Prevalence and incidence of injuries among female cricket players: a systematic review and meta-analysis

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ABSTRACT

Objective: The objective of the review was to describe the incidence and prevalence of injuries among female cricket players of all ages, participating in all levels of play.

Introduction: Cricket, a bat-and-ball sport, is becoming popular among women of all ages and abilities worldwide. However, cricket participation carries a risk of injury. Injuries negatively affect sport participation, performance, and short- and long-term health and well-being. Injury prevention, therefore, is the key to safe, long-term cricket participation as a physical activity goal. Epidemiological data are needed to underpin evidence-based injury-prevention strategies.

Inclusion criteria: Studies reporting incidence and prevalence of injuries in female cricket players of all ages, participating in all levels of play, were included in this review, including studies that report data by sex or by sport. Studies were excluded if they did not have enough data to calculate prevalence or incidence, did not distinguish female injury data from male injury data, focused on athletes participating in other sports, or focused on case studies.

Methods: A systematic review and meta-analyses were conducted according to the JBI and PRISMA 2020 guidelines. MEDLINE, SPORTDiscus, Physiotherapy Evidence Database (PEDro), EBSCO MasterFILE Premier, EBSCO CINAHL Complete, ProQuest Health and Medical Complete, Scopus, and ScienceDirect were systematically searched from inception to August 2021. Additionally, Cochrane Central Register of Controlled Trials and ClinicalTrials.gov were searched. EBSCO MegaFile Premier, OpenGrey (SIGLE), WorldCat, Grey Matters, Grey Literature, and Google Scholar were searched for gray literature. Full-text articles that met the inclusion criteria were critically appraised using tools from JBI, and were extracted and synthesized in narrative summary and tabular format. Three meta-analyses were conducted: injury incidence rates, injury prevalence proportions, and injury incidence proportions. Heterogeneity was assessed using the I^2 statistic and the random-effects model.

Results: Of the 7057 studies identified, 4256 were screened after duplicates were removed. A total of 23 studies met the inclusion criteria. Risk of bias was low for 21 studies. The injury incidence rate for elite cricket was 71.9 (SE 21.3, 95% CI 30.2–113.6) injuries per 1000 player hours, time-loss injury incidence rate was 13.3 (SE 4.4, 95% CI 4.6–22.0) injuries per 1000 player hours, and non-time-loss injury incidence rate was 58.5 (SE 16.9, 95% CI 25.6–91.7) injuries per 1000 player hours. The injury prevalence proportion for community to elite cricket was 65.2% (SE 9.3, 95% CI 45.7–82.3) and the injury prevalence proportion for community cricket was 60% (SE 4.5, 95% CI 51.1–68.6). The injury incidence proportion for community cricket was 5.6 (SE 4.4, 95% CI 0.1–18.3) injuries per 10,000 participants. Elite cricket players were more frequently injured than community cricket players. The most prevalent body regions injured were the shoulder and knee, and most were sustained by fast bowlers. Injuries to the hand, wrist, and fingers had the highest incidence and were most sustained by fielders.

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Conclusions: The study's findings can help stakeholders (including players, coaches, clinicians, and policymakers) make informed decisions about cricket participation by informing and implementing strategies to promote cricket as a vehicle for positive public health outcomes. This review also identified gaps in the available evidence base, and addressing these through future research would enhance women's cricket as a professional sport.

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Keywords: female athlete; physical activity; recreation sport; team sport; youth sports

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Introduction

Cricket is one of the most popular sports in the world. Although women have been playing cricket for more than 200 years,[1] the popularity of cricket among women of all ages and levels of play (from community to elite) has increased in recent years. For example, women's cricket participation has rapidly grown in countries such as Australia,[2,3] Bangladesh,[4,5] India,[6] and the United Kingdom,[7,8] and is promoted as a source of physical activity. The health benefits of regular physical activity are well-known, and females engaging in team sports such as cricket enjoy positive physical and mental health effects associated with sport participation.[9,10] Furthermore, since the first International Cricket Council's Women's World T20 Championship in 2009, increased interest and investment now provide women opportunities to pursue a professional sporting career in cricket.[11]

A 2018 narrative review by Munro and Christie[12] evaluated the available evidence on women's cricket to identify gaps in knowledge and research priorities. Nine publications were included in the narrative review. The authors concluded that existing literature predominantly focused on Australian elite fast bowlers and also that there is a paucity of research into women's cricket. Consequently, the authors recommended additional research for women's cricket on various player roles, levels of play, match formats, anthropometric characteristics of players, injury prevalence, and injury mechanisms.[12] However, the findings of Munro and Christie[12] are subject to methodological limitations associated with the narrative review methodology.

In a 2018 systematic review and meta-analysis, Perera *et al.*[13] grouped baseball, field hockey, cricket, lacrosse, T-ball, and softball as "bat-and-ball and ball-and-stick" sports according to the International Statistical Classification of Diseases and Related Health Problems (ICD-10-AM).[14] The authors grouped similar sports with similar injury potential because of the scarcity of available evidence in women's cricket. Although Perera *et al.*[13] provided the first detailed analysis of an injury profile of women who played competitive "bat-and-ball and ball-and-stick" sport, only two women's cricket studies[15,16] were included in their review, which does not give a true reflection of injuries sustained in women's cricket specifically. Further, data from the two cricket studies[15,16] were not included in the meta-analysis.[13] Also, neither review included data from community cricket players,[12,13] where the majority of players participate.

The Sequence of Prevention of Sports Injuries[17] and Translating Research into Injury Prevention Practice framework[18] are established frameworks for sport injury-prevention research. The first step is to define the problem through a systematic collection of data about the magnitude, characteristics, mechanisms, and consequences of sport injuries. However, there is no universal injury surveillance system available for men's or women's cricket at the international level to provide a comprehensive overview of cricket injuries. Although a few individual studies on the incidence and prevalence of injuries in women's cricket have been published, a systematic review is required to identify, analyze, and synthesize the current data pertaining to cricket injuries from recreation to elite-level cricket. Furthermore, a meta-analysis that combines data from individual studies to demonstrate the direction and magnitude of the overall effect of the injury rate will form a crucial building block in injury-prevention research in women's cricket. This review will provide quantified injury rates and proportions for women's cricket as a baseline for promoting and implementing evidence-based injury-prevention strategies. These data can enable stakeholders (including players, coaches, clinicians, administrators, and policymakers) to make informed decisions about cricket participation, and industry and policymakers can use the findings to inform strategies to increase safe cricket participation rates and promote the sport as a vehicle for positive public health outcomes.

In recent years, research into women's cricket has increased alongside the popularity of the sport. The authors found several peer-reviewed publications and gray literature sources to justify a systematic review exclusively for women's cricket. To avoid duplication, PROSPERO, MEDLINE, the Cochrane Database of Systematic Reviews, and the *JBI Database of Systematic Reviews and Implementation Reports* were provisionally searched. No current or in-progress systematic reviews on women's cricket injuries were identified. Therefore, the aim of this systematic review was to determine the incidence and prevalence of injuries sustained by female cricket players.

Review question

What is the incidence and prevalence of injuries among female cricket players at all levels of play (from community to elite)?

Inclusion criteria

Participants

Studies reporting injury incidence and prevalence in female cricket players of all ages and all levels of play were included in this review. Studies with insufficient data, studies with female cricket injury data not distinguished from those of males or other sport participants, and case studies were excluded.

Condition

Injuries sustained by female cricket players could be self-reported or diagnosed by health care professionals. Injuries were defined in accordance with the 2016 update of the International Consensus Statement on Injury Surveillance in Cricket:[19]

- A "match time-loss injury" is an occurrence that either prevents a cricket player from being fully available for match selection or, during a match, renders the player unable to bat, bowl, or keep wicket as necessary by either the rules or the captain of the team.
- A "non-time-loss injury" is a medical-attention injury that does not lead to time loss from the sport.
- A "medical-attention injury" is a health-related condition that potentially affects the training or match-play of a player and requires medical attention. Medical-attention injury can be a time-loss or non-time-loss injury.
- A "player-reported injury" is any injury that is self-reported by the player or individuals on the player's behalf without a medical diagnosis. Player-reported injury can be a time-loss or non-time-loss injury.
- A "general time-loss injury" is any injury that results in a player being declared unfit for a match, regardless of whether the match or training was already planned. General time-loss injury can be a medical-attention injury or player-reported injury. General time-loss injury includes match time-loss injury, training days missed, off-days, and off-season.

Context

Female cricket players from all levels of play from across the globe, regardless of cultural or sub-cultural factors, geographical locations, age, or race, who play in all formats of the game (ie, test, one day, and T20) were considered for inclusion.

Types of studies

Prospective and retrospective cohort studies, case-control studies, cross-sectional studies, and case series were included. However, case studies were excluded as this study design provides lower-quality evidence. Peer-reviewed publications and gray literature (dissertations, statistical reports, health care records, prevention records, and reports from government surveillance) were considered.

Methods

The JBI methodology for systematic reviews of prevalence and incidence[20] formed the foundation of this review. The review was registered with PROSPERO (CRD42020166052). An a priori review protocol was developed[21] according to JBI methodology and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement.[22]

Search strategy

The first step of the three-step search strategy was to conduct an initial literature search. The MEDLINE database was searched using the title, abstract, MeSH headings, and subheadings (including single

Table 1: Keywords and index terms used in the search strategy

Terms connected by OR	AND	Terms connected by OR	AND	Terms connected by OR
"Cricket sport"[MeSH Terms] **OR** Cricket[Text Words]		"Female"[MeSH Terms] **OR** Female[Text Words] **OR** "Women"[MeSH Terms] **OR** Women[Text Words] **OR** Woman[Text Words] **OR** Lad*[Text Words]		"Wounds and injuries"[MeSH Terms] **OR** injur*[Text Words] **OR** pain*[Text Words] **OR** wound*[Text Words]

words and phrases), and other terms fields (including author-supplied keywords). Keywords were also searched in MeSH terms. The lead author (JJ) trialed and refined the search strategy (Table 1) by adding and/or removing duplicate or inadequate search terms. The search strategy was retested to ensure it was robust and sensitive enough to identify all relevant studies.

The second step was to systematically search MEDLINE (PubMed), SPORTDiscus (EBSCO), Physiotherapy Evidence Database (PEDro), MasterFILE Premier (EBSCO), CINAHL Complete (EBSCO), Health and Medical Complete (ProQuest), Scopus (Elsevier), and ScienceDirect (Elsevier) databases from inception until August 2021 (see Appendix I for the complete search strategy). Additionally, Cochrane Central Register of Controlled Trials (CENTRAL) and ClinicalTrials.gov were searched. MegaFile Premier (EBSCO), OpenGrey (SIGLE), WorldCat, Grey Matters, Grey Literature, and Google Scholar databases were searched for unpublished studies (Appendix I). Known experts in the field of cricket research were contacted to identify any additional publications.

The third step of the search strategy was a secondary search of the reference lists of the selected studies (backward citation tracking) and forward citation tracking via Google Scholar to identify any additional studies that cited the articles since they were published.

There were no language limitations placed on the search. All studies identified from the searches were in English and no translation was needed.

Study selection

All identified studies were collated using EndNote v. X9.3 (Clarivate Analytics, PA, USA) and then imported into Microsoft Excel (Redmond, Washington, USA). Duplicates were removed using Microsoft Excel. Titles and abstracts were independently screened by two authors (JJ and MD) against the a priori inclusion and exclusion criteria. Full-text articles relevant to the study were exported into the JBI System for the Unified Management, Assessment and Review of Information (JBI SUMARI; JBI, Adelaide, Australia).[23] Full-text articles were independently screened by the same two authors (JJ and MD), removing studies that did not fulfill the inclusion criteria (see Appendix II for rationales for exclusion). Any disputes regarding study inclusion/exclusion were resolved by discussion between the two reviewers (JJ and MD), while a third reviewer (BO) acted as an adjudicator.

Assessment of methodological quality

Methodological quality was independently evaluated by two authors (JJ and MD) using the JBI critical appraisal instruments.[20] The JBI critical appraisal checklist for prevalence studies[20] provided a numerical score out of a possible 9 points. The JBI critical appraisal checklist for cohort studies[20] provided a numerical score out of a possible 11 points. The JBI critical appraisal checklist for case series[20] provided a numerical score out of a possible 10 points. Any methodological quality scoring disagreements were resolved by consulting a third author (BO). The methodological quality assessment process, including the number of items agreed/disagreed on and any discussions (in the case of disagreement), were documented for each study. The intra-rater agreement was assessed using k statistic. All studies were included in the review regardless of methodological quality.

Data extraction

Two authors (JJ and MD) independently extracted the data using the standardized data extraction instrument from JBI SUMARI. The data extracted included article details (authors/year/country), study design (setting/aim), participant characteristics (age/

country/level of play/player role), injury data collection methods, injury definitions, injury prevalence and incidence, and body regions injured. Any disagreements between the two reviewers (JJ and MD) were resolved through discussion or with a third reviewer (BO).

Data synthesis

The pre-specified outcomes of interest for this descriptive study were injury incidence and prevalence, body region of injury, and the player role. Data were quantitatively synthesized in a narrative summary and tabular formats. To increase the accuracy of the overall estimate of the effect size of the injury incidence and prevalence, the data from individual studies were pooled in meta-analyses. At a minimum, two variables—an effect size (the dependent variable) and its variance (or the standard error squared [SE^2])—are needed to perform a meta-analysis. Effect size can vary depending on the study design; however, it must meet the following characteristics: i) it must not be a direct function of the sample size; ii) it must be a numerical value (to allow effect size comparisons across studies); and iii) it needs sufficient data available for calculation of SE of the effect size.[24]

Based on the data available from included studies, three separate effect sizes were identified: injury incidence rate (injury IR), injury prevalence proportion (injury PP), and injury incidence proportion (injury IP). Proportional meta-analyses were calculated using JBI SUMARI, and injury rates for reporting in accordance with cricket standards were calculated using Comprehensive Meta-Analysis 3.0 (Biostat Inc, 2015).[19] The random-effects model was used with in-study, as well as between-study variability. Heterogeneity was measured using the I^2 statistic and the χ^2 test. The pooled results were presented in forest plots. Meta-analysis 1 included data from elite cricket players. Meta-analysis 2 included data from community to elite cricket players, and subgroup analyses were performed by level of play. Meta-analysis 3 included data from community cricket players.

Meta-analysis 1: injury incidence rate as the effect size

The studies with sufficient data to calculate injury IR (ie, total number of injuries and total time of athletic exposure in hours) were included in meta-analysis 1. The injury IR was defined as the total number of injuries sustained per 1000 hours of athletic exposure. When information was not reported by the authors, the injury IR, SE, upper and lower limits of the 95% confidence interval (CI), and SE^2 were calculated. When possible, injury rate per 1000 exposure hours was calculated using match incidence and/or training incidence.[19] It should be noted that match and training exposure data were not separated in some studies, which meant that subgroup analyses for matches or training could not be performed. The injury IR was calculated using the following formula:

$$Injury\,IR\,per\,1000\,exposure\,hours = \frac{Total\,number\,of\,injuries \times 100}{Total\,time\,of\,athletic\,exposure\,in\,hours}$$

Meta-analysis 2: injury prevalence proportion as the effect size

Studies that reported the number of injured team members and the total number of squad players were used to calculate injury PP.[19] The injury PP was defined as the percentage of injuries sustained by the total squad members. The proportions for this meta-analysis were transformed to logits (using Freeman Tukey) for calculations and back transformed for reporting. The injury PP was calculated using the following formula:

$$Injury\,PP = \frac{Number\,of\,squad\,members\,injured \times 100}{Total\,number\,of\,squad\,members}$$

Meta-analysis 3: injury incidence proportion as the effect size

The studies that reported data (ie, number of injuries and number of participants) to calculate injury IP were included in meta-analysis 3. Data from the community level were included in this review. The injury IP was defined as the total number of injuries sustained per 10,000 participants. The proportions for this meta-analysis were transformed to logits (using Freeman Tukey) for calculations and back transformed for reporting. The injury IP was calculated using the following formula:

$$Injury\,IP\,per\,10{,}000\,participants = \frac{Number\,of\,injuries \times 10{,}000}{Number\,of\,athletes}$$

Table 2: Calculations for exposure hours for meta-analysis 1

Match format	Matches played*	Duration of match (days)	Conversion rate per two teams (hours)	Total exposure (hours)
Goggins et al.[28]				
One day (50 overs)	28	1	86.6	2424.8
One day (40 overs)	1	1	69.4	69.4
T20 (20 overs)	14	1	34.6	484.4
One day (no overs indicated)	6	1	67.2*	403.2
First-class match (2 days)	1	2	78	156
First-class match (3 days)	1	3	78	234
First-class match (4 days)	1	4	78	312
Total	52	-	-	**4083.8**
Warren et al.[8]				
T20 (20 overs)	68	1	34.6	**2352.8**

*average exposure hours per two teams calculated between first-class match, 50 overs, 40 overs, and 20 overs.

