Last day of incapacity) inclusive.

Please provide any further comments in regard to your assessment of the injury/condition?

By signing the declaration below, you confirm and agree to the following:

A. You have examined the Claimant's injury as described on this form;

B. You declare that all information provided by you and supplied herein is true and accurate.

Medical Practitioner's Signature: Date: / /

For more information, please refer to JLT Sport's web site:

www.jltsport.com.au/cricketaustralia

Important Information

Claim Conditions

Section A: Claimant's Details

Section B: Club Declaration

Section C: Loss of Income

Section D: Physician's Report

Send completed forms to:

ECHELON CLAIMS SERVICES

PO Box 7170,

Hutt Street, SA 5000

Or

Fax: (08) 8235 6450

Claims Enquiries:

Phone: 1800 640 009

www.jltsport.com.au

JLT Sport Personal Injury Claim Form

Australian Cricket National Club Risk Protection Programme

Important Information

Who should use this claim form?

You should complete this form if:

- ☑ **Insured -** You are a player, umpire, official or volunteer (Insured Person) of an Association/Club (the Insured) covered within the Australian Cricket National Club Risk Protection Programme; and
- ☑ **Injured -** You sustained an accidental injury during the Policy Period whilst actually participating in a sanctioned cricket event/activity; and
- ☑ **Non-Medicare -** You are likely to incur or have incurred medical costs that are not listed on the Medicare Benefits Scheme

Before completing this form, ensure you are familiar with the Product Disclosure Statement (PDS) available on JLT Sport's web site www.jltsport.com.au/cricketaustralia.

What is covered?

The Australian Cricket National Club Risk Protection Programme's Personal Accident cover provides some reimbursement for Non-Medicare Medical Costs and/or Loss of Income cover for 12 months from the date of injury.

Commonwealth Legislation prevents reimbursement of Medicare costs including the Gap. Non-Medicare Medical Benefits are covered up to the limits outlined below.

Please refer to JLT Sport's web site for the Product Disclosure Statement (PDS).

How much can I claim?

The following table outlines the reimbursement capacity within the Australian Cricket National Club Risk Protection Programme.

Non-Medicare Medical Costs	Loss of Income
85% Reimbursement	85% Reimbursement
$5,000 maximum per claim	$500 maximum per week
$50 excess per claim	14 day elimination period

All clubs receive the above coverage at the commencement of each period of cover. Associations/Clubs may choose to upgrade the Loss of Income cover for an additional premium. Upgraded cover is valid only from the date of purchase.

What is NOT covered?

The following examples demonstrate some areas not covered by the Personal Accident cover:

- ☒ Medicare items (see below);
- ☒ the Medicare Gap (see below);
- ☒ Injuries sustained whilst playing against medical advice.

Please refer to JLT Sport's web site for the Product Disclosure Statement (PDS) for further details.

What does "Non-Medicare" mean?

Medicare is a Commonwealth Government programme that provides free or subsidised treatment from medical professionals such as doctors and specialists. The Medicare Benefits Scheme (MBS) lists the items that are eligible for a Medicare rebate.

Sometimes, your doctor or specialist may charge more than the Medicare rebate, which may leave you with out-of-pocket expenses. This is commonly called the "Medicare Gap".

Section 126 of The Health Insurance Act 1973 (Cth) does not permit the Insurer or the JLT Trustee to reimburse any part of a Medicare Item (this includes the Medicare Gap).

This means that if your treatment is listed on the Medicare Benefits Scheme, it is not claimable through the Australian Cricket National Club Risk Protection Programme. For further information about Medicare please visit www.health.gov.au or www.medicare.gov.au

Please note: Some Private Health Funds may offer Medicare Gap Insurance Cover. JLT Sport is not a Private Health Fund, nor do we offer Private Health Insurance.

CRICKET AUSTRALIA

Important Information

WHAT'S COVERED?

NON-MEDICARE EXAMPLES:

Ambulance

Physiotherapist

Dental

Private Hospital Accom.

Chiropractor

WHAT'S NOT COVERED?

MEDICARE EXAMPLES:

Doctor

Surgeon

Surgeon's assistant

Anaesthetist

X-Rays

Public Hospitals

Send completed forms to:

ECHELON CLAIMS SERVICES

sportsclaims@echelonaustralia.com.au

Or

GPO Box 1693

Adelaide, SA 5001

Or

Fax: (08) 8235 6107

Claims Enquiries:

Phone: 1800 640 009

www.jltsport.com.au

JLT Sport Personal Injury Claim Form

Australian Cricket National Club Risk Protection Programme

Claim Conditions

How to lodge a Personal Injury Claim:

1. Complete ALL sections of the Personal Injury Claim Form
   - Your claim form may be returned if there is important information missing
   - For assistance, please contact Echelon on 1800 640 009
2. Send your completed claim form to Echelon within 180 days from the date of injury
   - ***Do not*** wait until your treatments have concluded before you lodge your claim
   - You can lodge your claim even if you have no out of pocket expenses
3. Echelon will confirm receipt of your claim and provide you with a claim number, or contact you should they require further information
4. Once you have received your Claim Number, you can forward further Non-Medicare Medical receipts to Echelon as your treatment continues (for up to 12 months from the date of injury).

What should I send with my claim?

Receipts - If you have already undertaken treatments for your injury and incurred Non-Medicare Medical costs please submit your receipts to Echelon.

Retain a copy - Please submit only original receipts to Echelon. We recommend you retain a copy of all receipts and your Claim Form for your records.

Private Health Insurance (if applicable) – Please claim through your Private Health Fund first and then send Echelon a copy of your Private Health rebate advice.

Claims Conditions:

Written notice containing full particulars of your injury (as per this Claim Form) must be submitted to Echelon within 180 days from the date of injury.

Subject to the Trustee's discretion and/or the Insurance Contracts Act 1984, any treatment must be completed within 12 calendar months from the date of injury.

All certificates and evidence required by Echelon must be provided by you upon request and at your expense (if applicable).

Who is Echelon?

Echelon Australia Pty Ltd (Echelon) is a wholly owned subsidiary of JLT. Echelon is the appointed claims management group for all Personal Injury claims on behalf of the Insurer and the Trustee of the Australian Cricket National Club Risk Protection Programme.

Who is JLT Sport?

JLT Sport is the appointed broker for the Australian Cricket National Club Risk Protection Programme. As a division of Jardine Lloyd Thompson Pty Ltd, JLT Sport is Australia's leading provider of insurance and risk protection for the sport, recreation and fitness industries

Collection Statement under Privacy Act 1988:

In accordance with the Privacy Act 1988 (and subsequent amendments), we, Jardine Lloyd Thompson Pty Ltd (and our subsidiaries and related entities) (JLT) draw your attention to the following:

- We may collect personal information about you by means of the enclosed document.
- We are collecting the information principally for the purpose of approaching the (re)insurance market, placing insurance, assessing and advising you on your insurance needs, claims handling or risk management (depending on your requirements). Other purposes include providing you with information about other JLT products or services. If you are proposing for or renewing insurance, the information is required pursuant to your duty of disclosure under the Insurance Contracts Act 1984, the Marine Insurance Act 1909 or at common law.
- The information we collect may be disclosed to third parties including but not limited to (re)insurers, insurance intermediaries, service providers, finance providers, advisers, agents and JLT related Group companies. Those entities will hold and use the data in accordance with their own privacy policies which may include disclosure to third parties located offshore.
- By providing the information requested in the attached document, you agree to us collecting, using and disclosing your personal information as outlined in this Collection Statement.
- If you do not provide all or part of the information requested, we may be unable to process your application or provide other required services, your application for insurance may be declined or you may prejudice your insurance cover.
- You have the right to request access to, and correct, any personal information that we hold about you, subject to the provisions of the Privacy Act 1988.
- To assist us in maintaining correct records we ask you to inform us of any changes in your personal information provided, as they occur.
- If you provide us with personal information about other individuals, you must ensure that those persons have been made aware of the above matters. Where the information collected relates to health, criminal record or other sensitive information as defined in the Privacy Act 1988, you must obtain it with the individual's consent.