Conversions of data for meta-analyses

Cricket player exposure hours were converted in accordance with the International Consensus Statements of 2005[25] and 2016,[19] as well as Orchard *et al.*[26] and Soomro *et al.*[27] A day of play for a first-class or test cricket match was equal to six hours of play per day (6 h/day) and a one-day match was six hours and 40 minutes per day (6.66 h/day).[19,26] The T20 format was taken as 2.66 h/day (generalizing 40 match overs from 6.66 hours of 100 overs played in one-day cricket).[26,27] The bowling guidelines of the International Cricket Council also suggest a similar number of 15 overs/h for T20 (ie, 40 overs/ 15 = 2.66 hours).[26,27] Once the format of play was determined, the conversion rate was used to calculate the exposure hours per format of play. To determine the total exposure hours for all players, the conversion rate was multiplied by 13 per two teams (13 players on the field at any given time, ie, 11 from the fielding team and two from the batting team).[26,27] Data from two studies[8,28] needed to be converted for meta-analysis 1 (Table 2).

Results

Study inclusion

An initial search identified 7057 studies (including duplicates) from 13 databases. After removal of duplicates, 4256 titles and abstracts were screened against the inclusion criteria. Ultimately, 129 full texts were retrieved and assessed, with 107 excluded (see reasons for exclusion in Appendix II). A total of 23 studies (22 from database searching and 1 from other methods of searching) satisfied the inclusion criteria (Figure 1). Ten were cross-sectional studies,[5,7,15,16,29-34] seven cohort studies,[2,3,8,28,35-37] one case-control study,[38] one descriptive study,[39] and four case series.[40-43] Ten studies were included in one or more meta-analyses: three studies[2,8,28] in meta-analysis 1 (injury IR), five studies[2,7,30,33,39] in meta-analysis 2 (injury PP), and three studies[3,41,43] in meta-analysis 3 (injury IP).

Methodological quality

Of the 15 studies[2,5,7,15,16,28-35,38,39] that reported injury prevalence, five studies[28,30,35,39,40] scored the maximum of 9 points in the JBI critical appraisal checklist for prevalence studies and one study[31] scored 5 points. The mean score was 7.4 (SD = 1.3; Table 3). Three cohort studies[2,28,35] were critically appraised using the JBI critical appraisal checklist for prevalence studies. The remaining four cohort studies[3,8,36,37] were appraised using the JBI critical appraisal checklist for cohort studies (Table 4). Two cohort studies[8,36] scored the maximum of 11 and the mean score of all four cohort studies was 8.8 (SD = 2.6). Four case series[40-43] were critically appraised using the JBI critical appraisal checklist for case series and scored 7.8 (SD = 0.8; Table 5). The two reviewers disagreed on 21 items, which were resolved through discussions. The inter-rater agreement between the two reviewers for all three critical appraisal tools was moderate (k = 0.6).

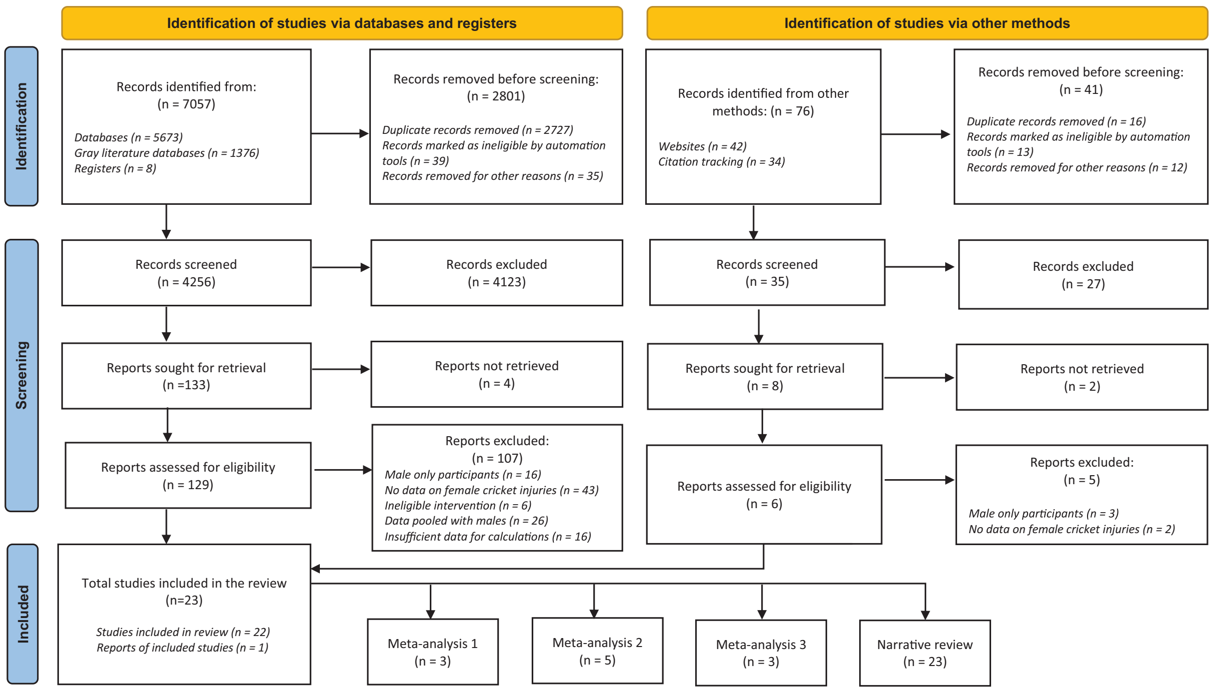


Figure 1: Search results and study selection and inclusion process[22]

Characteristics of included studies

A total of 7790 injuries were included in this review. Data from 1139 female cricket players aged between 12 and 38 years (mean age 23.79 years) were extracted from the 15 studies that reported injury prevalence.[2,5,7,15,16,28-35,38,39] The studies that reported injury incidence did not report the total participants in their cohort/case series, but rather the total injuries sustained by the cohort/case series during the given period of the study (Appendix III).

Nine studies used self-administered questionnaires,[5,7,15,29-34] four collected data from cricket seasons/tournaments,[2,8,28,39] three used injury surveillance databases,[36,37,40] two used observational methods,[35,38] three used hospital records,[41-43] and one used insurance claims.[3] Data for two studies were collected during international tournaments.[8,39] Data for four studies were collected during one or multiple seasons of cricket.[2,3,7,28] Out of the 23 included studies, six were thesis/dissertations (gray literature).[3,7,30,31,39,43]

Twelve studies were from Australia,[2,3,15,16,30,35-38,40-42] six from the United Kingdom,[7,8,28,32-34] two from Bangladesh,[5,31] two from South Africa,[29,39] and one from New Zealand.[43] Ten studies included elite-level players,[2,8,15,16,28,35-37,39,40] 11 studies included a mixture from community to elite-level players,[3,5,7,30-34,41-43] and two studies included junior/school-level cricket.[29,38] Twenty one studies included outdoor cricket players,[2,3,5,7,8,15,16,28,29,31-37,39-42,44] and two studies included both indoor and outdoor cricket players.[30,43] Eighteen studies did not indicate the formats of cricket played by the participants.[3,5,15,16,29-38,40-43] Multiple formats of cricket were reported in three studies,[2,7,28] one study only included one-day cricket (50 overs),[39] and one study only included T20 cricket[8] (Appendix III).

Review findings

Injury definitions

Injury definitions varied across the studies. Eighteen studies used their own definitions. Seven studies[2,7,8,28,30,31,39] reported time-loss and non-time-loss injuries in accordance with the 2005[25] or the 2016[19] update of the International Consensus Statement. Nine studies[2,3,30,36,37,40-43] reported medical-attention injuries. Four studies[5,7,37,39] used a modified injury definition derived from the 2016 update of the International Consensus Statement.[19] Three studies[2,8,28] used the exact definition of an injury as

Table 3: Critical appraisal of eligible prevalence studies

	Study (first author)															
Item	Basketter[7]	Bipasha[5]	Bullock[33]	Cai[32]	Cowan[39]	Goggins[28]	Hecimo-vich[38]	Murphy[35]	Paul[31]	Perera[30]	Perera[2]	Phillips[29]	Shah[34]	Stuelcken[15]	Stuelcken[16]	Total %
1. Was the sample frame appropriate to address the target population?	N	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	N	67%
2. Were study participants sampled in an appropriate way?	Y	N	Y	Y	Y	Y	U	Y	N	Y	Y	Y	Y	N	N	67%
3. Was the sample size adequate?	N	N	Y	Y	Y	Y	Y	Y	U	Y	Y	Y	Y	N	N	67%
4. Were the study subjects and the setting described in detail?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%
5. Was the data analysis conducted with sufficient coverage of the identified sample?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%
6. Were valid methods used for the identification of the condition?	Y	Y	Y	Y	Y	Y	Y	Y	U	Y	Y	Y	Y	Y	Y	93%
7. Was the condition measured in a standard, reliable way for all participants?	Y	Y	Y	Y	Y	Y	Y	Y	U	Y	Y	Y	Y	Y	Y	93%
8. Was there appropriate statistical analysis?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%
9. Was the response rate adequate, and if not, was the low response rate managed appropriately?	U	Y	N	N	Y	Y	Y	Y	Y	Y	N/A	N/A	N	Y	Y	60%
Score	**6/9**	**6/9**	**8/9**	**8/9**	**9/9**	**9/9**	**7/9**	**9/9**	**5/9**	**9/9**	**8/8**	**8/8**	**8/9**	**6/9**	**6/9**	
Risk of bias	Low	Low	Low	Low	Low	Low	Low	Low	Moderate	Low	Low	Low	Low	Low	Low	

Y, Yes; N, No; U, Unclear; N/A, Not applicable; JBI critical appraisal instrument for studies reporting prevalence data

Table 4: Critical appraisal of eligible cohort studies

Item	Study (first author)				
	Brooks[37]	Hill[36]	Perera[3]	Warren[8]	Total %
1. Were the two groups similar and recruited from the same population?	Y	Y	Y	Y	100%
2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?	N	Y	N	Y	50%
3. Was the exposure measured in a valid and reliable way?	Y	Y	Y	Y	100%
4. Were confounding factors identified?	Y	Y	Y	Y	100%
5. Were strategies to deal with confounding factors stated?	U	Y	Y	Y	75%
6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	N	Y	N	Y	50%
7. Were the outcomes measured in a valid and reliable way?	Y	Y	Y	Y	100%
8. Was the follow-up time reported and sufficient to be long enough for outcomes to occur?	Y	Y	Y	Y	100%
9. Was follow-up complete, and if not, were the reasons to loss to follow-up described and explored?	N	Y	N	Y	50%
10. Were strategies to address incomplete follow-up utilized?	N/A	Y	N/A	Y	50%
11.Was appropriate statistical analysis used?	Y	Y	Y	Y	100%
Score	**6/10**	**11/11**	**7/10**	**11/11**	
Risk of bias	Moderate	Low	Low	Low	

Y, Yes; N, No; U, Unclear; N/A, Not applicable; JBI critical appraisal checklist for cohort studies

Table 5: Critical appraisal of eligible case series

Item	Study (first author)				
	Kodikara[42]	McLeod[43]	Perera[41]	Saw[40]	Total %
1. Were there clear criteria for inclusion in the case series?	Y	Y	Y	Y	100%
2. Was the condition measured in a standard, reliable way for all participants included in the case series?	Y	Y	Y	Y	100%
3. Were valid methods used for identification of the condition for all participants included in the case series?	Y	Y	Y	Y	100%
4. Did the case series have consecutive inclusion of participants?	N	N	N	Y	25%
5. Did the case series have complete inclusion of participants?	N	N	N	N	0%
6. Was there clear reporting of the demographics of the participants in the study?	Y	Y	Y	Y	100%
7. Was there clear reporting of clinical information of the participants?	Y	N	Y	Y	75%
8. Were the outcomes or follow-up results of cases clearly reported?	N	Y	Y	Y	75%
9. Was there clear reporting of the presenting site(s)/clinic(s) demographic information?	Y	Y	Y	Y	100%
10. Was statistical analysis appropriate?	Y	Y	Y	Y	100%
Score	**7/10**	**7/10**	**8/10**	**9/10**	
Risk of bias	Low	Low	Low	Low	

Y, Yes; N, No; JBI critical appraisal checklist for case series

defined by the 2016 update of the International Consensus Statement.[19] Five studies[3,36,41-43] used a definition or diagnosis given by health care professionals and/or as recorded in medical records. One study[31] did not use an injury definition (Appendix III).

Injury prevalence

Overall injury prevalence

Annual injury prevalence for a 365-day period[19] was reported by six studies[15,28,30,35,39,40] and ranged from 7.7% in English international pathway players[28] to 93.3% in Australian elite players[2] over two years. General injury prevalence was reported by two studies[32,33] using a combination of community to elite-level players from the United Kingdom. The overall injury prevalence ranged from 54.2%[32] to 55.4%[33] (Table 6). Both studies explored long-term injury prevalence from the same data, and the difference in injury prevalence was owing to injury definitions. Bullock *et al.*[33] reported injury data on players who sustained injuries while playing cricket, whereas Cai *et al.*[32] reported injury data on players over the age of 30 years experiencing joint pain (Table 6). Although, both studies were included in the narrative review, only the larger cohort (ie, Bullock *et al.*[33]) was included in meta-analysis 2 to avoid duplication of data.

Time-loss injury prevalence

Time-loss injuries ranged from 4.1%[28] to 87.5%.[7] Of these, 34% of players missed less than three days of practice[39] and 35% of players missed four to seven days.[39] Further, 28.1% of players missed more than five days of training,[30] 14% of the players missed one or two matches,[30] and 10.3% missed more than five matches[30] (Table 6).

Non-time-loss injury prevalence

Non-time-loss injuries ranged from 0.7%[28] to 79.8%.[2] Non-time-loss injuries affected 4.1% of players but they were available to play, while 0.7% of injured players participated in modified sports activities.[28] Self-reported worst injury led to 41.7% non-time-loss injuries for training, and 66.4% nontime-loss injuries for matches.[30] At the elite level, 79.8% injuries did not lead to time-loss[2] (Table 6).

Medical-attention injury prevalence

Medical-attention injuries were reported in seven studies.[2,3,30,36,37,40,41] Medical-attention injuries accounted for 100% of all injuries sustained in five studies.[2,3,37,40,41] Two studies reported the percentage of players with medical-attention injuries ranged from 43%[30] to 92.5%[7] of all injuries sustained (Table 6).

All-complaint injury prevalence

Only one study[28] used an “all-complaint” injury definition and reported annual all-complaint injury prevalence of 8.4%. It should be noted that “all-complaint” injury definition includes medical illnesses (Table 6).

Injury prevalence by player role

Injury prevalence for bowling, for studies that did not separate the bowlers into fast and slow, was 1.1%[28] to 53.8%.[15] The prevalence of injuries in fast bowlers was 7.7%[8] to 53.8%[15] and in slow bowlers was 1.9%[8] to 5.8%[7] (Table 7). Injury prevalence for fielding was 2.3%[28] to 18.6%.[39] Injury prevalence for batting was 0.9%[28] to 26.9%,[7] and for wicketkeeping 0.2%[28] to 8.0%[7] (Table 7).

Percentage of injuries distributed by player role

Two studies[5,31] reported data for injured players only, rather than uninjured players as needed for injury prevalence calculations. The percentage of injuries were distributed among the player roles: bowlers (24.6%[31] to 41.2%[5]), batters (21.1%[31] to 41.2%[5]), followed by wicketkeepers (12.3%[31] to 17.7%[5]). Further, 42.1% injuries were in all-rounders who bat and bowl[31] (Table 7).

Distribution of injuries sustained by body region

The shoulder was the most frequently injured (3.7%[39] to 31.4%[30]) body region followed by the ankle, foot, and toes (3.7%[39] to 23%[30]). The third most prevalent body region was the lower back (7.4%[39] to 22%[30]). The general prevalence of studies that only investigated lower back pain ranged from 34.6%[38] in youth athletes to 53.9%[15] in elite fast bowlers. The general prevalence of knee pain in children was 75%.[29] The annual injury prevalence for head impacts over a five-year study period was 10.4%[40] (Table 8 and Figure 2).

Injury incidence

Overall injury incidence

Mean annual injury incidence of England pathway cricketers was 182.5 injuries per 100 players per year.[28] Mean annual incidence of self-reported worst injury in Australian elite and recreational cricket players was 798.6 injuries per 1000 participants.[30] The mean annual injury incidence of insurance claims in New Zealand over 10 years was 25.7 claims per 100,000 population.[43] The mean annual

Table 6: Injury prevalence and incidence of women's cricket injuries

Article	All players	Players injured	Injuries recorded	Time-loss injuries	Non-time-loss injuries	Medical-attention injuries	Prevalence (%)	Incidence
Basketter[7]	52	28	40	87.5% (40% [<7 days], 15% [8-30 days], 10% [31-90 days], 22.5% [>91 days])	12.5%	92.5%	53.8% annual injury prevalence (one season)	
Bipasha[5]	51	51						
Brooks[37]		27	27			100%		0.7 per 100,000 balls per player, 9.7 per 100,000 balls per team *hand fractures only
Bullock[33]	65	36					55.4% general injury prevalence	
Cai[32]	24	13					54.2% general injury prevalence	
Cowan[39]	56	26	27	85% total (34% [1-3 days], 35% [4-7 days], 8% [8-14 days], 8% [22 days])	15%		48.2% annual injury prevalence	
Goggins[28]	83		182.5	4.1% match time loss 2.3% players unavailable on any given day 31.2 per 100 players per year (mean annual injury incidence)	4.4% injured available 0.7% injured modified activity 151.3 per 100 players per year (mean annual injury incidence)		7.7% annual injury prevalence (4 seasons) 8.4% annual complaint injury prevalence	7.0 match time loss injuries/per 1000 player match days 182.5 per 100 players per year (mean annual injury incidence) 229.4 annual complaint incidence per 100 players per year
Hecimovich[38]	26	9	9				34.6% *lower back only	
Hill[36]	106		15			100%		3.7 head impacts per 1000 player days *head impacts only
Kodikara[42]			324			100%		0.4 head impacts per 1000 participants *head impact only
McLeod[43]			5430			100%		25.6 injury incidence rate per 100,000 participants (mean annual incidence, 10 seasons)
Murphy[35]	115	14	14				12.2% *shoulder only	
Paul[31]	57	57		56.1% total (28.7% [1-7 days], 19.3% [10-20 days], 8.8% [25-45 days])	43.9%		N/A	
Perera[3]			108			100%		1.3 per 10,000 registered players (mean annual injury incidence)

Table 6: (*Continued*)

Article	All players	Players injured	Injuries recorded	Time-loss injuries	Non-time-loss injuries	Medical-attention injuries	Prevalence (%)	Incidence
Perera[30]	164	109	114	Training: 19.8% (1-2 sessions), 28.1% (≥5 days) Matches: 14% (1-2), 10.3% (≥5)	41.7% (training) 66.4% (matches)	43%	66.5% annual injury prevalence	798.6 injuries per 1000 participants (mean annual injury incidence)
Perera[2]	121	113	600	20.2% 79.3 per 10,000 player hours	79.8% 345.4 per 10,000 player hours	100%	93.3% annual injury prevalence (2 seasons)	424.7 per 10,000 player hours (mean annual injury incidence, 2 seasons)
Perera[41]			668 (547 ED, 121 hospital)			100%		1.5 ED-presentations per 1000 participants (mean annual incidence, 12 seasons) 0.3 hospital admissions per 1000 participants (mean annual incidence, 12 seasons)
Phillips[29]	8	6	6				75% *knee only	
Saw[40]	183		19			100%	10.4% annual injury prevalence (5 seasons) *head impacts only	19 (1 per 2633 overs) (mean annual injury incidence, 5 seasons) *head impacts only
Shah[34]	43	3	3				7.5% *hand only	
Stuelcken[14]	26	14	14				53.9% *lower back only	
Stuelcken[15]	26	12	12				46.2% *shoulder only	
Warren[8]	171		137	14.6% total (4.6% unavailable for match selection) 2.1 time-loss injuries per 100 match days (mean annual injury incidence)	85.4% 12.2 non-time-loss injuries per 100 match days (mean annual injury incidence)		4.6% of players were unavailable for match selection	14.2 total injuries per 100 match days (mean annual injury incidence)

ED, emergency department; N/A, not applicable

Table 7: Injury prevalence for women's cricket by player role

Article	Total players	Batting	Bowling (fast/slow)	Fielding	Wicketkeeper	All-rounder
Basketter[7]	52	**26.9%**	19.2% (13.5% fast, 5.8% slow)		8%	
Cowan[39]	56	10.2%	8.8%	**18.6%** (11.6% field, 7% catch)		
Goggins[28]	83	0.9%	1.1%	**2.3%**	0.2%	
Hecimovich[38]	9		**34.6%** (knee only)			
Stuelcken[14]	26		**53.8%** (fast bowlers, lower back only)			
Stuelcken[15]	26		**46.5%** (fast bowlers, shoulder only)			
Warren[8]	171	3.9%	9.6% (7.7% fast, 1.9% slow)	15%	0.9%	
Distribution of injuries as percentages, not prevalence data as all cohorts were injured:						
Bipasha[5]	51 (all cohorts were injured)	**41.2%**	**41.2%**		17.7%	
Paul[31]	57 (all cohorts were injured)	21.1%	**24.6%**		12.3%	**42.1%**

Percentages in bold indicate the highest % per article.

incidence of hospital-treated cricket injuries in Australia was 1.5 emergency department (ED) presentations per 1000 participants and 0.3 hospital admissions per 1000 participants over 12 seasons.[41] The mean annual incidence of injuries that led to successful insurance claims was 1.3 injuries per 10,000 players[3] (Table 6). Australian elite cricketers reported a mean annual injury incidence of 424.7 injuries per 10,000 player hours over two seasons,[2] and the mean annual injury incidence in professional English players was 14.2 total injuries per 100 match days[8] (Table 6).

Time-loss injury incidence

The annual incidence of time-loss injuries ranged from 31.2 injuries per 100 players per year[28] to 79.3 injuries per 10,000 player hours.[2] The match time-loss ranged from 7.0 match time-loss injuries per 1000 player match days[28] to 2.1 time-loss injuries sustained per 100 match days[8] (Table 6).

Non-time-loss injury incidence

The non-time-loss injuries ranged from 151.3 injuries per 100 players per year[28] to 345.4 injuries per 100,000 player hours.[2] The match non-time-loss injuries were 12.2 injuries per 100 match days[8] (Table 6).

Medical-attention injury incidence

All the injuries presented in a detailed case series were medical-attention injuries with 1.9 injured cases per 1000 participants over 12 years.[41] The incidence of hand fractures was 0.7 injuries per 100,000 balls per player.[37] The incidence of head impact injuries was 3.7 per 1000 player days[36] and also one head impact per 2633 overs.[40] The incidence of head, neck, and facial cricket injuries was 0.4 per 1000 participants.[42] The incidence of successful insurance claims was 1.3 claims per 10,000 registered players over a 10-year period in Australia[3] and 25.6 per 100,000 population in New Zealand[43] (Table 6).

All-complaint injury incidence

Annual incidence of all-complaint injuries in elite English cricketers was 229.4 injuries per 100 players per year over five years.[28] It should be noted that the total "all-complaint" injuries include medical illnesses (Table 6).

Injury incidence by player role

Injury incidence for fielding ranged from 20.2%[43] to 74.9%.[37] Injury incidence for bowlers ranged from 18.7%[28] to 54.2%.[43] Injury incidence was 24.8%8 to 28.9%[2] for fast bowlers and 5.9%[8] to 8%[2] for slow bowlers. Injury incidence for batting was 10.1%[37] to 57.9%.[40] Injury incidence for all-rounders who bowl and bat was 38.5%[8] to 41.2%.[37] Injury incidence for wicketkeepers ranged from 3%[8] to 7.9%[30] (Table 9).

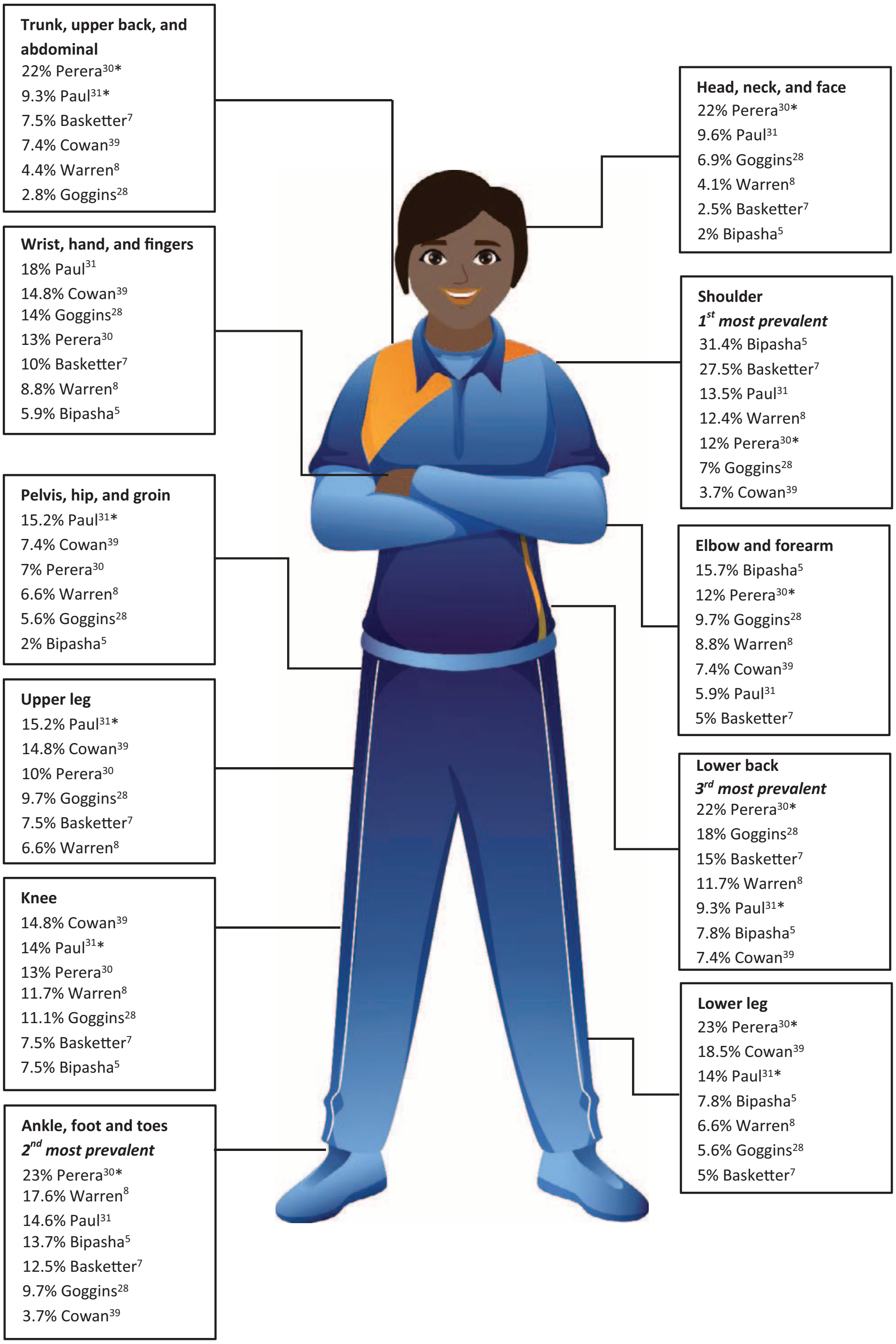
Distribution of injuries sustained by body region

Injury incidence was highest for wrist, hand, and fingers (12%[8] to 29%[41]), knee (9.1%[2] to 24%[3]), and head, neck, and face (4.2%[8] to 28%[41]). Injuries to the wrist, hand, and fingers were the most

Table 8: Injury prevalence of women's cricket by body region

Article	Player role (injured players)	Head/ neck face	Trunk/back/ abdominal	Shoulder	Elbow/ forearm	Wrist/ hand/ fingers	Lower back	Pelvis/ hip/ groin	Upper leg	Knee	Lower leg	Ankle/foot/ toes
Basketter[7]	All (40)	2.5%	7.5%	**27.5%**	5%	10%	15%		7.5%	7.5%	5%	12.5%
Bipasha[5]	All (51)	2%		**31.4%**	15.7%	5.9%	7.8%	2%		7.8%	7.8%	13.7%
	Bowler			**16.4%**	5.5%		1.8%	3.3%	3.3%	1.8%		3.3%
	Batter			**12.7%**	5.5%		1.8%		8.7%	5.5%		7.3%
	Wicketkeeper	1.8%		1.8%	3.63%	**5.5%**	1.8%	1.8%				
Cowan[39]	All (27)		7.4%	3.7%	7.4%	14.8%	7.4%	7.4%	14.8%	14.8%	**18.5%**	3.7%
Goggins[28]	All (83)	6.9%	2.8%	7%	9.7%	14%	**18%**	5.6%	9.7%	11.1%	5.6%	9.7%
Hecimovich[38]	Bowlers (9)						9 (100%)					
Murphy[35]	All (14)			14 (100%)								
Paul[31]	All (57)	9.6%	*combined with lower back	13.5%	5.9%	**18%**	*9.3%	*15.2%	*combined with hip	14%	*combined with knee	14.6%
	Bowler	2.5%	*combined with lower back	3.9%	1.4%	**4.8%**	*1%	*3.7%	*combined with hip	3.4%	*combined with knee	3.9%
	Batter	1.7%	*combined with lower back	2.8%	2.3%	**3.9%**	*2%	*3.4%	*combined with hip	3.4%	*combined with knee	3%
	Wicketkeeper	2%	*combined with lower back	1.1%	1%	**2.5%**	*1.7%	*1.7%	*combined with hip	1.1%	*combined with knee	2%
Perera[30]	All (14)	*22%	*combined with head/neck	*12%	*combined with shoulder	13%	*combined with head/ neck	7%	10%	13%	***23%**	***combined with lower leg**
Phillips[29]	All (6)									100%		
Shah[34]	All (3)	100%										
Stuelcken[14]	All bowler (14)						100%					
Stuelcken[15]	All bowler (12)			100%								
Warren[8]	All (137)	4.1%	4.4%	**12.4%**	8.8%	8.8%	11.7%	6.6%	6.6%	11.7%	6.6%	17.6%

Percentages in bold indicate the highest % per article.
*distributed as percentages (%) and not as prevalence totals



*results were grouped with other body regions

(totals are displayed as percentages of all injuries by body regions, not as prevalence calculations)

Figure 2: Injury prevalence of women's cricket by body region

commonly sustained by wicketkeepers and fielders (Table 10). Injury incidence by body region is summarized in Figure 3.

Meta-analyses

Meta-analysis 1: injury incidence rate as the effect size

The three studies[2,8,28] included in meta-analysis 1 (Table 11) received high critical appraisal scores, indicating a low risk of bias. The pooled estimate overall injury IR was 71.9 (SE 21.3, 95% CI 30.2–113.6, $P < 0.01$) injuries per 1000 player hours (meta-analysis 1a; Figure 4). Meta-analysis 1a scored low heterogeneity ($I^2 = 8.4\%$). The pooled estimate for the weighted time-loss injury IR was 13.3 (SE 4.4, 95% CI 4.6–22.0, $P < 0.01$) injuries per 1000 player hours (meta-analysis 1b; Figure 5). Meta-analysis 1b scored low heterogeneity ($I^2 = 29.1\%$). The pooled estimate of the weighted non-time-loss injury IR was 58.5 (SE 16.9, 95% CI 25.6–91.7, $P < 0.01$) injuries per 1000 player hours (meta-analysis 1c; Figure 6). Meta-analysis 1c scored low heterogeneity ($I^2 = 2.3\%$).

The formula used for standard error is as follows[3]:

$$SE = \frac{Upper\ limit\ of\ 95\%\ CI - Lower\ limit\ of\ 95\%\ CI}{3.92}$$

Meta-analysis 1a

$$\mathrm{SE} = \frac{113.6 - 30.2}{3.92} = 21.3$$

Meta-analysis 1b

$$\mathrm{SE} = \frac{22.0 - 4.6}{3.92} = 4.4$$

Meta-analysis 1c

$$\mathrm{SE} = \frac{91.7 - 25.6}{3.92} = 16.9$$

Meta-analysis 2: injury prevalence proportions as the effect size

The five studies[2,7,30,33,39] included in meta-analysis 2 (Table 12) received high critical appraisal scores, indicating a low risk of bias. The pooled estimate of the general injury PP was 65.2% (SE 9.3, 95% CI 45.7–82.3, $P < 0.01$; meta-analysis 2a). Meta-analysis 2a scored high heterogeneity ($I^2 = 94.1\%$). Sensitivity analyses were conducted by eliminating studies[2,30] with larger sample sizes, and the heterogeneity was reduced ($I^2 = 0\%$; Figure 7). Subgroup analyses were performed per level of play; community to elite levels were included in meta-analysis 2a, and community levels (excluding elite-only studies) were included in meta-analysis 2b. The injury PP for community levels was 60% (SE 4.5, 95% CI 51.1–68.6, $P < 0.01$) with moderate heterogeneity ($I^2 = 50\%$; meta-analysis 2b; Figure 8).