For further information contact your JLT Client Risk Adviser or the JLT Privacy Officer:
Jardine Lloyd Thompson Pty Ltd, 66 Clarence Street, SYDNEY NSW 2000
Telephone: (02) 9290 8000

Complete ALL sections

Send within 180 Days

Don't wait for treatment

Retain copies of all receipts

Retain a copy of your claim

Send completed forms to:

ECHELON CLAIMS SERVICES

sportsclaims@echelonaustralia.com.au

Or

GPO Box 1693

Adelaide, SA 5001

Or

Fax: (08) 8235 6107

Claims Enquiries:

Phone: 1800 640 009

www.jltsport.com.au

JLT Sport Personal Injury Claim Form

Australian Cricket National Club Risk Protection Programme

Section A: Claimant's Details

PERSONAL INFORMATION:

Claimant's Name: First Name ______ Surname ______

Postal Address: Street Address ______ State ______ Postcode ______

Occupation: ______

Contact Details: Email Address ______ Phone Number (Bus. Hours) ______

Personal Details: / / Date of Birth ○ Male ○ Female Gender / / Date of Injury AM PM Time of Injury

Club Name: ______

Association Name: ______

Describe your injury and how it happened (please attached additional pages if required):

INJURY RESEARCH DATA:

Session:	○ Playing	○ Training	○ Travelling	○ Event	○ Other	○ Warm up/down
Location:	○ Indoor	○ Outdoor				
Injured Person	○ Player	○ Umpire	○ Official	○ Trainer	○ Other	
Grade:	○ Senior	○ Junior	○ Not Applicable			
Playing Position:	○ Batting	○ Bowling	○ Fielding	○ Umpiring	○ Wicket Keeping	
Surface Type:	○ Asphalt	○ Concrete	○ Grass	○ Indoor	○ Timber	○ Synthetic Grass
Weather Conditions:	○ Fine	○ Rain	○ Extreme Heat	○ Extreme Cold		
Surface Conditions:	○ Wet	○ Dry	○ Muddy	○ Indoor	○ Other	

Resumption date(s): / / When will you resume WORK? / / When will you resume TRAINING? / / When will you resume PLAYING?

Private Health Cover: ○ Yes ○ No Do you have Private Health Insurance? ______ If YES, what is the name of your Private Health Insurance Provider?

Private Health Coverage: ○ Dental ○ Physiotherapy ○ Ambulance ○ Hospital

Ambulance Membership: ○ Yes ○ No

PAYMENT DETAILS:

EFT Payee Details: Bank ______ Name on Account ______ BSB ______ Account Number ______

CLAIMANT DECLARATION:

By signing the declaration below, you confirm and agree to the following:

A. The injury was sustained accidentally during a cricket activity and is not a pre-existing illness or condition.

B. You have viewed, read and understood the Product Disclosure Statement (PDS) at www.jltsport.com.au/cricketaustralia.

C. You understand that the Health Insurance Act 1973 (Cth) prohibits the Trustee and Insurer from reimbursing costs that are registered with Medicare (including the Medicare Gap).

D. You acknowledge and agree to the information contained herein (including personal information) being shared with authorised members of JLT, the insurer, the Trustee and the Claims Managers.

E. You authorise any hospital, physician or other person who has attended to your injury, or any employer, to furnish JLT's representatives with any and all information with respect to any sickness or injury, medical history, consultation, prescriptions, treatments, copies of all hospital or medical records and copies of employment records.

F. You agree that a photocopy or electronic version of this authorisation shall be considered as effective and valid as the original.

G. You declare that the forgoing particulars are true and accurate in every detail. You agree that if you have made, or shall make, in any further declaration regarding this injury, any false or fraudulent statements or suppress or conceal or falsely state any material whatsoever, the covers shall be void and all rights to recover there under for past or future injuries shall be forfeited.

Claimant's Signature* ______ Date: / /

*Parent or Guardian if under 18 years

Send completed forms to:

ECHELON CLAIMS SERVICES

sportsclaims@echelonaustralia.com.au

Or

GPO Box 1693

Adelaide, SA 5001

Or

Fax: (08) 8235 6107

Claims Enquiries:

Phone: 1800 640 009

www.jltsport.com.au

JLT Sport Personal Injury Claim Form

Australian Cricket National Club Risk Protection Programme

Section B: Club Declaration

CLUB DETAILS:

Claimant's Name: First Name ____ Surname ____

Club Name: ____

Club Contact: Club Contact Person ____ Position within Club ____

Contact Details: Contact Phone Number ____ Email Address ____

Association Name: ____

Registration Details: ○ Yes ○ No
Is the Club Registered for this Period of Cover?

Loss of Income Cover: ○ Yes ○ No $ ____ Per week
If known > Has the Club purchased additional Loss of Income cover? *(above the $500 per week provided within the Programme)*
If YES, what is the weekly limit purchased by the Club (if known)?

INJURY DETAILS:

Date/Time: / / Date of Injury ____ Time of Injury ____ AM PM

Circumstances: ○ Playing ○ Training ○ Travelling ○ Other

Opposition Club Name: ____
If applicable

Ground/Location: ____
Where did the injury occur?

Resumption date(s): ○ Yes ○ No
Has the Claimant returned to TRAINING?
/ / If YES, date Claimant returned?

○ Yes ○ No
Has the Claimant returned to COMPETITION?
/ / If YES, date Claimant returned?

CLUB DECLARATION:

By signing the declaration below, you confirm and agree to the following:

A. You are an authorised representative of, and you are acting on behalf of, the Claimant's Club or Association (as above).

B. After reasonable inquiry, you confirm the injury details supplied herein are true and accurate.

C. You declare the Claimant's injury was sustained accidentally during the cricket activity noted above and is not a pre-existing illness or condition.

D. You understand that registering your club with JLT Sport is a requirement of the Australian Cricket National Club Risk Protection Programme for each Period of Cover.

E. You confirm the club's level of cover as per the details provided above.

Club Representative's Signature: ____ Date: / /

Please check your that your club has purchased Loss of Income Cover

Send completed forms to:

ECHELON CLAIMS SERVICES

sportsclaims@echelonaustralia.com.au

Or

GPO Box 1693

Adelaide, SA 5001

Or

Fax: (08) 8235 6107

Claims Enquiries:

Phone: 1800 640 009

www.jltsport.com.au

JLT Sport Personal Injury Claim Form

Australian Cricket National Club Risk Protection Programme

Section C: Loss of Income

TO BE COMPLETED BY THE CLAIMANT:

Do you wish to claim Loss of Income Benefits? ○ Yes ○ No If NO, proceed to SECTION D

If you are NOT claiming Loss of Income Benefits please do not complete this section. Please proceed to Section D.

IMPORTANT INFORMATION – The excess applicable is 14 days, unless your sick leave balance exceeds this, in which case your sick leave balance becomes your excess period

Can you claim compensation from any other policy that includes loss of income benefits (such as Workers Compensation)? ○ Yes ○ No

Have you ever made previous claims in respect to a personal accident insurance policy or plan? ○ Yes ○ No

Have you engaged in any other income earning employment since you became injured? ○ Yes ○ No

TO BE COMPLETED BY THE CLAIMANT'S EMPLOYER (OR ACCOUNTANT IF SELF-EMPLOYED):

Claimant's Name: ______ First Name ______ Surname

Employer/Business: ______ Employer/Company Name ______ Contact Person

Postal Address: ______ Street Address ______ State ______ Postcode

Contact Details: ______ Email Address ______ Phone (Bus. Hours) ______ Mobile

Employment Status: ○ Full Time ○ Part Time ○ Casual ○ Self Employed

Employment Details: $ ______ Employee's NET weekly salary $ ______ Employee's GROSS week salary / / Date Employee commenced with company.

If Self-Employed or Casual, please provide average weekly salary based on 12 month period directly prior to injury.

Injury Details: / / Date employee ceased work / / Date expected to resume duties

Returned to Work: ○ Yes ○ No Has the Employee returned to work? / / If YES, what date did the Employee return?

Salary Received: ○ Yes ○ No If YES, what for?

During the period of incapacity, has the employee received a salary?

Sick Leave: ○ Yes ○ No from / / to / /

Annual Leave: ○ Yes ○ No from / / to / /

Other: ○ Yes ○ No from / / to / /

Net of business expenses, personal deductions and income tax; excludes bonuses, commissions and all other allowances. Excludes income derived from playing sport.

EMPLOYER'S DECLARATION:

By signing the declaration below, you confirm and agree to the following:

A. You are the Claimant's current employer (or accountant if the claimant is self-employed),
B. After reasonable inquiry, you confirm the employment and salary details supplied herein are true and accurate,
C. You will supply upon request any further information as required for the determination of this claim.

Employer's Signature: ______ Date: / /

** Accountant's signature (if claimant is self-employed)*

For more information, please refer to JLT Sport's web site:

www.jltsport.com.au/cricketaustralia

Please check your that your club has purchased Loss of Income Cover

Send completed forms to:
ECHELON CLAIMS SERVICES
sportsclaims@echelonaustralia.com.au
Or
GPO Box 1693
Adelaide, SA 5001
Or
Fax: (08) 8235 6107
Claims Enquiries:
Phone: 1800 640 009
www.jltsport.com.au

JLT Sport Personal Injury Claim Form

Australian Cricket National Club Risk Protection Programme

Section D: Physician's Report

This section must be completed (in full) by your attending physician.
An attending physician includes a general practitioner, physiotherapist, chiropractor or dentist.

THIS SECTION MUST BE COMPLETED WITHOUT EXPENSE TO JLT SPORT

PHYSICIAN'S REPORT

Claimant's Name: ______________ ______________
First Name Surname

Physician's Details: ______________ ______________
Physician's Name Phone Number

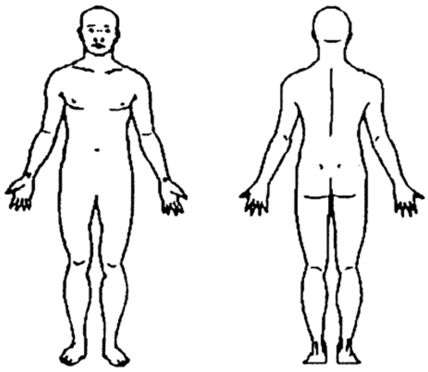
Injury Consultation: / / / /
Date of Injury Date of Consultation

Diagnosis/History of injury:

Injury Location:

○ Ankle ○ Arm ○ Dental ○ Facial ○ Foot
○ Hand ○ Head ○ Internal ○ Knee ○ Lower Leg
○ Shoulder ○ Spinal ○ Torso ○ Upper Leg

Please mark (×) the anatomical location below:



Injury Type:

○ Amputation ○ Bruising ○ Concussion ○ Cut ○ Death
○ Dental ○ Dislocation ○ Fracture/Break ○ Rupture ○ Sprain
○ Strain ○ Fatigue/Debilitation

First Medical Treatment: / / ______________
Date of treatment Name of attending physician

Do you consider the Claimant's injury to be a NEW injury? ○ Yes ○ No

Do you consider the Claimant's injury to a recurrence of a previous injury? ○ Yes ○ No

If YES, please provide details and a description:

Does the Claimant have any congenital defects or chronic deases? ○ Yes ○ No

If YES, please provide details and a description (dates, name of treating doctor, etc):

Please continue to Page 7.

Send completed forms to:
ECHELON CLAIMS SERVICES
sportsclaims@echelonaustralia.com.au
Or
GPO Box 1693
Adelaide, SA 5001
Or
Fax: (08) 8235 6107
Claims Enquiries:
Phone: 1800 640 009

www.jltsport.com.au

JLT Sport Personal Injury Claim Form

Australian Cricket National Club Risk Protection Programme

Section D: Physician's Report

PHYSICIAN'S REPORT (continued)

Have you referred the patient to any other services or treatment? ○ Yes ○ No

If YES, please provide details below:

Physiotherapy: ○ Yes ○ No ____ If YES, approx. number of treatments required.

Chiropractics: ○ Yes ○ No ____ If YES, approx. number of treatments required.

Surgery: ○ Yes ○ No ____ If YES, please provide details

Other: ○ Yes ○ No ____ If YES, please provide details

Has the Claimant been able to do any work since the injury occurred? ○ Yes ○ No

What date do you advise the Claimant to return to playing Cricket? / /

If YES, please provide details

PHYSICIAN'S DECLARATION:

By signing the declaration below, you confirm and agree to the following:

A. You have examined the Claimant's injury as described on this form;

B. You declare that all information provided by you and supplied herein is true and accurate.

Physician's Signature: ____ Date: / /

LOSS OF INCOME CLAIMS ONLY

The following Incapacity to Work Statement must be completed by a qualified Medical Practitioner (i.e. General Practitioner, Surgeon or a Specialist). It will not be accepted if completed by a Physiotherapist, Chiropractor, etc.

INCAPACITY TO WORK STATEMENT:

I, ____ (Medical Practitioner's Name) examined ____ (Claimant's Name) on / / (Date of examination)

In my opinion, this person is/has been unfit to work from / / (First day of incapacity) to / / (Last day of incapacity) inclusive.

Please provide any further comments in regard to your assessment of the injury/condition?

By signing the declaration below, you confirm and agree to the following:

A. You have examined the Claimant's injury as described on this form;

B. You declare that all information provided by you and supplied herein is true and accurate.

Medical Practitioner's Signature: ____ Date: / /

For more information, please refer to JLT Sport's web site:

www.jltsport.com.au/cricketaustralia

Send completed forms to:

ECHELON CLAIMS SERVICES

sportsclaims@echelonaustralia.com.au

Or

GPO Box 1693

Adelaide, SA 5001

Or

Fax: (08) 8235 6107

Claims Enquiries:

Phone: 1800 640 009

www.jltsport.com.au

Appendix H – Publications arising from this thesis

McLeod G, O'Connor S, Morgan D, Kountouris A, Finch CF, Fortington LV. Prospective reporting of injury in community-level cricket: A systematic review to identify research priorities. Journal of Science and Medicine in Sport, 2020: In Press, https://doi.org/10.1016/j.jsams.2020.04.023

McLeod G, O'Connor S, Morgan D, Kountouris A, Finch CF, Fortington LV. Medical-attention injuries in community cricket: a systematic review. BMJ Open Sport and Exercise Medicine, 2020;6:e000670. doi:10.1136/ bmjsem-2019-000670

BMJ Open Sport & Exercise Medicine

Medical-attention injuries in community cricket: a systematic review

Geordie McLeod ,[1] Siobhán O'Connor ,[2] Damian Morgan,[3] Alex Kountouris,[4] Caroline F Finch ,[1] Lauren V Fortington [1]

To cite: McLeod G, O'Connor S, Morgan D, *et al*. Medical-attention injuries in community cricket: a systematic review. *BMJ Open Sport & Exercise Medicine* 2020;**6**:e000670. doi:10.1136/bmjsem-2019-000670

► Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/bmjsem-2019-000670).

Accepted 23 February 2020

Check for updates

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[3]Federation Business School, Federation University Australia, Ballarat, Victoria, Australia
[4]Sports Science and Sports Medicine, Cricket Australia, Melbourne, Victoria, Australia

Correspondence to
Dr Lauren V Fortington;
l.fortington@ecu.edu.au

ABSTRACT

Objectives The aim was to identify and describe outcomes from original published studies that present the number, nature, mechanism and severity of medically treated injuries sustained in community-level cricket.

Design Systematic review.

Methods Nine databases were systematically searched to December 2019 using terms "cricket*" and "injur*". Original, peer-reviewed studies reporting injury for at least one injury descriptor (body region, nature of injury and/or mechanism of injury) in community-level cricketers of all ages were included. Qualitative synthesis, critical appraisal and descriptive summary results are reported within the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines.

Results Six studies were included: five reported hospital-treated data and one reported insurance claims data. Two had a low risk of bias. In hospital-based studies, fractures were the most frequent injury type. Upper and lower limb injuries (age ≥15 years) and injuries to the head (age <15 years) were the most common body region injured. Being struck by the ball was the most common mechanism for injury presenting to hospitals. Children were also commonly struck by equipment. One study using insurance claims data reported soft tissue injuries as the main of injury type.

Conclusion Hospital treatment data were most prominent, which emphasised injuries of a more serious nature or requiring acute care. These injuries were primarily fractures, dislocation/sprain and strains, bruising and open wounds with the majority resulting from players being struck by the ball. Research into whether properly fitted protective equipment, at an approved standard, is worn and is effective, is recommended.

What is already known?

- ► Compared to elite levels of the game, injury in community-level cricket is much less reported.
- ► Medically treated injuries may be a cause of lost time from sport and work for community-level players and a negative influence on future health and well-being.

What are the new findings?