Meta-analysis 2a

$$\mathrm{SE} = \frac{82.3 - 45.7}{3.92} = 9.3$$

Meta-analysis 2b

$$\mathrm{SE} = \frac{68.6 - 51.1}{3.92} = 4.5$$

Meta-analysis 3: injury incidence proportions as the effect size

The three studies[3,41,43] with community-level cricket data included in meta-analyses 3 (Table 13) received high critical appraisal scores, indicating a low risk of bias. The pooled estimate of the general injury IP was 5.6 (SE 4.4, 95% CI 0.1–18.3, $P < 0.01$) injuries per 10,000 participants (Figure 9). Meta-analysis 3 scored high heterogeneity ($I^2 = 100\%$) and sensitivity analyses were not possible due to the limited studies pooled in the meta-analysis.

Meta-analysis 3

$$\mathrm{SE} = \frac{18.3 - 0.1}{3.92} = 4.4$$

Discussion

The main findings of this study were as follows: i) the overall injury IR for elite women's cricketers was 71.9 injuries per 1000 player hours with a time-loss injury IR of 13.3 injuries per 1000 player hours and nontime-loss injury IR of 58.5 injuries per 1000 player hours; ii) the overall injury PP for community to elite level was 65.2% and injury PP for community levels was 60%; iii) the overall injury IP for community level was 5.6 injuries per 10,000 participants; iv) hand, wrist, and fingers had highest injury

Table 9: Injury incidence for women's cricket by player role

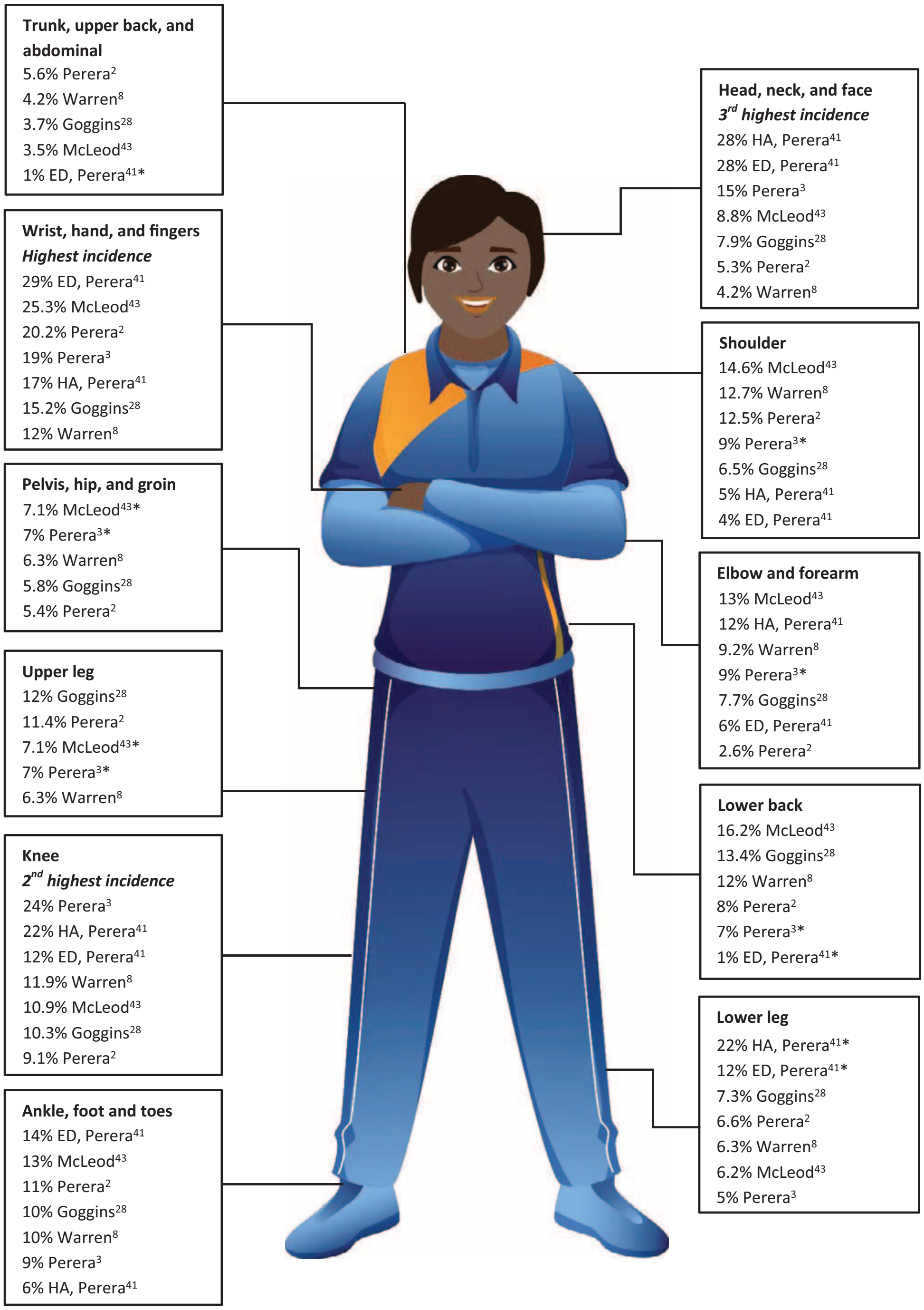
Article	Cricket role	Total injury incidence/ injuries recorded	Distribution of injuries among different player roles
Brooks[37]	Batting	2 per 100,000 balls per team 1 per 100,000 balls per player *hand fractures only	10.1% *hand fractures only
	Fielding	14.4 per 100,000 balls per team 1.4 per 100,000 balls per player *hand fractures only	**74.9%** *hand fractures only
	Wicketkeeper	2.9 per 100,000 balls per team 2.9 per 100,000 balls per player *hand fractures only	15% *hand fractures only
Goggins[28]	Batting	22.7 per 100 players per year	21.8%
	Bowling	19.5 per 100 players per year	18.7%
	Fielding	56.4 per 100 players per year	**54.1%**
	Wicketkeeper	5.6 per 100 players per year	5.3%
McLeod[43]	Batting	277 claims	20.8%
	Bowling	723 claims	**54.2%**
	Fielding	270 claims	20.2%
	Wicketkeeper	65 injuries	4.9%
Perera[3]	Batting	52 injuries recorded	**48%**
	Fielding	41 injuries recorded	38%
	Wicketkeeper	8 injuries recorded	7%
Perera[30]	Batting	18 injuries recorded	15.8%
	Bowling	38 injuries recorded (31 fast, 9 slow)	35.1% (27.2% fast, 7.9% slow)
	Wicketkeeper	9 injuries recorded	7.9%
	All-rounder	47 injuries recorded	**41.2%**
Perera[2]	Batting	121 injuries recorded	20.7%
	Bowling	216 injuries recorded (169 fast, 47 slow)	36.9% (28.9% fast, 8% slow)
	Wicketkeeper	22 injuries recorded	3.8%
	All-rounder	225 injuries recorded	**38.5%**
Saw[40]	Batting	11 (1 per 2633 overs) *head impacts only	**57.9%** *head impacts only
	Fielding	8 (1 per 2633 overs) *head impacts only	42.1% *head impacts only
Warren[8]	Batting	1.5 per 100 match days	14.9%
	Bowling	3.1 per 100 match days (2.5 fast, 0.6 slow)	30.7% (24.8% fast, 5.9% slow)
	Fielding	5.2 per 100 match days	**51.5%**
	Wicketkeeper	0.3 per 100 match days	3%

Percentages in bold indicate the highest % per article.

Table 10: Injury incidence of women's cricket by body region

Article	Cricket role (injuries sustained)	Head/neck/ face	Trunk/ back/ abdominal	Shoulder	Elbow/ forearm	Wrist/ hand/ fingers	Lower back	Pelvis/hip/groin	Upper leg	Knee	Lower leg	Ankle/foot/ toes
Brooks[37]	All (27)					100%						
Goggins[28]	All (184.4)	7.9%	3.7%	6.5%	7.7%	**15.2%**	13.4%	5.8%	12%	10.3%	7.3%	10.2%
Hill[36]	All (3.7)	100%										
Kodikara[42]	All (324)	100%										
McLeod[43]	All (3046)	8.8%	3.5%	14.6%	13%	**25.3%**	16.2%	*combined with upper leg	*7.1%	10.9%	6.2%	13.4%
	Bowler	6.8%	11.5%	20.5%	2.4%	2.2%	**24.8%**	*combined with upper leg	*6.4%	12%	2.9%	13.3%
	Batter	14.5%	5%	8.3%	5.7%	**16.2%**	13.4%	*combined with upper leg	*10.5%	10.5%	3.2%	14.1%
	Fielder	9.7%	6%	8.1%	4.7%	**19.3%**	6.7%	*combined with upper leg	*10.4%	16.3%	5.6%	13.9%
	Wicketkeeper	16.8%	6%	7.7%	3%	**33.8%**	9.2%	*combined with upper leg	*3%	10.8%	3%	6%
Perera[3]	All (108)	15%		*9%	*combined with shoulder	19%	7%	*combined with upper leg	*7%	**24%**	5%	9%
Perera[2]	All (351)	5.3%	5.6%	12.5%	2.6%	**20.2%**	8%	5.4%	11.4%	9.1%	6.6%	10.8%
	Bowler		2.3%			1.7%	3.1%			2.3%	1.4%	**4.3**%
	Batter			2%		2.8%	2.8%	1.4%	**4.8%**	2.3%	2.6%	3.1%
	Fielder	1.4%		9.1%	1.4%	**13.7%**	2%	1.4%	4%	3.7%	2.6%	
	Wicketkeeper					2%			1.4%			**2.8%**
Perera[41]	Emergency department (547)	28%	*1%	4%	6%	**29%**	*combined with trunk/ abdominal			*12%	*combined with knee	14%
	Hospital admissions (121)	28%		5%	12%	**17%**				*22%	*combined with knee	6%
Saw[40]	All (19)	100%										
Warren[8]	All (14.2)	4.2%	4.2%	12.7%	9.2%	**12%**	12%	6.3%	6.3%	11.9%	6.3%	9.9%

Percentages in bold indicate the highest % per article.
*distributed as percentages (%) and not as incidence totals



*results were grouped with other body regions
ED = emergency department
HA = hospital admissions
(distributed as percentages and not as incidence calculations)

Figure 3: Injury incidence of women's cricket by body region

Table 11: Incidence rates for elite women's cricket injury (meta-analysis 1)

First author	All squad members	Seasons of play	Total exposure hours	Total number of injuries	Injury IR (logits)	95% confidence intervals	Injury IR per 1000 player hours	95% confidence intervals
Overall injury IR:								
Goggins[28]	83	4	4083.8	472	0.1156	(0.1052, 0.1260)	115.6	(105.2, 126.0)
Perera[2]	121	2	5297.7	225	0.0425	(0.0369, 0.0480)	42.5	(36.9, 48.0)
Warren[8]	171	1	2352.8	137	0.0582	(0.0485, 0.0680)	58.2	(48.5, 68.0)
Pooled total	**375**	**7**	**11,734.3**	**834**	**0.0719**	**(0.0302, 0.1136)**	**71.9**	**(30.2, 113.6)**
Time-loss injury IR:								
Goggins[28]	83	4	4083.8	98	0.0240	(0.0192, 0.0287)	24.0	(19.2, 28.7)
Perera[2]	121	2	5297.7	42	0.0079	(0.0055, 0.0103)	7.9	(5.5, 10.3)
Warren[8]	171	1	2352.8	20	0.0085	(0.0048, 0.0122)	8.5	(4.8, 12.2)
Pooled total	**375**	**7**	**11,734.3**	**160**	**0.0133**	**(0.0046, 0.0220)**	**13.3**	**(4.6, 22.0)**
Non-time-loss injury IR:								
Goggins[28]	83	4	4083.8	374	0.0916	(0.0823, 0.1009)	91.6	(82.3, 100.9)
Perera[2]	121	2	5297.7	183	0.0345	(0.0295, 0.0395)	34.5	(29.5, 39.5)
Warren[8]	171	1	2352.8	117	0.0497	(0.0407, 0.0587)	49.7	(40.7, 58.7)
Pooled total	**375**	**7**	**11,734.3**	**674**	**0.0585**	**(0.0254, 0.0915)**	**58.5**	**(25.4, 91.5)**

IR, incidence rate

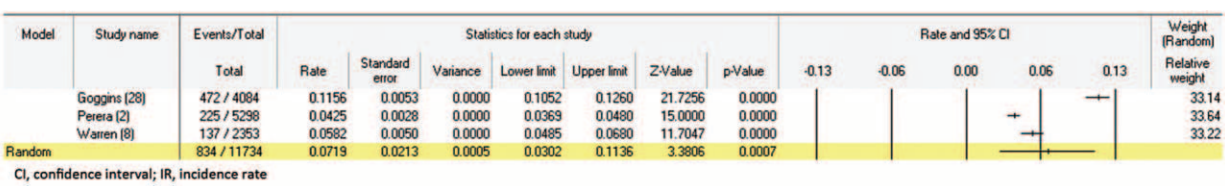


Figure 4: Overall injury incidence rate for elite women's cricket per 1000 player hours (meta-analysis 1a)

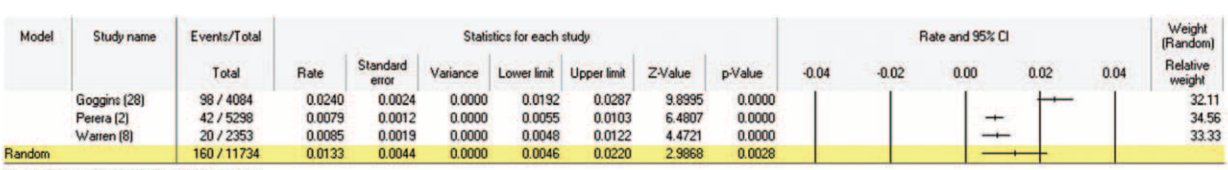
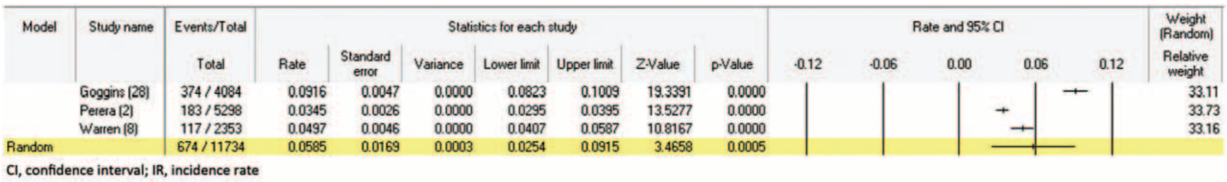


Figure 5: Time-loss injury incidence rate for elite women's cricket per 1000 player hours (meta-analysis 1b)

incidence ranging from 12%[8] to 29%[41]; v) injuries to shoulders (3.7%[39] to 31.4%[30]), knees (9%[2] to 24%[3]), and ankles, feet, and toes (3.7%[39] to 23%[30]) were prevalent; vi) prevalence of injuries in fast bowlers was the highest per role ranging from 7.7%[8] to 53.8%[15]; and vii) fielders reported the highest incidence of injuries per role ranging from 20.2%[43] to 74.9%[37] of all injuries sustained.

Data collection methods varied across the studies included in this review; some included self-administered questionnaires,[5,7,15,29-34] data from hospital records and/or insurance claims,[3,41-43] and data from injury surveillance systems.[2,8,28,36,37,39,40] Nine studies[5,7,15,29-34] relied on participants to recall data on previous injuries and complete self-report questionnaires, resulting in reporting bias.[45] Further,



Model	Study name	Events/Total Total	Rate	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value	Rate and 95% CI	Weight (Random) Relative weight
	Goggins (28)	374 / 4084	0.0916	0.0047	0.0000	0.0823	0.1009	19.3391	0.0000		33.11
	Perera (2)	183 / 5298	0.0345	0.0026	0.0000	0.0295	0.0395	13.5277	0.0000		33.73
	Warren (8)	117 / 2353	0.0497	0.0046	0.0000	0.0407	0.0587	10.8167	0.0000		33.16
Random		674 / 11734	0.0585	0.0169	0.0003	0.0254	0.0915	3.4658	0.0005		

CI, confidence interval; IR, incidence rate

Figure 6: Non-time-loss injury incidence rate for elite women's cricket per 1000 player hours (meta-analysis 1c)

18 studies[3,7,15,16,29,30,32-43] used their own injury definitions rather than the definitions set out by the 2016 edition of the International Consensus Statement.[19] In addition, injury diagnosis from different medical health professionals and/or the scarcity of resources (under certain circumstances) needed for accurate injury diagnosis might have increased the risk of incorrect diagnosis or documentation of injury data.