- ► Studies reporting medically treated cricket injuries are limited and biased toward hospital data sources (five studies) compared to insurance claims data (one study). The information is dated with only two study being published in the last 5 years. More effective injury reporting is required at community levels.
- ► Fractures, bruising and open wounds/lacerations were the most common injury types, with the majority caused by players being struck by the ball. These findings suggest that future research should consider whether properly fitted and maintained protective equipment, designed to an approved standard, is worn by players and is effective.
- ► For children under 15 years, the head was the most commonly injured body part. Children also had many injuries from being struck by equipment (other than the ball). This finding suggests a need for close supervision of junior cricketers to ensure a safe environment together with education of these players on safe behaviour, appropriate playing techniques and need for protective equipment.

INTRODUCTION

Cricket is a non-contact, bat and ball sport played mostly in Commonwealth countries. Injuries can occur in all activities of the game, for example when bowling, batting or fielding, and from a range of causes such as being hit by the cricket ball, falling when attempting to catch or overuse/repetitive strain, particularly in bowlers.[1] Protective equipment is only worn by players in high-risk activities (batting, specialist fielding positions), including leg pads, gloves and helmets. Nevertheless, participation still carries a risk of injury and monitoring of injury occurrence remains an important element of promoting safety in the game.

During the 2017/2018 season, approximately 704 000 people,[2] or around 3% of the Australia population, were engaged in competitions or club-based cricket across junior or senior levels, most of whom are considered to be community level players. Since 2002, the national body for cricket in Australia, Cricket Australia (CA), and affiliated State bodies have routinely monitored injuries in their elite players.[3] Although the cohort of participants at community level is

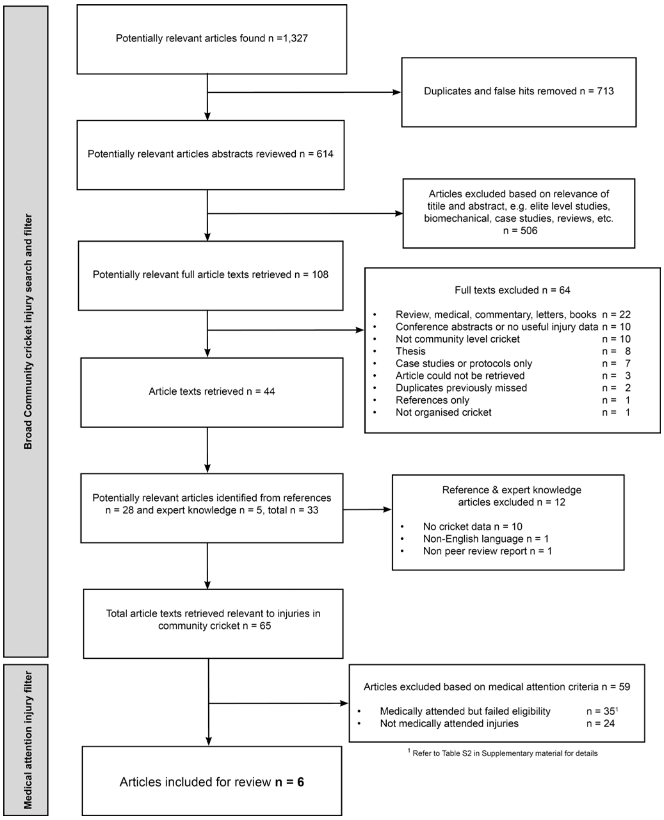

Figure 1 Search and study selection flow chart.

substantially greater, and therefore the total public health burden from injury potentially larger, there is no routine injury surveillance system available to monitor injuries in this player group. As shown in other sports, the injury profile in elite athletes is often very different to that seen in community participants.[4]

Hospitals, emergency departments (EDs), general practitioners (ie, family doctor), insurers and sports or allied health clinics are all possible sources of injury data for community sports injury.[5] In Australia, hospital and ED datasets offer the most readily available data on sports injury because it is coded using the 10th edition of the Australian Modification to the International Classification of Diseases (ICD-10-AM). This classification includes specification of an activity code for external causes of injury, including specific activity (eg, cricket) for sports and leisure.

It is important to identify and understand the profile of community cricket injuries because it is through this process that we can begin to assess any discernible problem. Just as important is the fact that many injuries may be acute and interruptive of sport and/or work life. At the community level, participation is more likely to be driven by enjoyment, personal fitness and social factors.[6] Injury may be a barrier to current and future participation, which may have flow on health effects.[7] Return to physical activity postinjury has been shown to be influenced by the degree to which the injury may affect the participant's work–life, and hence ability to derive income.[8] An examination of medically treated injuries can be used to confirmwhat current information exists around injuries in community cricketers and who is seeking treatment, which may enable better targeted prevention strategies.[9]

The aim of this systematic review was to identify and describe outcomes from studies that present the number, nature, mechanism and severity of medically treated injuries sustained in community level cricket. The profile of these injuries is presented together with the quality of the data reporting.

METHODS

Protocol and registration

This systematic review was registered online through the International prospective register of systematic reviews (PROSPERO)[10] record CRD42017079047 and is reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines.[11]

Search strategy

Nine databases were searched: CINAHL, MEDLINE and SPORTDiscuss (all through EBSCOHost), ScienceDirect, SCOPUS, Web of Science, PubMed, Informit and Google Scholar. Reference lists of included articles were checked for additional studies of relevance and experts (CFF and AK) were consulted for knowledge of any additional studies not already captured. The search terms were "cricket*" AND "injur*" (and synonyms/derivatives) being present in the title, abstract or keywords of a paper. Variations to the search strings were used depending on the database. An example of a search description is shown in online supplementary table S1. The initial search was conducted by GM and included all community cricket injury papers published before the 30 September 2017. Updated searches were performed by GM in April 2018, November 2018 and December 2019 with additional relevant papers included (figure 1).

Eligibility criteria

Review of the full text identified studies that reported medical-attention data from community cricket over the past 30 years (1988–2018). The term of 30 years was considered appropriate to reflect the game and injuries that may exist in its present forms. Community cricket was defined as encompassing all organised cricket (indoor and outdoor), from junior development and club cricket up to and including premier level cricket in Australia (or its equivalent, ie, one level below state, provincial or county cricket), school cricket, including state and national representative school championships not managed by national or state cricketing bodies. Community cricket excluded high performance centres, or equivalents, where community level players may be training or playing temporarily under the auspices of higher cricketing bodies. Where the population/level of play was not presented or was unclear in the original studies, we contacted the corresponding author for clarification.

All included studies were required to report data on the number of injuries and at least one of the following variables representing core items in sports injury surveillance[12]:

1. Body region injured (eg, head, wrist)
2. Nature of the injury (eg, fracture, sprain, strain)
3. Mechanism of injury (eg, fall, hit by ball).

To enable the identification of the most frequently occurring injuries, and therein derive injury prevention priorities, studies which reported only on a specific type of injury (eg, stress fracture) or body part (eg, head) were excluded. Medical-attention studies that were excluded based on the above criteria are listed in online supplementary table S2. Case studies, editorials, reports, letters, books, reviews and conference proceedings were also excluded.

Study selection

After the initial search was completed, duplicates and false hits were removed, and two authors (GM and SOC) independently screened the titles and abstracts for eligibility. Publications were excluded only when both reviewers agreed that the title/abstract clearly confirmed the study was not relevant to the review aims. Where it was unclear, the full article was assessed. The full text of the remaining articles was examined independently by the same two authors for eligibility. Any disagreements regarding inclusion were resolved through discussion with a third author (LVF).

Critical appraisal/risk of bias

A self-developed, nine-item critical appraisal tool (table 1) was designed using elements of the Downs and Black tool[13] and Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.[14] A specific item regarding injury definition and injury severity (item 5; table 1) was included as being pertinent to aims of this review in line with reporting under the current and previous cricket consensus statements. Although not formally validated, two authors (GM and SOC) tested the tool with a selection of similar (but not included) papers to ensure its relevance and applicability to the types of study designs included. Modifications and explanations to the tool were agreed on prior to its evaluation of articles for this review.

Risk of bias assessment was based on three of the items (2, 3 and 4) relating to selection, information and attrition biases.[15 16] If each of these items was answered 'yes', then the study was considered to have a low likelihood of bias. If one of these items was considered to have only been partially satisfied, the study was considered to have an unclear likelihood of bias. Any 'no' response to these items resulted in the study being considered to have a high likelihood of bias. Studies were assessed independently by two authors (GM and SOC) and where agreement could not be reached then a third author (LVF) was consulted.