Although the different methods of data collection bring together a variety of records across a wide range of cohorts, standardized injury definitions[19] and data collection methods are of great importance for reducing reporting bias[45] and can be effectively applied across all settings. Two studies[31,37] included in this review produced critical appraisal scores of 5/9[31] and 6/10,[37] indicating moderate risk of bias. To reduce publication bias, researchers (JJ and MD) recalculated the injury data calculations presented by these studies to make sure the results aligned with the standards of the 2016 edition of the International Consensus Statement.[19] This review did not make any direct conclusions from these two studies, and they were not included in the meta-analyses due to a lack of data required for the calculations, rather than being excluded based on their critical appraisal scores. As a result, only studies with a low risk of bias were included in the meta-analyses.

Injury rates and proportions

The weighted overall annual injury IR was 71.9 injuries per 1000 player hours in elite female cricket players. The statistical heterogeneity was low, and the data from the three studies[2,8,28] included in meta-analysis had low variability. With that in mind, high incidence of injuries for female cricketers is a concern, particularly given the short- and long-term impact of injuries.

The data included in meta-analysis 1 were published in the past five years,[2,8,28] indicating injury

Table 12: Prevalence proportions for women's cricket injury (meta-analysis 2)

First author	All squad members	Seasons of play	Injured squad members	Injury PP (logits)	95% confidence interval	Prevalence of injuries	95% confidence interval
General injury PP for community to elite cricket:							
Basketter[7]	52	1	28	0.538	(0.401, 0.673)	53.8%	(40.1, 67.3)
Bullock[33]	65	N/A	36	0.554	(0.431, 0.673)	55.4%	(43.1, 67.3)
Cowan[39]	56	1	26	0.464	(0.335, 0.596)	46.4%	(33.5, 59.6)
Perera[30]	164	1	109	0.665	(0.590, 0.735)	66.5%	(59.0, 73.5)
Perera[2]	121	2	113	0.934	(0.882, 0.972)	93.4%	(88.2, 97.2)
Pooled total	**458**	**-**	**312**	**0.652**	**(0.457, 0.823)**	**65.2%**	**(45.7, 82.3)**
General injury PP for community cricket:							
Basketter[7]	52	1	28	0.538	(0.401, 0.673)	53.8%	(40.1, 67.3)
Bullock[33]	65	N/A	36	0.554	(0.431, 0.673)	55.4%	(43.1, 67.3)
Perera[30]	164	1	109	0.665	(0.590, 0.735)	66.5%	(59.0, 73.5)
Pooled total	**281**	**-**	**173**	**0.600**	**(0.511, 0.686)**	**60.0%**	**(51.1, 68.6)**

N/A, not applicable; PP, prevalence proportion

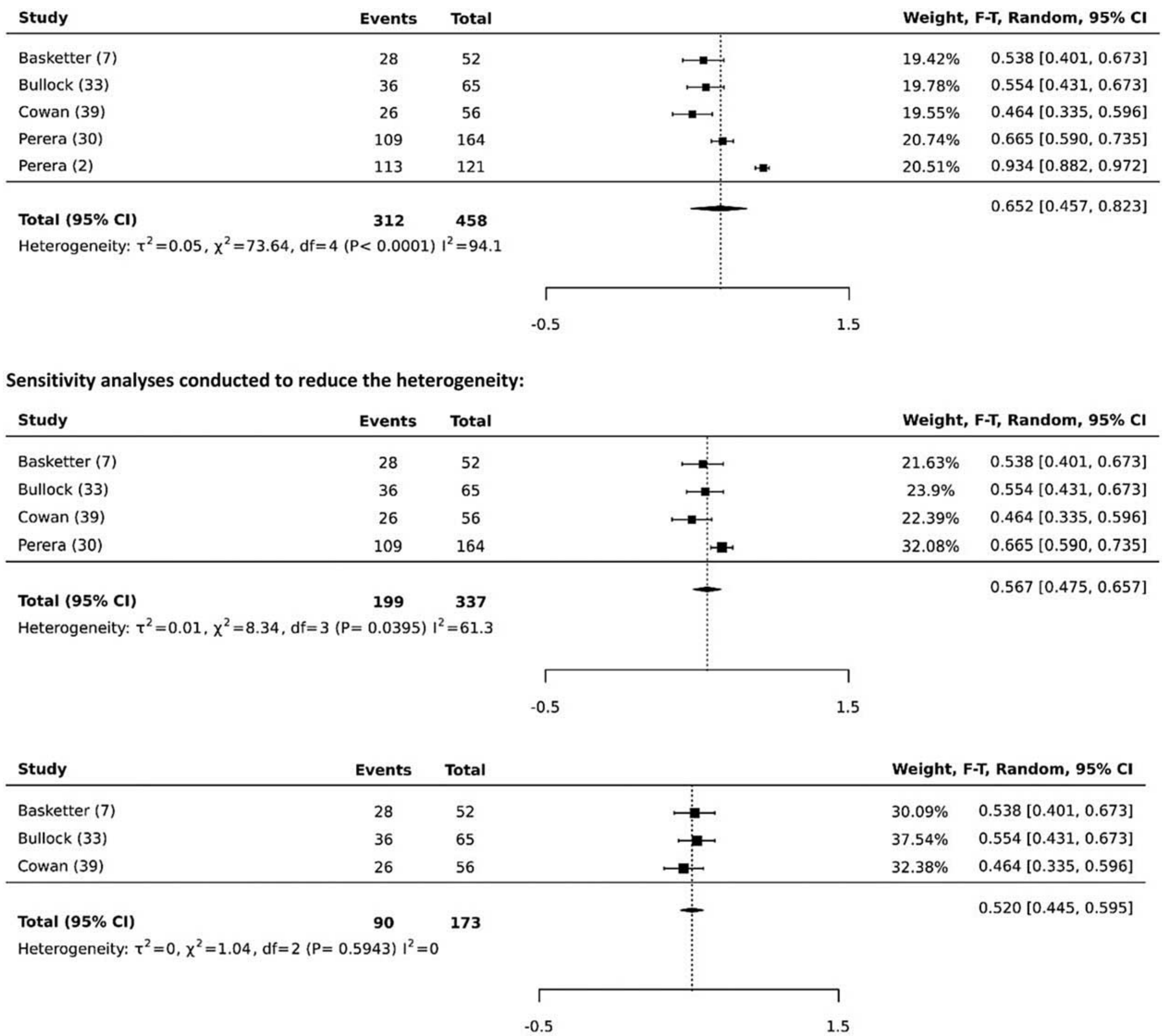


Figure 7: General injury prevalence proportion for women's cricket (meta-analysis 2a)

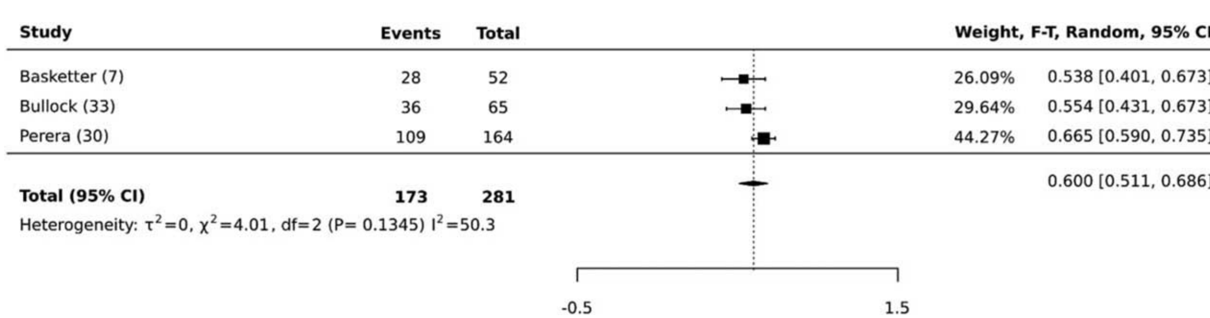


Figure 8: Injury prevalence proportion for community women's cricket (meta-analysis 2b)

Table 13: Incidence proportions for community women's cricket injury (meta-analysis 3)

First author	Total number of injuries per 100 participants	Population	Injury incidence proportions (logits)	95% confidence interval	Injury incidence per 10,000 participants	95% confidence interval
Perera[3]	10,500	835,719	0.013	(0.012, 0.013)	1.3	(1.2, 1.3)
Perera[41]	66,800	360,679	0.185	(0.184, 0.186)	18.5	(18.4, 18.6)
McLeod[42]	543,000	21,136,266	0.026	(0.026, 0.026)	2.6	(2.6, 2.6)
Pooled total	**620,300**	**22,332,664**	**0.056**	**(0.001, 0.183)**	**5.6**	**(0.1, 18.3)**

epidemiology in women's cricket is a novel and emerging field of research interest alongside the increasing popularity of the sport. Injury IR for women's bat-and-ball and ball-and-stick sports (community to elite level) was 6.2 injuries per 1000 person-days of athletic exposure,[13] greater in competition than practice (15.8 vs 3.1), and lower than for women's cricket. Comparing women cricket players to other elite female athletes (participating in soccer, basketball, and gymnastics), the injury IR of 8.6 injuries per 1000 hours of athlete exposure[46] is lower than for women's cricket.

The injury IR for men's cricket (from community to elite levels) was 5.3 injuries per 1000 player hours,[27] lower than for women's cricket. Further, the annual incidence over 10 seasons (from 2006 to 2016) in Australian elite male cricket players was 64 injuries per 100 players per season (or 13.2 injuries per 1000 player hours).[47] There is strong epidemiological evidence from team sports such as soccer, basketball, and ice hockey that injury risks vary between sexes.[48-50] This finding can be partly explained by possible physiological differences in female and male players, and differences in speed and/or style of skill acquisition. Also, factors such as skill level, bowling speed, workloads, and match fixtures are different and may influence injury risk,[6,51,52] and this warrants further exploration. The time-loss injuries in the 10 seasons was 155 injuries/1000 days of play.[47] A review[27] conducted for men's cricket did not include time-loss and non-time-loss data to compare men's and women's cricket injury rates.

The overall injury PP for community to elite level was 65.2%. The statistical heterogeneity was high and sensitivity analyses were conducted (removing the larger sample sizes) to reduce the heterogeneity (94% to 0%). The data from the three studies[2,8,28] included in meta-analysis 2 had low variability. It should be noted that the injury PP presented in this review was point or general prevalence, and owing to the constrains of the data, annual prevalence could not be calculated. We observed that the injury PPs were different between levels of play (65% community to elite vs 60% community only). In contrast to our findings, the average annual injury prevalence rate was lower for elite men's cricket at 12.5%[47] and for elite female soccer, basketball, and gymnastics athletes at 47.9% (95% CI 43.6%–52.6%).[46] As discussed previously, high prevalence of injuries can be due to factors such as skill level, bowling speed, physical development, workloads, match fixtures, and access to resources.

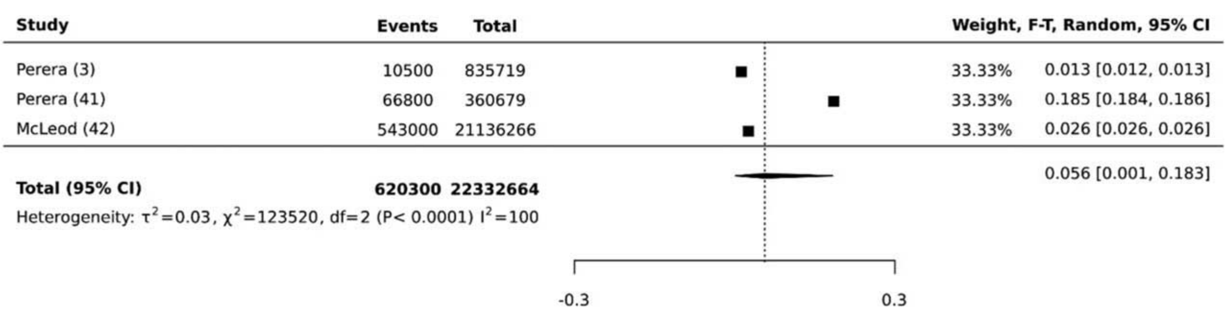


Figure 9: Injury incidence proportion for community women's cricket (meta-analysis 3)

Body region of injuries

The hand, wrist, and fingers had the highest injury incidence in this review, ranging from 12%[8] to 29%.[41] The hand, wrist, and finger injuries were the second most common injury in women playing competitive bat-and-ball and ball-and-stick sports.[13] Sports such as cricket and softball carry a high risk of injury to the hand, wrist, and fingers because of the risk of acute impact from the fast-moving ball.[53,54] Although batters wear gloves and wrist guards and wicketkeepers wear gloves, the impact of the hard ball can cause tissue damage regardless of whether the player is wearing gloves.[55] The risk of injury to the hand, wrist, and fingers[56] might be elevated in fielders because these players do not wear gloves. Given the high incidence of hand and finger injuries among female fielders, it is possible that some players' catching and fielding techniques predispose them to hand and finger injuries. More research is required to investigate these factors.

The body region most prevalent for injuries was the shoulder (3.7%[39] to 31.4%[30]). Shoulder injuries are common in athletes playing overhead striking and throwing sports, such as tennis, baseball, and handball.[57,58] The repeated use of the shoulder with the hand over the head is a typical characteristic of injuries sustained during overhead sports.[16,35,52] The glenohumeral joint (shoulder joint) is intrinsically more unstable when compared with a ball-and-socket joint such as the acetabulofemoral joint (hip joint). Thus, the shoulder is more susceptible to injury during the deceleration phase of the throwing action when a large amount of energy transfers through the joint.[59] We found shoulder injuries in women's cricket to be more prevalent among fast bowlers (3.9%[31] to 46.5%[16]) than other player roles. Similarly, male fast bowlers presented with 20.6%[47] more shoulder injuries than other cricket player roles. The rapidly moving arm is decelerated with the entire body using a kinetic chain, and the shoulder muscles produce significant compressive forces to prevent joint dislocation.[16,35] Factors such as shoulder distraction force, and alterations in the range of motion in body regions such as the shoulder, trunk, lumbar region, and hip may contribute to the risk of injury for female fast bowlers.[15,16,35] Research studies report that during the fast-bowling action, the ratio of eccentric external to concentric internal rotational strength of the shoulder is far below the standard considered sufficient for adequate joint stability and muscle control.[60] Muscle changes from repetitive use of scapular muscles can affect the scapula's position and increase the risk of shoulder injury.[61] Neuromuscular shoulder injury-prevention exercise programs[62] are specifically designed for throwing athletes to strengthen and condition the shoulder muscles, and to improve throwing mechanics.[54] Therefore, a cricket-specific neuromuscular shoulder injury-prevention exercise program can improve shoulder strength and balance, core stability, and muscle control, consequently allowing female cricket players to achieve maximum performance while minimizing the risk of an injury.

Similar to women playing competitive bat-and-ball and ball-and-stick sports,[13] lower-limb injuries to the knee (9%[2] to 24%[3]) and ankle, foot, and toes (3.7%[39] to 23%[30]) were common in women's cricket. Lower-limb injuries are also common in men's cricket and the highest injury incidence was hamstring strains.[47,63] The risk of hamstring injuries are known to be high in males,[64,65] likely because of running (eg, sprinting, sudden acceleration or deceleration while running at high speed, such as running between wickets) and jumping (eg, to field a ball). Cricket involves sudden bursts of running, rapid change of direction, and rebounding when diving to catch or stop the ball. Poor neuromuscular control and strength are established risk factors for lower-limb injuries.[66,67] Females have a higher ankle inversion-eversion range of motion and lower levels of dynamic postural control compared to males.[50] Joint laxity and hormone fluctuations predispose female athletes to lower-limb injuries;[12,48,50] for example, fluctuating levels of estrogen, progesterone, and relaxin can increase ligamentous laxity and decrease neuromuscular performance affecting integrity of the ligament.[48,50] Traumatic injuries to the joints (eg, knee, ankle) can also increase the risk of post-traumatic osteoarthritis, consequently affecting long-term cricket participation. In other sports, such as women's football, neuromuscular injury-prevention programs have reduced 27% of overall injuries and 45% ligament injuries.[68] Adequate neuromuscular control in terms of muscle recruitment and timing, and muscle strength can increase joint stability.[69]

Head, face, and neck injuries were frequently sustained by community and elite players included in this review (4%[8] to 28%[41]). Although batters were less frequently injured, the increased risk and severity of head impacts and concussion[36,40] is a concern. Being struck by a fast-moving ball during batting and fielding can be a potential injury mechanism. In countries such as Australia, it is mandatory for batters to wear a helmet in games and in practice when they are facing a pace bowler.[55] However, fielders are unlikely to wear helmets and are potentially more vulnerable to severe head injuries, which can lead to hospital presentations.[41] Given the potential severity of injury, use of protective gear, such as helmets for batters, close fielders, and wicketkeepers, should be encouraged across all levels of play.[55] Skills training, for example, in reducing visual reaction time, could also reduce the risk of injuries resulting from head impacts.[36]

Injuries sustained by player role

As discussed previously, shoulder injuries were most prevalent in female bowlers. Fast bowling involves repetitive unnatural shoulder counter-rotation, trunk lateral flexion, and extension associated with side-on, front-on, or mixed bowling actions, increasing injury risk.[16,51,70-72] Male fast bowlers are injured 20.6%[47] more frequently than slower bowlers, and high bowling workloads (eg, number of overs delivered) and spikes in bowling workloads (eg, transitioning from T20 to test cricket) have been identified as key risk factors.[73,74] Fast bowlers also have higher workloads[75,76] as they cover more distance (20% to 80% of the total distance covered) compared to other roles and have 35% less recovery time between their spells (overs), which can partly explain the heightened injury risk in this group.[71,74,77,78] Bowling techniques and associated mechanical factors, such as vertical and horizontal ground reaction forces experienced during the delivery stride, can also increase injury risk.[79,80] Fast bowlers absorb approximately five times their body weight through their front foot [81] and two times their body weight through their back foot, which transmits through the lower limb to the spine, increasing the risk of injuries to the shoulder and lower back. Factors such as shoulder distraction force and alterations in the range of motion in body regions, such as the shoulder, trunk, lumbar region, and hip, may contribute to the risk of injury for female fast bowlers.[15,16,35] An interesting finding from this review was that the injury data for women's cricket did not indicate high injury incidence or prevalence for lower back injury when compared to men's cricket. However, the most prevalent injury in elite men's cricket from 2006 to 2016 was lumbar stress fractures,[47] mostly sustained by fast bowlers. This could be a result of the increased bowling workloads,[73,74] bowling speed,[79] and skill development[57] of male cricket players compared to their female counterparts.

Players who sustained injuries while fielding ranged from 38%3 to 74.9%.[37] The common body regions injured by fielders and wicketkeepers were the hand, wrist, and fingers. Fielders catch or stop the ball with their bare hands, increasing the risk of impact of the fast-moving ball on the hand, risk of falling, and collision injuries. For example, when catching a ball, the finger might forcefully hyperextend. The force of the hyperextension can damage the volar plate ligament that maintains the structural integrity of the proximal interphalangeal joint and can cause an avulsion fracture from the force of hyperextension. Many players at the community level may be yet to develop cricket-specific skills, such as fielding, thus their risk of cricket injuries is increased as a result of shortcomings in technique and training. Therefore, female cricket players could benefit from skills training to improve their reaction time and their hand-eye coordination, which could mitigate the risk of injury.[82]

Methodological discussion

The systematic review and meta-analysis are influenced by the quality of the findings of the included studies; therefore, they are subject to the same limitations presented in each included study. For example, study design, imprecision owing to random errors from sampling variations, participant follow-up, injury definitions, data collection methods, data analysis, and reporting in the included studies can influence the methodological quality of this review. All studies included in this review were observational studies (level 3b, 4b, and 4c), providing lower-level evidence.[83] However, sufficient injury prevalence and incident data were reported in observational studies; therefore, they were suitable for our review.[23] One of the important aspects of an epidemiological study is loss to follow-up and incomplete follow-up, which can introduce bias, thus compromising the validity of the data.[84] The cumulative evidence of a systematic review may also be influenced by publication bias; it is likely that studies with positive findings are more easily published than studies that do not find an effect.

Six studies from gray literature[3,7,30,31,39,43] were included in this review and were individually assessed for their methodological quality (7/10[3], 6/9,[7] 9/9,[30] 5/9,[31] 9/9,[39] and 7/10[43]). Owing to good methodological quality, these studies were deemed reasonable to include in the results. Two independent reviewers (JJ and MD) used critical appraisal tools from JBI to assess methodological quality.[20] The inter-rater agreement between the two reviewers was moderate ($k = 0.6$). The mean score of the 15 injury prevalence studies was 7 (out of a possible 9). Furthermore, two studies[2,29] achieved a maximum score of 8/8 and four studies[28,30,35,39] achieved a maximum score of 9/9 in the JBI critical appraisal checklist for prevalence studies. The mean score of the four studies appraised as cohort studies was 8 (out of possible 11), with two studies[8,36] achieving the maximum score in the JBI critical appraisal checklist for cohort studies. Four case series[40-43] were critically appraised using the JBI critical appraisal checklist for case series and scored 7 or above out of 10.

Bias is a systematic deviation from the truth in the results that can manifest due to limitations in study design, conduct, or analysis.[85] The bias of the included studies can cause systematic error of the results, thereby over- or under-estimating the effect. Pooling flawed or biased results from different studies can compromise the credibility of systematic review findings. The methodological quality was assessed using several JBI critical appraisal tools,[20] and the risk of bias was low for 21 studies included in this review.[2,3,5,7,8,15,16,28-30,32-36,38-43] Two studies[31,37] scored moderate critical appraisal scores, indicating moderate risk of bias.[2,3,7,8,28,30,33,39,41,43] All studies included in the meta-analyses had low risk of bias. The use of concise injury definitions would produce better data, as well as consistency across different datasets, and also would enable comparison with other research. However, the injury definitions used varied across studies, with seven studies[2,5,7,8,28,37,39] using definitions consistent with the 2005 and 2016 editions of the International Consensus Statement.[19,25] It is also imperative to have a clear definition of exposure (eg, player participation, players entering/leaving cohorts) to accurately measure injury rates/incidence. Such limitations further highlight the need to follow the International Consensus Statement[19,25] to standardize and improve the quality of the data reported in women's cricket.

Our review included seven cohort studies[2,3,8,28,35-37]; however, owing to no follow-up data, it was not possible to assess the impact of loss to follow-up on the validity of studies included in this review. Clear reporting of participants entering and exiting a cohort enables calculation of loss to followup, thus should be an appropriate standard for future epidemiological studies. Such limitations further highlight the need to follow guidelines such as Strengthening the Reporting of Observational studies in Epidemiology Extension for Sport Injury and Illness Surveillance to report findings.[86] In addition, of the 23 studies included in this review, only 10 studies were included in the three meta-analyses.[2,3,7,8,28,30,33,39,41,43] This was because several studies did not report athletic exposure hours for the players, nor did they report total squad/cohort (injured and uninjured) needed for prevalence calculations that were vital to calculate effect sizes, thus limiting the number of studies included in the meta-analyses. The results from meta-analyses 1 (including their sub-group analyses) were homogenous with high precision and indicative of level 1 evidence. Meta-analysis 2 presented with high heterogeneity, due to differences in sample sizes of the studies included. Meta-analysis 3 had a high heterogeneity, because of the variation in population sizes, and should be interpreted with caution. Because this is the first review of women's cricket injuries, meta-analysis 3 was included to assist in pooling the data at the community level of women's cricket, despite their high heterogeneity.

Only seven studies[2,7,8,28,30,31,39] reported time-loss and non-time-loss injury data. However, capturing time-loss and non-time-loss injuries at the community level might be difficult due to the lack resources available. In community-level cricket, players are not closely monitored, so injuries may go unreported. It is therefore critical to tailor injury surveillance strategies and injury definitions to collect accurate data. Better understanding of the nature, body region, and mechanism of women's cricket injuries will allow for the development of evidence-based injury-prevention strategies. As a result, injury monitoring at the community level, with the assistance of cricket coaches and managers, could be a viable option.[87] However, because there are costs associated with this approach, full use must be taken of all available resources and opportunities that modern technology can provide to bridge these gaps and make injury surveillance accessible at the community level.

Previous injury is the strongest risk factor for subsequent injury to the same or another body part. However, subsequent injuries were not investigated in this review owing to the lack of available data, and this is a limitation of this review. It should be noted that multiple injuries throughout the season were reported in several incidence studies. Because of the physical demands of cricket, overuse injuries are frequent in elite male cricketers,[47,63] attributable to high workloads, high-intensity training, and rigorous match time scheduling.[47,73-75,88,89] Further, the risk of overuse injuries is greater in female athletes participating in sports compared to their male counterparts.[44] Owing to the limitations in the data, we were not able to provide a subgroup analysis of overuse injuries, thus our data may be biased toward acute injuries. Exploring burden, risk factors, and mechanisms of overuse injuries should be the focus of future studies.

Conclusions

Women's cricket injury epidemiology is a novel and emerging field of research. To our knowledge, this is the first systematic review and meta-analyses to provide a comprehensive overview of current data pertaining to women's cricket injuries from community to elite level of play. The overall injury IR for elite cricket was 71.9 injuries per 1000 player hours, the overall injury PP was 65.2%, and the injury IP for community cricket was 5.6 injuries per 10,000 participants. Elite-level players were more frequently injured than other levels of play. Injuries to the hand, wrist, and fingers; knee; lower back, ankle, foot and toes; head; and shoulder were common. Fielders (highest incidence) and fast bowlers (highest prevalence) were more frequently injured than other playing positions. Inclusion of data from recreation to elite level of play from across the globe, and synthesized findings per level of play and body region are strengths of this review. The cumulative evidence in this review may be influenced by methodological limitations of the included studies, and future women's injury epidemiology research should be conducted prospectively using an injury definition derived from the International Consensus[19] guidelines with a clear definition of exposure (eg, player participation, players entering/leaving cohorts, workloads) to accurately calculate injury rates and proportions.

Recommendations for practice

Quantifying and reporting injury rates are stepping stones to injury prevention, and highlight the importance of injury surveillance and adequate player management. Given the dearth of research in women's cricket, our findings provide stakeholders (including players, coaches, clinicians, administrators, and policymakers) with level 1 evidence to make informed decisions about cricket participation. The injury data provided by this review can be used to create injury-prevention programs, reduce the burden of injuries, increase player availability, identify areas to direct resources, and enhance team performance. Injury-prevention strategies in women's cricket could and should be developed by identifying injury-causing factors and emphasizing the importance of specific skills training for women's cricket, such as visual and auditory reaction stimulation, improved hand-eye coordination, as well as optimal player conditioning and management to prevent injuries. Furthermore, the findings can be used to inform strategies to increase safe cricket participation rates, promote the sport as a vehicle for positive public health outcomes, and improve the level of professionalism for women's cricket.

Recommendations for research

This review highlighted the limitations of the existing data. High-quality epidemiological data are lacking for all levels of play. We recommend that further studies follow the 2016 edition of the International Cricket Consensus Statement and guidelines such as Strengthening the Reporting of Observational studies in Epidemiology Extension for Sport Injury and Illness Surveillance to standardize and improve the quality of the data reported in women's cricket. Further, a clear definition of exposure (eg, player participation, players entering/leaving cohorts) needs to be incorporated to accurately measure injury rates/incidence. Future studies should also investigate the etiology, risk factors, and injury mechanisms in women's cricket.

Declaration

Author NKPP is the author of several studies included in this review; however, she was not involved in study selection, assessment of methodological quality, or data extraction.

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Appendix I: Search strategy

MEDLINE (PubMed)

Date searched: August 30, 2021

Keywords were searched in all text (including title/abstract) and MeSH terms.

"Female filter" was applied.

((((cricket*[Text Word]) AND (((((women[Text Word]) OR (woman[Text Word])) OR (female*[Text Word])) OR (lady[Text Word])) OR (ladies[Text Word]))) AND (((injur*[Text Word]) OR (pain*[Text Word])) OR (wound*[Text Word]))) OR (((cricket sport[MeSH Terms]) AND ((women[MeSH Terms]) OR (female[MeSH Terms]))) AND ((wounds and injuries[MeSH Terms]) OR (pain[MeSH Terms])))) AND (female[Filter])

Results: 90

Cochrane Central Register of Controlled Trials (Cochrane Library)

Date searched: August 30, 2021

Keywords were searched for in all text words and MeSH terms. Word variations have been searched (box ticked). No filters were applied.

ID	Searched for	Results
#1	(women) OR (woman) OR (female*) OR (lady) OR (ladies)	828,182
#2	(cricket*)	79
#3	(injur*) OR (pain*) OR (wound*)	270,140
#4	#1 AND #2 AND #3	8
#5	MeSH descriptor: [Female] explode all tre	463,244
#6	MeSH descriptor: [Women] explode all trees	695
#7	#5 OR #6	463,256
#8	MeSH descriptor: [Cricket Sport] explode all trees	5
#9	MeSH descriptor: [Wounds and Injuries] explode all trees	26,673
#10	MeSH descriptor: [Pain] explode all trees	51,491
#11	#9 OR #10	75,451
#12	#7 AND #8 AND #11	0
#13	#4 OR #12	8

Results: 8

Physiotherapy Evidence Database (PEDro)

Date searched: August 30, 2021

The PEDro search builder provides tabs to be selected/filled out to do the search. The keyword "cricket*" was search for in 'Abstract & Title' and the other keywords were substituted in the tab options. No filters were applied.

Searched for	Results
Cricket*	6
Cricket* AND (injur* OR pain* OR wound*)	2
Cricket* AND (female* OR woman OR women OR lad*)	0
Cricket* AND (injur* OR pain* OR wound*) AND (female* OR woman OR women OR lad*)	0

Results: 0

EBSCO

Date searched: August 30, 2021

A combined search was done in the following databases affiliated with EBSCOHost: CINAHL Complete, Masterfile Premier, SPORTDiscus, MegaFile Premier (Academic Search Ultimate, Business Source Ultimate, and Regional Business News). The search was done in all text; search in MeSH terms was not available. The following expander was used: 'Apply related words', ticked; 'Also search within the full text of the articles', ticked; 'Apply equivalent subjects', ticked. 'Sex: female', ticked.

Search TX - All Text:	Results
S1 TX cricket OR TX cricket sport OR TX cricket game (Narrow by Subject Gender: - female)	295
S2 TX (female or women or woman or females) OR TX lady OR TX ladies (Narrow by Subject Gender: - female)	2,069,575
S3 TX (injury or injuries or accident or trauma) OR TX (wounds and injuries) OR TX pain (Narrow by Subject Gender: - female)	367,178
S4 S1 AND S2 AND S3 (Narrow by Subject Gender: - female	156

Results: 156

Scopus

Date searched: August 30, 2021

Keywords were searched in all text words (including title/abstract). MeSH terms search was not available. No filters or limitations were applied.

The key string was searched in the advanced search option:

(ALL (cricket*) AND ALL (female* OR women OR woman OR ladies OR lady) AND ALL (injur* OR pain* OR wound*) AND NOT ALL (crickets) AND NOT ALL (gryllidae))

Results: 538

ScienceDirect

Date searched: August 30, 2021

Keywords were searched in all text words (including title/abstract). MeSH terms search was not available. No filters or limitations were applied. ScienceDirect does not support wildcards. Only 8 Boolean connectors could be used per search. Search terms were adjusted to include ALL the terms; two separate searches were conducted, and the search results combined:

Searched for	Results
1. cricket AND (female OR females OR woman OR women) AND (injury OR injuries OR pain)	2927
2. cricket AND (lady OR ladies) AND (injury OR injuries OR pain)	348
Search 1 and 2 were combined for the following search results	4275

Results: 4725

ProQuest Health and Medical Complete

Date searched: August 30, 2021

Searched in all text:

Set No.	Searched for	Results
S1	(cricket or cricketer or cricketers) OR Cricket OR (cricket sport). Additional limits - Humans; Females	552
S2	female OR woman OR women OR lady OR ladies Additional limits - Humans; Females	616,835
S3	injury OR injuries OR wound OR pain OR (wounds and injuries) Additional limits - Humans; Females	202,128
S4	S1 AND S2 AND S3. Additional limits - Humans; Females	164

Results: 164

WorldCat

Date searched: August 30, 2021

Full text search option not available. Searches could only be done in keywords and title. The search was refined by: “Formats”: articles: all (ticked); books: thesis/dissertation (ticked). Other formats such as video, image, music, etc., excluded.