Data collection and data items

Two authors (GM and SOC) independently extracted data from the eligible articles on a custom data extraction form, which included study design, country, setting and context, aims, year and timeframe, ethics, overall participant numbers, age range, gender, levels of play, facets of play (eg, batting, bowling and/or fielding), participant recruitment, data collection methods, injury definition, injury severity measure/definition, number of injuries, exposure measures, incidence, prevalence, nature

Table 1 Critical appraisal of studies

		Study (first author and year)						
	Item	Perera, 2019[22]	Finch, 1998[20]	Walker, 2010[19]	King, 2018[17]	Upadhyay, 2000[18]	Forward, 1988[21]	Overall % of yes
	Likelihood of bias*	Low	Low	Low	Unclear	Unclear	High	
1	Were the study aims and design described adequately and are they compatible?	Yes	Yes	Yes	Yes	Yes	Partial	83
2	Was the study setting, subjects, source, target population and size described adequately?	Yes	Yes	Yes	Yes	Partial	Partial	67
3	Was the method of data collection described adequately and did it seek to minimise information bias?	Yes	Yes	Yes	Partial	Yes	Partial	67
4	Has there been appropriate reporting of attrition of subjects or missing data?	Yes	Partial	Partial	Partial	Partial	Partial	17
5	Was there an injury definition and/or injury severity measure/definition provided and were they suitable for the study design?	Yes	Partial	Yes	Yes	Yes	Partial	67
6	Were the injury outcomes and exposure measures reported in a standardised, justified and reasonable manner?	Partial	Yes	Yes	Yes	Yes	Yes	83
7	Were limitations to the study discussed adequately?	Yes	Yes	Yes	Yes	No	No	67
8	Is there a summary of key results, their potential generalisability and whether they and any conclusions match the aims and/or reflect the limitations of the study?	Yes	Yes	Yes	Yes	Yes	Partial	83
9	Does the study explain any ethics requirements, author conflicts of interest and/or funding arrangements?	Yes	Partial	Yes	Yes	No	No	50

*Items 2, 3 and 4 (shaded) used to assess the likelihood of bias.

(type), locations (body parts), mechanisms, severity, losses/dropouts, and number of injuries not defined. Any disagreement regarding study type, participant characteristics, measurement methods or main results was clarified by discussion with a third author (LVF).

Data synthesis/summary measures

To address the primary aim of this review and identify the number, nature, mechanism and severity of injuries in community cricket, a qualitative synthesis is presented, with tabular summaries. Further details are presented in combination, where appropriate, for the relevant summary outcomes: injury rates, prevalence/proportions, nature, body location, mechanism/setting and severity. To address the secondary aim of reporting quality, we summarised the completeness of reporting (n and %) for individual items of the critical appraisal tool to identify which areas are well addressed and which need improvement.

RESULTS

Over 1300 articles were identified from which 65 were relevant to community cricket injury (refer to figure 1). Six articles met all inclusion criteria and were retained for analysis.

Study characteristics

Table 2 summarises the characteristics and outcomes of included studies. Three studies were specific to cricket and two studies included cricket among other sports or injury reporting. Three of the studies were based in New Zealand (NZ)[17–19] and two in Australia.[20 21] Three studies used ED presentation data only,[18 20 21] one used hospital admission data only,[19] one used both ED presentation and admission data[22] and one used insurance claims data.[17] One study was specific to indoor cricket,[21] while the remainder of the studies did not specify so outdoor and indoor are assumed combined.

Critical appraisal

(table 1)summarises the critical appraisal of the studies: two recorded a low likelihood of bias,[19 20] two were unclear[17 18] and one recorded a high likelihood of bias.[21] The overall percentage of items addressed adequately (ie, recorded yes responses) for all studies was 65%. (n=35 of 54). Item 4 (reporting of attrition and missing data) was the most incompletely answered with all studies recording partial responses. Item 9 (ethics, author conflicts and funding) recorded 50% of yes answers. All other items recorded 67% or greater proportions of yes answers.

Injury incidence rates and prevalence

The injury rate for cricket-related hospitalisation in NZ from 2000 to 2005 was 2.3 per 100 000 population per year, while for participation the injury rate for cricket-related hospitalisation was 39 per 100 000 participants per year.[19] In the same NZ hospital study, almost 1% of all cases were related to cricket injury.[19] An NZ study looking at insurance claims over the 2012 to 2016 period reported 0.4% of the total claims (of the five sports investigated) were due to cricket-related injury.[17] A study looking at ED presentations across Australia from 1989 to 1993 reported 3.7% of children under 15 years of age and 7.3% of all adults (defined as 15 years or older) presenting with sports injuries were cricket related.[20] A study looking at hospital-attended cricket injuries in females in Victoria, Australia, from 2002/2003 to 2013/2014, reported an overall injury rate of 1.9 per 1000 participants, with an overall downward trend over that time period.[22]

Nature of injury

Table 3 summarises the injury nature reported by the six studies. For ED presentations in NZ among children aged 9 to 13 years, fracture was the highest proportion of injuries recorded (43.3% of all cases) with both concussion/head injury and internal organ rupture as the equal second highest injury nature (13.3%).[18] Of the Australian ED presentations from 1989 to 1993, for children under 15 years of age, bruising (30.2%) was the highest proportion of cricket-related injury type, with fractures (17.8%) and lacerations (17.8%) equal second.[20] For adults (15 years or older), sprain and strain (combined) was the highest proportion of injury nature (26.0%), followed by fracture (20.7%) and bruising (19.6%).[20] Fractures were also the most common injury nature for females in Victoria, Australia, for hospital admissions (47.1%), while dislocation, sprain, and strain were more common in ED presentations (36.4%).[22] For indoor cricket injuries seen at ED, fracture was the highest proportion of injury nature (34.3%) followed by sprain (15.6%) and dislocation (10.9%).[21] Fracture was the most common injury nature in hospital admissions in NZ (43.8%) with sprain (15.2%) and avulsion/dislocation (6.2%) as the next two highest injury nature proportions.[19] For cricket injuries resulting in insurance claims in NZ, soft tissue injury was the highest reported injury nature (64.0%) followed by fractures (30.9%).[17]

Body regions injured

Table 4 summarises the body regions of injury in the six studies. With the exception of children aged under 15 years presenting to Australian EDs, the upper limb was the body region with to the highest proportion of injury, ranging from 33%[20] to 47%.[21] The lower limb injury proportion ranged from 16%[20] to 35%.[17] The proportion of head injury was highest in children under 15 years presenting to Australian EDs at 44%[20] and 27% for ED presentations in NZ.[18] For older age groups presenting to EDs or admitted to hospital, head injury ranged from 17%[20] to 23%.[19] Twenty-eight per cent of females of all ages required hospital treatment for head/face/neck injuries in Victoria, Australia.[22] For injuries resulting in moderate to serious or serious insurance claims in NZ, head injuries represented 7% of the cases.[17] Trunk and back injuries ranged from 2%[17] to 13%[18] across all studies.

Table 2 Study characteristics and injury outcomes from five original studies of medical-attention injuries in community cricket (n=6)