((kw:female* OR women OR woman OR lady OR ladies) AND (kw:cricket*) AND (kw:injury* OR wound* OR pain*) AND NOT (kw:insect* OR Gryllidae*) AND NOT(kw:poet* OR poem* OR fiction*)) *OR ((ti: female* OR women OR woman OR lady OR ladies) AND (ti:cricket*) AND (ti:injur* OR pain* OR wound*) AND NOT (ti:insect* OR Gryllidae*) AND NOT(ti:poet* OR poem* OR fiction*))

Results: 934

Greylit.org
Date searched: August 30, 2021

The following search was done:

((cricket* AND (female* AND woman* AND women* AND lady* AND ladies) AND (injur* AND wound* AND pain*))

Results: 0

The GreyLit search builder provides tabs to be selected/filled for a refined search. No applicable filters or limitations applied. The following keywords were searched:

Cricket*	0
Cricket* AND (injur* OR wound* OR pain*)	0
Cricket* AND (female* OR woman OR women OR lad*)	0

Results: 0

Grey Matters
Date searched: August 30, 2021

The search builder provides tabs to be selected / filled for a refined search. No applicable filters or limitations applied. The following keywords were searched:

Searched for	Results
Cricket*	1
Cricket* AND (injur* OR wound* OR pain*)	1
Cricket* AND (female* OR woman OR women OR lad*)	0
Cricket* AND (injur* OR wound* OR pain*) AND (female* OR woman OR women OR lad*)	0

Results: 0

OpenGrey SIGLE
Date searched: August 30, 2021

The following search was done in all text: (No filters or limitations were applied)

(cricket* AND (female* AND woman* AND women* AND lady* AND ladies) AND (injur* AND wound* AND pain*))

Results: 0

ClinicalTrials.gov
Date searched: August 30, 2021

The advanced search builder was used by entering different keywords in selected tabs:

Condition or disease: Injury; Pain; Wound (synonyms searched)

Other terms: cricket*e

Sex: Studies with female participants

Results: 0

Condition or disease: Injury; Sports (synonyms searched)

Other terms: cricket*

Sex: Studies with female participants

Results: 0

Google Scholar
Date searched: August 30, 2021

Due to the limitations in the advanced search function of Google Scholar, multiple searches were performed. Different variations were search for separately in the boxes "with all of the words" and "with the exact phrase" as shown below:

Search terms anywhere in the article:

with the exact phrase	Female cricket	Women cricket	Woman cricket	Lady cricket	Ladies cricket
with at least one of the words	Injur* pain* wound*	Injur* pain* wound*	Injur* pain* wound*	Injur* pain* wound*	Injur* pain* wound*
Without the words	crickets, insect* gryllidae	crickets, insect* gryllidae	crickets, insect* gryllidae	crickets, insect* gryllidae	crickets, insect* gryllidae
Total number of results	179	194	11	7	52

Appendix II: Studies ineligible following full-text review

Reason for exclusion: male only participants (n=19)

Annear PT, Chakera TMH, Foster DH, Hardcastle PH. Pars interarticularis stress and disc degeneration in cricket's potent strike force: the fast bowler. Aus N Z J Surg. 1992;62(10):768-73.
Bayne H, Elliott B, Campbell A, Alderson J. Lumbar load in adolescent fast bowlers: a prospective injury study. J Sci Med Sport. 2016;19(2):117-22.
Crewe H, Elliott B, Couanis G, Campbell A, Alderson J. The lumbar spine of the young cricket fast bowler: an MRI study. J Sci Med Sport. 2012;15 (3):190-4.
Dutton M, Tam N, Gray J. Incidence and impact of time loss and non-time-loss shoulder injury in elite South African cricketers: a one-season, prospective cohort study. J Sci Med Sport. 2019;22(11):1200-1205.
Forrest MR, Hebert JJ, Scott BR, Dempsey AR. Exercise-based injury prevention for community-leveladolescent cricket pace bowlers: a cluster-randomised controlled trial. J Sci Med Sport. 2020;23(5):475-80.
Jones ME, Davies MA, Leyland KM, Delmestri A, Porter A, Ratcliffe J, *et al.* Osteoarthritis and other long-term health conditions in former elite cricketers. J Sci Med Sport. 2018;21(6):558-63.
Kountouris A, Portus M, Cook J. Quadratus lumborum asymmetry and lumbar spine injury in cricket fast bowlers. J Sci Med Sport. 2012;15(5):393-7.
Martin C, Olivier B, Benjamin N. the functional movement screen in the prediction of injury in adolescent cricket pace bowlers: an observational study. J Sport Rehabil. 2017;26(5):386-395.
Olivier B, Taljaard T, Burger E, Brukner P, Orchard J, Gray J, *et al.* Which extrinsic and intrinsic factors are associated with non-contact injuries in adult cricket fast bowlers? Sports Med. 2016;46(1):79-101. -y.
Olivier B, Lala B, Gillion N. The cricketer's shoulder and injury: asymmetries in range of movement and muscle length. S Afr J Physiother. 2020;76 (1):754.
Orchard JW, Kountouris A, Sims K. Incidence and prevalence of elite male cricket injuries using updated consensus definitions. Open Access J Sports Med. 2016;7:187-194.
Orchard J, James T, Alcott E, Carter S, Farhart P. Injuries in Australian cricket at first class level 1995/1996 to 2000/2001. Br J Sports Med. 2002;36 (4):270-4; discussion 275.
Ranson C, Gregory PL. Shoulder injury in professional cricketers. PhysTher Sport. 2008;9(1):34-9.
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Shah SR, Horsley I, Rolf CG. Anterior internal impingement of the shoulder in rugby players and otheroverhead athletes. Asia Pac J Sport Med ArthroscRehabil Technol. 2017;8:13-17.
Wang H, Liu H, Wu J, Li C, Zhou Y, Liu J, *et al.* Age, gender, and etiology differences of sports-relatedfractures in children and adolescents: a retrospective observational study. Medicine. 2019;98(4):e13961.
Wani AA, Ramzan AU, Tariq R, Kirmani AR, Bhat AR. Head injury in children due to cricket ball scenario in developing countries. PediatrNeurosurg. 2008;44(3):204-7.
Wells D, Alderson J, Camomilla V, Donnelly C, Elliott B, Cereatti A. Elbow joint kinematics during cricket bowling using magneto-inertial sensors: a feasibility study. J Sports Sci. 2019;37(5):515-524.
Whitehouse DP, Kelleher-Unger IR, Newcombe VFJ. Head injury and concussion in cricket: incidence, current guidance, and implications of sports concussion literature. Transl Sports Med. 2021;4:319–326.

No data on female cricket injuries (n=45)

Armsey TD, Hosey RG. Medical aspects of sports: epidemiology of injuries, preparticipation physicalexamination, and drugs in sports. Clinic Sport Med. 2004;23(2):255−79.
Barrett BT, Flavell JC, Bennett SJ, Cruickshank AG, Mankowska A, Harris JM, *et al.* Vision and visual history in elite/near-elite-level cricketers and rugby-league players. Sport Med Open. 2017;3(1):39.
Beckles HM. Chapter 14: A purely natural extension: women's cricket in West Indies cricket culture. In:Beckles H, Stoddart B, editors. Liberation cricket: West Indies cricket culture. Manchester University Press; 1995. p.222.
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Burroughs A, Nauright J. Women's sports and embodiment in Australia and New Zealand. Int J HistorySport. 2000;17(2-3):188-205.
Carty H. Children's sports injuries. Eur J Radiol. 1998;26(2):163-76.
Chaurasiya M, Mehta D. Effect of core stability exercises in enhancing the upper and lower body strength of women cricket players. Int J Yog Hum Mov Sport Sci. 2018;3(8):248-50.
Chuter GSJ, Muwanga CL, Irwin LR. Ulnar collateral ligament injuries of the thumb: 10 years of surgicalexperience. Injury. 2009;40(6):652-6.
Dane S, Can S, Karsan O. Sport injuries in right-and left-handers. Percept Motor Skills. 1999;89(3):846-8.
Debnath UK, Freeman BJC, Gregory P, De la Harpe D, Kerslake RW, Webb JK. Clinical outcome and return to sport after the surgical treatment of spondylolysis in young athletes. J Bone Joint Surg. 2003;85(2):244-9.
Delilbasi C, Yamazawa M, Nomura K, Iida S, Kogo M. Maxillofacial fractures sustained during sports played with a ball. Oral Surg Oral Med Oral Pathol Oral RadiolEndod. 2004;97(1):23-7.
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Drosos GI, Pozo JL. The causes and mechanisms of meniscal injuries in the sporting and non-sportingenvironment in an unselected population. Knee. 2004;11(2):143-9.
Felton PJ, Lister SL, Worthington PJ, King MA. Comparison of biomechanical characteristics between male and female elite fast bowlers. J Sport Sci. 2019;37(6):665-70.
Finch CF, Boufous S. The descriptive epidemiology of sports/leisure-related heat illness hospitalisations in New South Wales, Australia. J Sci Med Sport. 2008;11(1):48-51.
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Forrest MR, Hebert JJ, Scott BR, Dempsey AR. Modifying bowling kinematics in cricket pace bowlers with exercise-based injury prevention: a cluster-randomised controlled trial. J Sci Med Sport. 2020;23(12):1172-7.
Fowlie J, Eime RM, Griffiths K. Barriers to adolescent female participation in cricket. Ann Leisure Res.2020;24(4):1-19.
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Appendix III: Characteristics of included studies

First author	Study design, aim, setting	Participants, age, cricket, level, cricket format	Data collection methods	Injury definition	Injury prevalence, incidence	Body region injured
Basketter[7]	Cross-sectional study (level 4b; dissertation) This study aimed to collect information on the rate and injuries sustained during the summer 2013 season in England and Wales	52 female cricket players Age (mean): 21.7 years (range 18-45) Level of play: multiple (10 elite, 37 county, 5 club) Formats of cricket: multiple (T20, ODI)	A questionnaire was used to collect injuries sustained by players during the summer season	Own injury definition used; injury was defined as a problem that caused a player to miss training or playing time	28 out of 52 female cricket players reported injuries; a total of 40 injuries were reported Injuries according to player role: batters 14, pace bowlers 7, spin bowlers 3, and wicketkeepers 4 35 time-loss injuries were reported: 16 (<7 days), 6 (8-30 days), 4 (31-90 days), 9 (>91 days) 5 no-time-loss injuries were reported	Shoulder (28%), lower back (15%), wrist and hand (10%), foot (8%), thigh (8%), knee (8%), forearm (3%), elbow (3%), trunk (3%), and neck (3%)
Bipasha[5]	Cross-sectional study (level 4b) This study aimed to identify the cricket injuries and related patterns among female cricketers from December 2017 to June 2018 in Bangladesh	51 female cricket players Age (mean): 16.86 ± 2.596; (12-14 years n = 14, 15-17 years n = 8, 18-20 years n = 29) Level of play: unspecified (more than 6 months' professional cricket) Formats of cricket: unspecified	A purposeful sampling technique was used, and a face-to-face interview was performed to gather data using an interviewer and formal questionnaire	International Consensus Statement definitions from 2005 with slight modifications	51 female cricket players with injuries were reported Injuries by player roles: bowlers 21, batters 21, wicketkeepers 9	Shoulder (31.4%), elbow (15.7%), ankle (13.7%), meniscus (7.8%), hamstring (7.8%), back pain (7.8%), fractures (5.9%), wrist (3.9%), head (2%), finger (2%), and groin (2%)
Brooks[37]	Retrospective cohort study (level 3b) This study aimed to review all cases of hand fractures from the online Athlete Management System from December 2015 to December 2018 in Australia	27 female cricket players (study included male cricket players) Age (mean): 25.4 ± 4.5 years for females Level of play: elite cricket Formats of cricket: unspecified	Data were collected using Cricket Australia's online Athlete Management System (Fair Play Pty Ltd) Injury data were recorded by medical staff	Own injury definition used for injuries, return to play was categorized as: i) days injured, where the player was unable to play/participate in matches or training, and ii) the period (days) needed to return to full play	Hand fractures per 100,000 balls per team for female players: 9.6; batters 6.6; fielders 14.4; wicketkeepers 2.8 Hand fractures per 100,000 balls per female players: 0.7; batters 1.0; fielders 0.4; wicketkeepers 3.1 Female players had a higher incidence of hand fractures in matches compared to males	27 female cricket participants with hand fractures

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First author	**Study design, aim, setting**	**Participants, age, cricket, level, cricket format**	**Data collection methods**	**Injury definition**	**Injury prevalence, incidence**	**Body region injured**
Bullock[33]	Cross-sectional study (level 4b) This study was part of the CHWS, conducted in England and Wales in March 2017 and aimed to investigate the effect of resilience, playing standard, and playing status among cricketers	65 current and former female cricket players (study included male cricket players) registered on the England and Wales Cricket Board national database Age: unspecified Level of play: multiple (32 elite and 27 recreational) Formats of cricket: unspecified	A questionnaire was sent to cricket players registered on the England and Wales Cricket Board national database	Own injury definition used: i) cricket-related injury leading to more than 4 weeks of reduced participation in exercise, training, or sport; ii) joint pain and osteoarthritis; iii) general health and disease prevalence; iv) physical activity; v) resilience, quality of life, and flourishing	36 out of 65 (55%) female cricket players played sport while injured Participants aged older than 30 years; 27 out of 51 (53%) female cricket players played sport while injured	N/A
Cai[32]	Cross-sectional study (level 4b) This study was part of the CHWS, conducted in England and Wales in March 2017 and aimed to investigate the prevalence of joint pain and osteoarthritis in previous cricketers	24 current and former female cricketers registered on the England and Wales Cricket Board national database (study included male cricket players) Age: unspecified Level of play: multiple Formats of cricket: unspecified	A questionnaire sent to cricket players registered on the England and Wales Cricket Board national database	Own injury definition used: joint pain or osteoarthritis was defined as joint-specific doctor-diagnosed osteoarthritis	13 out of 24 (54%) former female cricket players reported joint pain	N/A
Cowan[39]	Descriptive study (level 4b; dissertation) This study aimed to determine injury rate and anatomical areas among female cricket players during the Women's World Cup of Cricket (March—April 2005) in South Africa	56 female cricket players Age (mean): 25.2 ± 1.10 years Level of play: elite cricket Formats of cricket: 50 overs (World Cup)	Data were collected using questionnaires; injuries and training practices during the World Cup were documented, including the 8-month period prior to the World Cup	Own injury definition used. Injuries were defined as an incident that prevents a player from competing in a match or training session, or an incident that needs medical attention Acute and chronic injuries were distinguished and reported	27 injuries out of 56 players (48.2%) were recorded; a frequency of 0.48 injuries per player; 11 injuries sustained 8 months prior to the World Cup; most injuries during World Cup 16 (58%) Injuries sustained per player role: batting 22%, bowling 19%, fielding 25%, catching 15%, throwing 8%, other 4% Time-loss injuries: 64% of players sustained acute injuries; 36% were recurrent; playing time loss was 1-3 days (34%) and 4-7 days (35%); these two groups calculated 69% of practice days missed; there were 0% missing practice for 15-21 days, 3 injuries forced players to miss more than 22 days of practice	Lower limb (59%), upper limb (26%), thoracic (15%), lumbar (15%), spine (15%), and trunk (15%)

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First author	**Study design, aim, setting**	**Participants, age, cricket, level, cricket format**	**Data collection methods**	**Injury definition**	**Injury prevalence, incidence**	**Body region injured**
Goggins[28]	Prospective cohort study (level 3b) This study aimed to describe injury and illness epidemiology within women's international pathway cricket, and understand what affects the availability of players in this context where players are engaged parttime in England and Wales from April 2015 to March 2019	83 female cricket players included in the study Age (mean): 19.75 ± 4.03 years Level of play: elite cricket Formats of cricket: multiple (first class, ODI, T20)	Four years of injury data were routinely collected and analyzed by the England and Wales Cricket Board and a university research partner	International Consensus Statement definitions were used (2016 update)	Overall prevalence was 4.1% (95% CI 2.7-6.2), with 95.9% of players injured when selected on any day of the match Bowling was the player role with the highest annual time-loss prevalence (0.6% of 172 players being unavailable); lower back injuries for bowlers caused 1.3% overall prevalence of 0.6% of players fully unavailable for a match on any given day; 8.4% of players were affected by medical complaint injuries; 2.3% of players were unavailable for any given match day The average injury incidence was 7.0 playing time-loss injuries sustained per 1000 team match days (95% CI 4.610.6) and per 1000 player match days. Fielding (56.4 injuries/100 players per year) accounted for the highest total average and time-loss injury incidence rates Overall, about 8.4% of players were affected (they were unavailable or were unable to play) because of medical complaints, with an average of 2.3% of players entirely inaccessible on any day of cricket during the year	The highest average annual complaint for body region injured was the lower back (1.3% total prevalence and 0.6% of players were fully inaccessible for any day during the year); followed by medical illness; and thirdly, injuries to the knee