First author, year (reference)	Setting/context and aims	Overall participants (n), age, sex	Injury data collection methods	Injury definition, SM	No of injured (n_p) and injuries (n_i)	EM, incidence/prevalence	Nature of injuries	Body region/part injured	Mechanism of injuries	Severity of injuries	Other information
Perera, 2019[22]	A comprehensive profile of hospital-treated cricket injuries sustained by female cricketers in Victoria, Australia, from 2002/2003 to 2013/2014.	n=668 cases overall with 547 ED presentations and 121 HA All females aged 5 years or more Top three age groups for HA: 20–24: 19.0% 10–14: 16.5% 30–34: 10.7% Top three age groups for ED: 10–14: 19.9% 15–19: 15.7% 20–25: 13.3%	Data sourced from Victorian Injury Surveillance Unit which collects ED data under the Victorian Emergency Minimum Dataset and HA data under the Victorian Admitted Episode Dataset	ED presentation or HA. For HA, SM: <2 days bed stay or ≥2 days bed stay.	ED n_p=547 HA n_p=121	Per 1000 participants Overall=1.9 (95% CI 0.8 to 4.5)	HA: Fractures=57 (47.1%) Dislocation, sprain and strain=22 (18.2%) Injury to muscle and tendon=8 (6.6%) Superficial injury=6 (5.0%) Other unspecified=28 (23.1%) ED: Dislocation sprain and strains=199 (36.4%), fractures=92 (17.2%) Superficial injury=80 (14.6%) Open wound=46 (8.4%) Injury to muscle and tendon=38 (6.9%) Eye injury—excluding foreign body=16 (2.9%) Intracranial injury=9 (1.6%) Other unspecified=67 (11.9%)	HA: Head=34 (28.1%) Shoulder=6 (5%) Elbow=14 (12%) Wrist/hand=21 (17.4%) Abdominal/lower back/ spine/pelvis=0 Knee/lower leg=27 (22%) Ankle/foot=7 (5%) Unspecified=12 (10%) ED: Head=152 (27.8%) Shoulder=22 (4%) Elbow=33 (6%) Wrist/hand=158 (29%) Abdominal/lower back/ spine/pelvis=6 (1%) Knee/lower leg=66 (12%) Ankle/foot=77 (14%) Unspecified=6 (1%) Suppressed=27 (5%)	HA: Hit/struck/crushed by ball or bat=54 (44.6%) Fall=33 (27.3%) Overexertion and/ or strenuous movements=15 (12.4%) Other unspecified=15 (12.4%) Not reported=4 (3.3%) ED: Hit/struck/crushed by ball or bat=349 (63.8%) Fall=104, (19.0%) Other unspecified=94 (17.1%)	HA: Bed stay <2 days=95 (78.5%) Bed stay ≥2 days= 26 (21.5%)	
King, 2018[17]	Provide retrospective analysis of moderate to serious injury and serious injury claims and related costs for five sporting codes using national insurance claims (ACC) in New Zealand from 2012 to 2016.	n=853 to 324 claims from which 60 803 moderate to serious claims (3072 cricket related), 597 serious claims (15* cricket related) Age 0–85+ years Sex: M=2864, F=208 for moderate to serious claims M=12, F=3 for serious claims*	Retrospective analysis of data from ACC for 5 years from 2012 to 2016	Any injury which qualified for a moderate to serious injury or serious injury claim. SM=Any injury which qualified as either a 'moderate to serious' or 'serious' injury defined by the ACC based on level of benefits and care provided.	n_p cricket related: moderate to serious injury claims=3072, serious injury claims=15	EM=NR 0.4% of all claims cricket related	Moderate to serious claims: Soft tissue=1980 (64.4%) Fracture/dislocation=948 (30.9%) Laceration/wound=59 (1.9%) Concussion/brain injury=44 (1.4%) Deafness=15 (0.49%) Gradual onset=14 (0.46%) Dental injuries=6 (0.20%) Hernia=6 (0.20%) Serious claims: Concussion/brain injury=9 (60%) Fracture/dislocation=6 (40%)	Moderate to serious claims: Head/neck=212 (6.9%) Upper limb=1086 (35.4%) Lower limb=1394 (45.4%) Chest/back/shoulder=72 (2.3%) Serious claims*: Head/neck=15 (56%) Lower limb=12 (44%)	NR	3072 moderate to serious claims. 15 serious claims	Cricket ranked fifth for total moderate to serious injury claims but third for mean cost per claim. Cricket ranked equal third for serious injury claims but fifth for mean costs per claim. Moderate to serious claims for fracture/ dislocations increased significantly over 2012–2016.
Walker, 2010[19]	Hospitalisation of cricket players in NZ from 2000 to 2005 inclusive. Identify the epidemiology of injury resulting in hospitalisation, agents and mechanisms (products and activities) associated with injury and evidence of assistance to those developing activity-specific PPE.	n=498 cases Age range=2–80 years 0–9: 8% 10–19: 28% 20–29: 23% 30–39: 21% 40–49: 12% 50–59: 4% 60+: 3% Sex: M>F but no numbers	Retrospective analysis of NZ's National Minimum Dataset of public and private hospitals	ICD-10-AM codes for case hospitalised for at least one night, including bystanders injured as a direct result of cricket activity. SM=Serious non-fatal cases based on ICISS score of ≤0.941.	n_p=n_i=498	EM=100 000 people/year and 100 000 participants/ year. Population IIR=2.3 Participant IIR=39 Almost 1% of all cases were cricket related	Fracture: 218 (44%) Sprain/strain/soft tissue: 76 (15%) Dislocation: 31 (6%) Contusion: 27 (5%) Rupture/tear: 18 (4%) Concussion: 14 (3%) Open wound: 12 (2%) Seizure: 11 (2%) Other: 90 (18%)	Head and neck: 114 (23%)—28 fractures, 11 open wounds, 10 concussions Upper limb: 178 (36%)—111 phalanges, 32 lower arm, upper arm and shoulder 33 Lower limb: 156 (31%)—Achilles 44, tibia/fibula 27, ankle 25, knee 21 Trunk and back: 14 (3%) Not specified: 36 (7%)	Exposure to inanimate mechanical forces: 240 (48%) —of these 144 (60%) were hit by ball and 33 (14%) hit by bat. Falls: 108 (22%) Overexertion or repetitive movements: 102 (21%) Exposure to animate objects (eg, player collisions): 34 (7%) Unspecified: 3%	20 (4%) cases were classified as serious non-fatal, 11 due to being struck by bat or ball, 6 due to collisions with other players, 2 from falls and 1 from overexertion.	For children under 10 years who were injured under exposure to inanimate mechanical forces, 25 (72%) were struck by the bat.

Continued

Table 2 Continued

First author, year (reference)	Setting/context and aims	Overall participants (n), age, sex	Injury data collection methods	Injury definition, SM	No of injured (n_p) and injuries (n_i)	EM, incidence/ prevalence	Nature of injuries	Body region/part injured	Mechanism of injuries	Severity of injuries	Other information
Upadhyay, 2000[18]	Emergency presentations to Starship Children's Hospital Auckland, NZ. Describe the nature of injuries sustained by children playing cricket from 1993 to April 1998.	n=60 cases Age range=9–13 years Sex NR	Retrospective review of existing data	Injury secondary to playing cricket under ICD code E-8897 SM=NR.	n_p=n_i=60	EM=NR	Fracture: 26 (43.3%) Closed head injury: 8 (13.3%) Blunt trauma: 8 (13.3%) Other: 18 (30%)—noted as soft tissue contusions, ligamentous injuries, minor lacerations and abrasions	Head/face and neck: 16 (26.7%) Thorax/abdomen: 8 (13.3%) Upper limb: 18 (30%) Other unspecified: 18 (30%)	Hit by ball: 31 (51.6%) Hit by bat: 12 (20%) Fall: 12 (20%) Collision with player: 3 (5%) Fall on bat handle: 1 (1.7%) Fall on stumps: 1 (1.7%)	Two injuries were severe, both blunt abdominal trauma. 19 cases (31.6%) required operative procedures. Median range of days of stay in hospital: 1–2.5 days. 18 cases did not require admission to hospital (all other).	Not applicable
Finch, 1998[20]	ED presentations of sports injuries in selected parts of Australia for the period 1989–1993. Describe sports injury cases presented to selected hospital EDs and redress the lack of community-based information on sports injury in Australia.	n=516 221 98 140 attendees to NISU EDs 51 203 <15 years old (children) 46 837 ≥15 years old (adults) not specific to cricket Gender NR	Data collected from 74 public hospitals and medical centres on standardised collection forms throughout Australia	NR SM=NR	$n_{p(children)}$=1945 $n_{i(children)}$=2345 $n_{p(adults)}$=3408 $n_{i(adults)}$=3846	EM=NR 3.7% of all children presenting with sports injury and 7.3% of all adults presenting with sports injury related to cricket	Children/adult: Haematoma/bruising: 30.2 %/19.6% Fracture: 17.8 %/20.7% Laceration: 17.8%/11.8% Sprain/strain: 12.4%/26.0% Inflammation/swelling/pain: 7.5%/10.6% Superficial abrasion: 2.9%/1.2% Other: 11.4%/11.5%	Children/adults: Head: 44.2%/16.6% Upper extremity: 33.9%/32.6% Lower extremity: 15.5%/22.8% Trunk: 3.2%/4.2% Other: 11.4 %/11.5%	Head and facial injuries generally associated with hits with the ball or bat	8.2% of ED presentations for children were admitted to hospital. 5.4% of ED presentations for adults were admitted to hospital.	Not applicable
Forward, 1988[21]	Review indoor cricket injuries presenting to ED of Royal Perth Hospital, Australia, over a 6-month period. (Published in 1988—no reference to dates investigated.)	n=64 cases 19–34 years Sex: M=50, F=14	Recording of all indoor cricket injuries presenting in ED	NR (all indoor cricket-related injuries) SM=work time loss	n_p=64 n_i=65	EM=NR	Fractures: 19–22 (includes three bruised or fractured ribs) Grade I/II ligament strains: 10 Eye-specific damage: 6 Dislocations: 5 Bruising: 2–5 (includes three bruised or fractured ribs) Friction burns (infected): 4 Lacerations: 4 Avulsions: 2 Concussion: 1 Other: 7	Head and neck: 14—eye injuries 6 (43%), supraorbital ridge 4 (29%), nasal bone 3 (21%) Upper limb: 30—proximal phalanx 11 (37%) Lower limb: 18—ankle 5 (28%), knee 5 (28%) Thorax: 3—ribs 3 (100%)	Batters most often struck on fingers by ball Wicket-keepers: 5 of 7 injuries due to being struck in eye by ball One player was struck by the bat in an argument	No time off work: 19% <1 week off: 19% 1 week—1 month: 19% >1 month: 11% Not known: 32%.	Activity at onset: Fielding: 72% Batting: 17%

*There is some disparity in the reported figures of the number of serious for cricket-related injury (reported in different tables as n=15 and n=27).
ACC, Accident Compensation Corporation; ED, emergency department; EM, exposure measure; F, female; ICD-10-AM, 10th edition of the Australian Modification to the International Classification of Diseases; ICISS, International Classification Injury Severity Score; IIR, Injury Incidence Rate; M, male; NISU, National Injury Surveillance Unit; NR, not reported; NZ, New Zealand; PPE, personal protective equipment; SM, severity measure.

Table 3 Injury nature for studies reporting medical-attention injury in community cricket (ED presentations unless otherwise noted)

First author, year (reference)	No of injuries	Age range	Concussion/ closed head intracranial injury or seizure	Superficial injury	Eye injury	Fracture	Avulsion / dislocation	Injury to muscle and tendon or rupture/ tear	Internal organ injury	Open wound/ laceration	Soft tissue	Sprain	Strain	Bruising	Overuse	Inflammation*	Abrasion/ friction burn	Other/ NR
Perera, 2019[22]	HA: 121	5–45+ years	–	5.0%	–	47.1%	†	6.6%	–	–	–	18.2%†		–	–	–	–	23.1%
	ED: 547	5–45+ years	1.6%	14.6%	2.9%	17.2%	†	6.9%	–	8.4%	–	36.4%†		–	–	–	–	11.9%
King, 2018[17]	3087**	0–85+ years	1.7%	–	–	30.9%	–	–	–	1.9%	64.1%	–	-	–	0.5%	–	–	0.9%
Walker, 2010[19]	HA: 498	2–80 years	5.0%‡	–	–	43.8%	6.2%	3.6%	–	2.4%	–	–	15.2%	5.4%	–	–	–	18.1%
Upadhyay, 2000[18]	60	9–13 years	13.3%	–	–	43.3%	–	–	13.3%		–	–	–	–	–	–	–	30.1%
Finch, 1998[20]	2345	<15 years	–	–	–	17.8%	–	–	–	17.8%	–	12.4%§		30.2%	–	–	2.9%	11.4%
	3846	≥15 years	–	–	–	20.7%	–	–	–	11.2%	–	26.0%§		19.6%	–	–	1.2%	11.5%
Forward, 1988[21]	65	19–34 years	1.5%	–	9.2%	33.8%¶	10.8%	–	–	6.2%	–	15.4%	–	6.2%	–	–	6.2%	10.7%

*Includes pain and swelling.
†Dislocation, sprain and strain were combined.
‡Includes 2.2% seizures.
§Sprain and strain combined.
¶Includes bruised ribs as three cases were classifiedas bruised or fractured.
**Insurance claims.
ED, emergency department presentations; HA, hospital admission; NR, not reported.

Table 4 Percentage of body regions for medical-attention injuries in community cricket

First author, year (reference)	No of injuries	Head/face/neck	Upper limb	Trunk/back	Lower limb	Unspecified
Perera, 2019[22]						
HA	121	28.1	33.9	–	28.1	9.9
ED	547	27.8	38.9	1.1	26.1	6.1
King, 2018[17]	3087*	7.4	35.2	2.3	45.5	9.6
Walker, 2010[19]	498	22.9	35.7	2.8	31.3	7.3
Upadhyay, 2000[18]	60	26.7	30.0	13.3	NR	30.0
Finch, 1998[20]						
Ages <15 years	2345	44.2	33.9	3.2	15.5	11.4
Ages ≥15 years	3846	16.6	32.6	4.2	22.8	11.5
Forward, 1988[21]	65	21.5	46.2	4.6	27.7	0.0

*Number of claims (there were no 'multiple locations' injuries reported).
ED, emergency department presentations; HA, hospital admissions; NR, not reported.

Specific body parts injured were provided in three hospital-based studies.[19 21] Of the upper limb injuries admitted to hospital in NZ, almost two-thirds (62%) were to the fingers. Thirty-two per cent of the lower limb injuries were to the Achilles tendon.[19] Of the indoor cricket injuries presenting to EDs in Australia from 1989 to 1993, 50% of the head injuries were to the nasal bone or the bony region above the eye (supraorbital ridge) and 43% were to the eye itself. Thirty-seven per cent of upper limb injuries were to the fingers (proximal phalanx) and the ankle and knee each made up 28% of the lower limb injuries.[21] Of the hospital-attended injuries in females in Victoria, Australia, the wrist and hand made up the majority of upper limb injuries in ED presentations (29%) and hospital admissions (17%), with the knee being the most common injured region of the lower limb in ED presentations (12%) and admissions (22%).[22] Of the wicket-keepers injured in indoor cricket, 71% were eye injuries due to being struck by the ball.[21] The study of NZ insurance claims reported that of the moderate to serious claims (n=3072) for the head/neck/face region, 31% of the claims were to the head, with 25% to nose specifically and 25% to other facial areas. For the upper limb, 41% of the claims were to the finger/thumb, 32% to the shoulder and 15% to the wrist/hand. For the lower limb, the majority of claims were for the knee (51%) and ankle (26%). In the trunk/back region, the chest (44%) was the most common claim, with back/spine (26%) and abdomen/pelvis (25%) at similar levels. For serious claims (n=27), 56% were to the head and 44% to the hip, upper leg and thigh.[17]

Mechanism of injury

Table 5 summarises the broad mechanisms of injury reported by four studies. Being struck by the ball was consistently the highest proportion of mechanism reported, varying from 31.4%[19] to 98.4%.[21] Being struck by the bat or equipment was relatively high in the ED presentations for children (23.3%)[18] when compared with the hospital admission proportion of 7.2% for a broader age group (2 to 80 years); however in the same study, it was reported that for children under 10 years the proportion was 72%.[19] An Australian study looking at female cricket injuries reported higher proportions of ED presentations compared with hospital admissions for being struck by the ball or bat.[22] An earlier Australian study on ED presentations noted that head and facial injuries in children (<15 years) were generally associated

Table 5 Broad mechanism of injury as a percentage of all medical-attention injuries in community cricket

First author, year (reference)	No of injuries	Struck by ball	Struck by bat or equipment	Non-specific overexertion	Non-specific falls	Player collision	Other/NR
Perera, 2019[22]							
HA	121	44.6*		12.4	27.3	–	15.7
ED	547	63.8*		–	19.0	–	17.2
Walker, 2010[19]	498	28.9	6.6	20.5	21.7	6.8	15.5
Upadhyay, 2000[18]	60	51.7	23.3	–	20.0	5.0	–
Forward, 1988[21]	65	98.4	1.6	–	–	–	–

*Struck by ball or bat combined.
ED, emergency department presentations; HA, hospital admissions; NR, not reported.

with being hit by the ball or bat, though numerical data were not available.[20] Non-specific fall and player collisions were similar across ED presentations and hospital admissions for the two NZ studies despite the age range differences.[18 19]

Position of play when injured

One study, for indoor cricket, provided information on injuries with regard to the position of play for the injured player, with injuries occurred mainly in fielding (72%) and then batting (17%).[21]

Injury severity

One study identified 21.5% of hospitalised cricket-related injuries to females in Victoria, Australia, required a bed stay of two or more days.[22] One study identified that 4% (n=20) of cricket-related hospital admissions were classified as serious non-fatal injuries on the International Classification Injury Severity Score (ICISS) scale. Of these, 11 were due to being struck by the ball, 6 due to collisions with other players, 2 from falls and 1 from overexertion.[19] For children (aged 9–13 years) presenting to ED in NZ, 30% did not require hospital admission and 32% required operative procedures. Two children had abdominal trauma injuries that were classified as severe. The median range for days of stay in hospital for the operative cases among the children was 1 to 2.5 days.[18] The severity of injuries from indoor cricket presentations to ED in Australia was measured by time off work. Equal proportions of cases required no time off work (19%), less than 1 week off work (19%) and between 1 week and 1 month off work (19%). Eleven per cent of cases required greater than 1 month off work.[21] For the study that investigated moderate to serious and serious injury claims for cricket-related insurance claims in NZ, 0.5% (n=15) of claims were serious. Although not reported specifically for cricket, minor injuries accounted for 93% of all claims.

DISCUSSION

Main findings

Data items for improved reporting

Successful injury prevention strategies should be informed by high-quality injury data. Medical-attention injuries were chosen as the focus of this review because they are costly to the public health system[23] (and individuals) and because the diagnosis from a medical professional is considered to provide more accurate results than self-report data.[24 25] For medical-attention community cricket injuries, we identified six studies that reported epidemiological data inclusive of all body parts/injury types. Only two studies were considered to have a low likelihood of bias, meaning that the reported results could be subject to selection and information biases.[26] Two key areas are highlighted for inclusion in future original research studies: item 4 (missing data and subject attrition) and item 9 (reporting of ethical standards, conflicts of interest and funding). A further four items were only moderately well addressed and should be considered for improved reporting: item 7 (study limitations), item 5 (injury definition), item 3 (description of data collection method) and item 2 (study setting).

High prevalence of fractures and head injuries

As might be expected from the data sources, the types of injuries that were treated in hospitals/EDs were primarily fractures. Cricket is a projectile sport and it is likely that many of the fractures were due to being struck by the ball and or equipment, as has been reported in a prospective cohort study of junior players in Australia.[27] Falls are another common mechanism that can lead to fracture. For injuries requiring hospital treatment, the head/face/neck was the second most common injured body region behind the upper limb. An interesting observation from the hospital data was that the overall proportions of head/face/neck cases seen in females, in Victoria, Australia, from 2002 to 2012 were similar to those reported for both sexes (but would be predominantly male) throughout Australia from 1989 to 1993.[20 22] Although difficult to compare directly between the studies, it might suggest a possible issue with helmet use. Given that helmets have been shown to be protective, specifically at junior levels in cricket,[28] and anecdotally against fatalities,[29] we might expect to see a comparatively lower proportion in the more recent study, especially as the data used were largely from the period in which the wearing of helmets was generally mandatory for players under the age of 18 years. There may be other factors involved in the comparable proportion of head/face/neck face injuries. Other factors include improper fitting of helmets, lax regulation of wearing protective equipment, especially at training, or the injuries occurring in other aspects of the game such as in the field, where protective equipment is not normally mandated.

Another recent study based on insurance claims data from NZ reported lower proportions of head/neck/face injuries than the Australian hospital data and other earlier studies.[17] The relatively low proportion of head/neck/face injuries in the insurance claim data is possibly reflective of the nature of injuries recorded in this dataset (being a no-fault claims system), rather than a clear reduction in the proportion of cases (when compared with the hospital data from earlier timeframes). Regardless of the reason for the change, 50% of these injuries were to the face. Investigation of the mechanisms for these injuries, including the use of appropriate personal protection (such as a helmet with face guard for batters/wicket-keepers and protective glasses for wicket-keepers), is needed.

Injuries over time

Besides the number and types of injuries sustained, the temporal patterns and incidence rates need to be understood. Looking at injury over time enables practitioners to identify when, what and in whom cases are increasing or decreasing, therein supporting the decisions required on prevention measures. One of the difficulties in presenting injury incidence rates, and possibly why only two studies[19 22] reported these, is the requirement for an accurate denominator (risk exposure). Cricket is a sport with several, separate activities (batting, bowling and fielding) which further complicates accurate collection of exposure data. Although guidance for this data collection is presented in the consensus statements,[25 30] this guidance is best suited to the elite levels of the game. Improving the consistency of injury surveillance including exposure to injury risk at a community level requires a targeted and tailored approach within those settings.[6]

Limitations

The type and consistency of data extracted from the articles in this review limited our ability to conduct any quantitative analysis. Due to the majority of the studies within this review being outdated, it is difficult to provide unequivocal recommendations from the data reported.

While hospital data can be a useful, routinely collected, source of acute injury data, reliance on it underestimates the overall prevalence of cricket injuries as it is likely that many will not require hospital treatment. Earlier research has reported that up to 50% of adults with a sports injury seek treatment by a community-based practitioner, including family doctors, physiotherapists or sports medicine specialists.[31 32] While not included in this review due to the lack of detailed epidemiological data, two studies were identified in which the proportion of injury by sport was noted for a sports medicine clinic (wherein 3% of 6479 cases and 4% of 1682 cases in consecutive years were cricket related[33] and a general practice (5% of 78 were cricket related).[34] The level of organisation (eg, formal or recreational) in which the cricket was played when the injury occurred is also often not known with any accuracy, which can hamper specific advice for injury prevention policy.

In addition to limitations of the included studies, there were also limitations of the review process itself that need to be considered in understanding the results. The search strategy was deliberately broad to identify all original cricket-related studies, including reference searches and knowledge from two authors with extensive cricket research backgrounds. However, it is still possible that large studies reporting on all types of sports or other injuries could have reported on cricket, within a subgroup analysis (as similar to those that were identified).

The tool used for critical appraisal of the included studies was self-developed, based on the Downs and Black tool[13] and STROBE statement,[14] with reference to bias assessment from Hoy *et al*[16] and the Cochrane Collaboration.[15] While not formally validated, the items were agreed by the author team to be the minimum data for reporting and interpreting injury data in line with the study aim. It is, however, possible that the tool may overestimate or underestimate the quality of the studies reviewed.

CONCLUSIONS

From studies of medical-attention injuries in community cricket, fractures, bruising and open wounds/lacerations were identified as relatively more common than other injury types. The majority of these injuries were likely sustained by players being struck by the ball. However, the evidence on which these findings are based is largely outdated and biased toward hospital-treated cases. Head/neck and face injuries were relatively common, suggesting that further investigations of their injury mechanism and the use of appropriate personal protective equipment are needed.

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Review

Prospective reporting of injury in community-level cricket: A systematic review to identify research priorities

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ABSTRACT

Objectives: Cricket is a popular sport enjoyed worldwide. Injuries in cricket are not well understood at community level but are important to understand for prevention to ensure the game continues to be enjoyed safely. This systematic review was designed to assess the quality of data collection and reporting, and to summarise the injury data, in studies of community cricket players.
Design: Systematic review.
Methods: Nine databases were searched to November 2018 using the terms "cricket*" and "injur*". A nine-item critical appraisal and three-item likelihood-of-bias evaluation was conducted on included studies. Data completeness was evaluated against recommendations in the international cricket consensus statement for recording/reporting injury and the Australian Sports Injury Data Dictionary (ASIDD). Descriptive injury data (n,%) are presented in tabular format for different subgroups (activity, position, population).
Results: Thirteen studies were included, of which eight were rated as unclear, one as high and three having a low likelihood-of-bias. The mean score for completeness of data against the consensus statement was 3.5/10 (95%C.I. 2.8–4.2). The mean score for completeness of data against the ASIDD was 4.4/6 (95%C.I. 3.9–5.0). Bruising and inflammation was the most common injury in junior cricket. Stress fractures were most common in studies of bowlers. Where studies included all activities, batting accounted for most injuries (7–49%).
Conclusions: The included studies inconsistently addressed recommended items for injury surveillance in community sport and cricket. Most studies focused on junior levels or adolescent bowlers, with bruising/inflammation and stress fractures being most common, respectively.