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First author	**Study design, aim, setting**	**Participants, age, cricket, level, cricket format**	**Data collection methods**	**Injury definition**	**Injury prevalence, incidence**	**Body region injured**
Hecimovich[38]	Case-control study (level 3d) This study aimed to investigate the ratio of lumbar lordosis between juniorlevel cricket players with and without lower back injuries; data were collected from the Talented Athlete Program (Western Australian Cricket Association) in 2016	26 female cricket players (study included male cricket players) Age: 13-17 years; mean: 14.3 $\pm$1.0 Level of play: junior cricket (13-17 years) Formats of cricket: unspecified	Data were collected using observational methods from participants in the Talented Athlete Program (Western Australian Cricket Association)	Own injury definition used: lower back injury from bowling or a similar action, which prevented involvement in at least one training session or match during the previous cricket season. The lower back injury was selfreported with parent/ guardian confirmation	9 out of 26 female cricket players reported lower back injury	9 female cricket players with lower back injury
Hill[36]	Prospective cohort study (level 3b) This study analyzed head impacts and concussions using the Cricket Australia database over 2 seasons (2015-2016 and 20162017) of elite-level male and female cricketers	106 domestic and international female cricket players in the 2015-2016 season, 98 female cricket players in 2016 - 2017 season (study included male cricket players) Age/formats: unspecified Level of play: elite cricket	Prospective analysis of head impacts and concussions using the Cricket Australia online medical database and data from concussionspecific neurological tests performed on post-impact players	Own injury definition used: concussion was diagnosed using the Berlin Concussion Consensus, together with a medical diagnosis from a doctor (neurocognitive testing), and monitoring the signs and symptoms of players after impact	15 head impacts that resulted in 8 concussions (over 367 team days of play) in women's matches Overall incidence was 3.7 head impacts (2.0 concussions) per 1000 player days; 0.5 concussion per 1000 player match hours	15 head injuries with 8 concussions
Kodikara[42]	A retrospective case series (level 4c) This study aimed to report an epidemiological profile of hospital-treated head, neck, and facial cricket injuries in Victoria, Australia, from 2007/08 to 2016/17	324 female injuries were reported Age: The 10- to 14-year age group required the most treatment (males and females) Level of play and formats: unspecified	An examination of all Victorian hospital-treated head, neck, and facial cricket injuries sustained by all cricket participants over the age of 5 years between July 2007 and June 2017	An "injury" was defined as "any cricket injury requiring hospital treatment." VISU extracted all of these cases and isolated "head, neck, and facial cricket injuries" from their hospital and emergency department records	324 head, neck, and facial injuries were reported, 95 injuries from organized cricket The IIR for head, neck, and facial was 0.4 per 1000 participants	324 head, neck, and facial injuries

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First author	**Study design, aim, setting**	**Participants, age, cricket, level, cricket format**	**Data collection methods**	**Injury definition**	**Injury prevalence, incidence**	**Body region injured**
McLeod[43]	A retrospective case series (level 4c; dissertation) This study is a descriptive examination of current insurance claims data for 10 years, from July 1, 2008 to June 30, 2018, from the ACC, New Zealand	5430 cricket-related claims by females Age: The most common age group was 15 to 19 years, followed by 10 to 14 years, and 20 to 24 years Level of play and formats: unspecified	The ACC of New Zealand initially provided statistics on cricket-related claims for both males and females between July 2008 and June 2018	The ACC program is a nofault system, and the computerized claim form (ACC45) used to collect injury data includes nonmandatory fields. One such field is the claimant's or their health provider's statement of damage, which limits the information acquired to being mainly representative, but not a completely definitive measure of all claims. Injury variables assessed were injury nature/type, body regions, and injury factors	Annual IIR per 100,000 population per year: 2008/09: 28.3 (95% CI 26.0–30.7) 2009/10: 26.3 (95% CI 24.1–28.6) 2010/11: 23.8 (95% CI 21.7–26.1) 2011/12: 22.6 (95% CI 20.5–24.8) 2012/13: 24.5 (95% CI 22.4–26.9) 2013/14: 24.9 (95% CI 22.8–27.2) 2014/15: 26.5 (95% CI 24.4–28.9) 2015/16: 26.0 (95% CI 23.8–28.3) 2016/17: 26.9 (95% CI 24.7–29.1) 2017/18: 26.2 (95% CI 24.1–28.5) Average annual IIR over 10 years: 25.7 (95% CI 25.0–26.4) per 100,000 population	Lower back (16.2%), knee (10.9%), ankle/foot (13.4%), head/neck (8.8%) shoulder (14.6%), elbow (13%), hip/thigh (7%), hand/finger (25.3%), lower leg (6.2%), and trunk (3.5%)
Murphy[35]	Prospective cohort study (level 3b) This study analyzed the factors associated with the risk of dominantshoulder injury in one season of the Australian women's national cricket league (2017-2018)	115 female cricket players Age (mean): 26.0 ± 4.4 years Level of play: elite level Formats of cricket: unspecified	Data were captured from musculoskeletal screening tests that were performed on the players	Own injury definition used: any incidence that caused a player to be unavailable to play, throw, or perform shoulder movements due to a shoulder injury	14 players developed injuries in the dominant shoulder (12%) throughout the season; shoulder impingement (57%) was the most common diagnosis Throwing (64%) accounted for the most injuries in the shoulder	14 shoulder injuries were reported (authors gave prevalence for each type of shoulder injury)
Paul[31]	Cross-sectional study (level 4b; dissertation) This study aimed to identify the most common injuries in Bangladeshi cricketers in 2007	57 female cricket players Age (mean): 19.14 ± 3.41 years Level of play: unspecified Formats of cricket: unspecified	Data were collected using a questionnaire; the study sample group included injured cricket trainees and players among the Bangladeshi cricketers	No clear injury definition given	359 injuries sustained by 57 players 12 (21.1%) were batters, 14 (24.6%) were bowlers, 24 (42.1%) were all-rounders, and 7 (12.3%) were wicketkeepers	Head and neck (9.6%), shoulder (13.5%), elbow (5.9%), wrist, hand, and finger (18%), back and trunk (9.3%), hip and thigh (15.2%), knee and leg (14%), ankle and foot (14.6%)

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First author	Study design, aim, setting	Participants, age, cricket, level, cricket format	Data collection methods	Injury definition	Injury prevalence, incidence	Body region injured
Perera[3]	Cohort study (level 3b; dissertation) This study investigated the injuries that contributed to successful insurance claims during the 2002–03 until the 2012-13 cricket seasons in Australia	108 insurance claims Age groups: 15-19 years 17.6% (19), 20-24 years 16.7% (18), and 25-29 years 15.7% (17) Level of play: unspecified Formats of cricket: unspecified	Insurance claims were collected from the JLT-Sport database, including the injury date, geographical location, association played for, injuries sustained, player role, playing surface, body region injured, nature and description of injury, and age/gender of the players	Own injury definition used: incident causing harm to a player and resulting in a JLT-Sport insurance payout Two independent researchers using the Orchard Sports Injury Classification System version 10 independently reported the collected data relating to the body area and type of the injury	108 insurance claims 89 injuries occurred during competition (82.4%) leading to an insurance payout; most were incurred during batting (52.5%) Claims related to fielding reflected 38% of female cricket claims	Knee (24.1%), upper distal extremity including hand, wrist, and fingers (19.4%), and teeth (14.8%)
Perera[30]	Cross-sectional study (level 4b; dissertation) This study analyzed data from the Injury Surveillance in Women's Cricket in Australia using a survey distributed via Survey Monkey from 2004 to 2013	164 female cricket players (163 outdoor, 37 indoor) Age (mean): 23.7 $\pm$ 7.4 years Level of play: multiple (153 club, 106 state, 18 national, 32.9% professional, 67.1% non-professionals) Formats of cricket: unspecified	Data were collected using questionnaires distributed to cricket players in Australia via Survey Money	Own injury definition used: injury is any physical problem that caused pain, bleeding, loss of movement, or loss of function, and included the gradual onset of aches, pain, discomfort, or stiffness without a specific event responsible for the complaint	109 players sustained injuries (114) during the 2014 - 15 season, and 18% (20) sustained more than 3 injuries 798.6 injuries sustained per 1000 participants	26 distal lower-limb injuries (23%) and 5 head, neck, and spine injuries (22%) were recorded

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First author	Study design, aim, setting	Participants, age, cricket, level, cricket format	Data collection methods	Injury definition	Injury prevalence, incidence	Body region injured
Perera[2]	Cohort study (level 3b) This study obtained injury data by the Athlete Management System of Cricket Australia on all elite female players over two seasons in Australia from March 2014 to March 2016	121 female cricket players with 621 injuries reported Age (mean): 24.2 years ±4.5 Level of play: elite cricket Formats of cricket: multiple (ODI,T20, multi-day match)	Cricket injury and health data were prospectively gathered by a team of doctors and physiotherapists from elite-level female players (state and national) using the Fair Play AMS 2016 database	Own injury definition used: injury is an incident causing a player to seek medical treatment and that affects match or training time; and/or prevents a player from performing his/her player role during a match, as instructed by the captain	600 injuries were suffered by 113 players; 77.7% (94) sustained 1 injury; 477 accidents were acute (79.5%) and 73.2% (439) were recent The most frequent time-loss injuries were 121 (20.2%) time-loss injuries (94 recent and 27 recurrent), resulting in a total of 3638 days (average: 30 days) away from cricket Match injury incidence was 424.7 injuries/ 10,000 hours for all injuries, and 600 medicalattention injuries; 79.3 injuries/10,000 hours for time-loss, with 77.7% of players registering more than one injury. Compared to the progressive onset injuries, there were 79.5% acute injuries, 20.2% of all emergency treatment injuries contributed to time loss; 34.7% were match time-loss injuries All injuries amounted to 424.7 injuries/10,000 hours and time-loss injuries amounted to 79.3 injuries/10,000 hours	The most frequently injured areas were the thigh (14.0%), wrist (12.8%), knee (11.3%), shoulder (11.0%), and lumbar spine (10.5%) The most frequent time-loss injuries were wrist and hand (19.8%), lower back (16.5%), and knee (14.9%) Six players experienced injuries to the lumbar spine, causing the most time loss (average 110.5 days/injury)
Perera[41]	A retrospective case series (level 4c) This study investigated the data relating to cricket injuries captured in hospital databases from 1 July 2002 to 30 June 2014, including datasets maintained by the Victorian Injury Surveillance Unit in Australia	668 female cricket cases Age: 10- to 14-year-old age group was identified as the most frequently injured group Top three age groups for hospital admissions were 20-24 (19.0%), 10-14 (6.5%), and 30-34 (10.7%); the top age groups for emergency departments were 10-14 (19.9%), 15-19 (15.7%), and 20-25 (13.3%) Level of play and formats: unspecified	Data compiled from hospital records of injuries sustained by Victoria, Australia, women's cricketers for the period 1 July 2002 to 30 June 2014	Own injury definitions used: injuries were diagnosed by health care practitioners and captured in the database of the hospitals	668 cases; emergency departments accounted for 547 cases and hospital admissions accounted for 121 cases All incidence cases were documented as 1.5 emergency department presentations per 1000 participants (95% CI 0.93.9) and 0.3 hospital admissions per 1000 participants (95% CI 0.8-1.5)	Hospital admissions: head (28.1%), shoulder (5%), elbow (12%), wrist/hand (17.4%), knee/lower leg (22%), ankle/foot (5%), unspecified (10%), and abdominal/lower back/spine/pelvis (5%) Emergency department: head (27.8%), shoulder (4%), elbow (6%), wrist/ hand (29%), ankle/foot (14%), abdominal/lower back/spine/pelvis (1%), knee/lower leg (12%), and unspecified (1%)

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First author	**Study design, aim, setting**	**Participants, age, cricket, level, cricket format**	**Data collection methods**	**Injury definition**	**Injury prevalence, incidence**	**Body region injured**
Phillips[29]	Cross-sectional study (level 4b) This study reported the incidence of anterior knee pain across different participatory levels, age, and gender groups in schools in South Africa in 2007	8 female cricket players (study included male cricket players) Age: 11-17 years Level of play: junior/school cricket Formats of cricket: unspecified	Data were collected using questionnaires that were distributed to 10- to 17-year-old adolescents in 8 primary and 5 secondary schools in South Africa	Own injury definition used: s/he must have indicated on the diagram the origin of the pain on the anterior surface of the knee, listed pain lasting longer than 1 month, indicated the level of pain as mild to extreme, and indicated that the pain interfered with sports involvement	6 out of 8 female cricket players reported knee pain	6 female cricket payers with anterior knee pain
Saw[40]	A retrospective case series (level 4c) This study explored situational factors consistent with concussion in elite male and female cricket players in Australia from July 2014 to February 2019	183 females with head impacts (study included male cricket players) Age (mean): 26 $\pm$ 5 (range 16-38) Level of play: elite cricket Formats of cricket: unspecified	Data captured from the online datasets of Cricket Australia (Athlete Management System and The Cricket Analyst, Fair Play Pty Ltd) were used in the analysis	Own injury definition used: concussion was diagnosed using the concussion protocol and consensus concept of the organization's act by an experienced specialist practicing in sports medicine	19 head impacts recorded from 183 female cricket players Batting head impacts 11 ($\sim$1 per 2266 overs), fielding head impacts 8 ($\sim$1 per 3139 overs)	19 head impacts
Shah[34]	Cross-sectional study (level 4b) This study described the relationship between hand injury and ipsilateral pain and osteoarthritis in cricketers using the CHWS database. All participants were recruited between March and May 2017 in England and Wales	43 female cricket participants (20 current and 23 former cricketers) Age (mean): 54.7 (SD $\pm$ 12.1 male and female cricketers) Level of play and formats: unspecified	A questionnaire sent to cricket players registered on the England and Wales Cricket Board national database as part of Cricket Health and Wellbeing Study	To screen for a history of doctor-diagnosed hand osteoarthritis, participants were asked, "Have you ever been advised by a doctor that you have osteoarthritis (wear and tear or joint degeneration) in your hand/finger?"	Prevalence of hand injuries was 7.5%	3 hand injuries were reported

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First author	**Study design, aim, setting**	**Participants, age, cricket, level, cricket format**	**Data collection methods**	**Injury definition**	**Injury prevalence, incidence**	**Body region injured**
Stuelcken[14]	Cross-sectional study (level 4b) This study investigated lower back pain in elite female fast bowlers. It assessed factors of the lumbar spine and hip motion range, as well as trunk extension from bowlers in Australia in 2007 with and without history of low back pain	26 elite female fast bowlers (male cricket players were included in this study) Age (mean): 22.5 ± 4.5 years Level of play: elite cricket Formats of cricket: unspecified	Data were collected using a self-administered questionnaire and medical records Several lumbar spine and hip motion tests were collected using goniometry Trunk extension was tested using a modification from the Sorensen Test	Own injury definition used: bowlers with lumbar pain whether self-reported or diagnosed: i) pain was due to or worsened by cricket skills; ii) pain had been experienced in the previous 12 months; or iii) pain had occurred at some point in the bowling career and could be confirmed by reports maintained by the medical team staff	54% of female fast bowlers (14/26 players) presented with a history of lower back pain Out of 14 bowlers, 9 had endured at least one episode of lower back pain in the previous 12 months and 6 had recorded recurring episodes of lower back pain in their careers 3 of the 14 female bowlers reported current back pain	14 lower back injuries
Stuelcken[15]	Cross-sectional study (level 4b) This study investigated the prevalence of shoulder pain and compared the strength and range of motion of female fast bowlers with and without shoulder pain in Australia in 2007	26 female cricket players Age (mean): 22.5 ± 4.5 years Level of play: elite cricket Formats of cricket: unspecified	Data on injuries, player demographics, cricket experience, and history of shoulder pain related to or aggravated by bowling or throwing were collected using a questionnaire	Own injury definition used: if a bowler had a history of shoulder pain i) in the last year or ii) at some point that was documented by the medical staff in the team	12 out of 26 bowlers reported shoulder pain	12 shoulder injuries

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First author	**Study design, aim, setting**	**Participants, age, cricket, level, cricket format**	**Data collection methods**	**Injury definition**	**Injury prevalence, incidence**	**Body region injured**
Warren[8]	Prospective cohort study (level 3b) This study investigated the incidence and prevalence of injuries among female cricket players during two- year professional T20 cricket tournament in England from 2016-2017	171 (84 players were included in 2016 and 87 in 2017) with 137 injuries recorded Age: 16-38 years (mean 23.4 $\pm$ 4.8) Level of play: elite cricket Formats of cricket: T20	All injuries and illnesses sustained by female cricket players were documented throughout the duration of the tournament	Own injury definition used: i) uninjured when a player is available for a match selection; ii) injured but still available for match selection; iii) injured but still available for match selection (with modified activity); iv) when a player is completely unavailable due to an injury	137 injuries (20 time-loss and 117 non-time-loss) 2.1 time-loss injuries and 12.2 non-time-loss injuries sustained per 100 match days. The largest rate of injury happened in the elbow (1.8 injuries per 100 match days), the lower back (1.7 injuries per 100 match days), and the knee (1.7 injuries per 100 match days) Fielding-associated injuries have the greatest overall incidence of injury (5.2 injuries in 100 match days), 3.3% of players were fielders missing matches at any given day Throwing (2.3 injuries per 100 match days) and fast bowling (2.1 injuries per 100 match days) accounted for the most injuries, whereas catching injuries caused the most time-loss injuries (2.5% of players missing matches on any given day)	The highest incidence of injuries resulted in the shoulder (1.8 injuries per 100 match days), the lower back (1.7 injuries per 100 match days), and the knee (1.7 injuries per 100 match days) The hand (1.7%), head and face (0.8%), and hip (0.6%) accounted for the most time-loss injuries

ACC, Accident Compensation Corporation; CHWS, Cricket Health and Wellbeing Study; CI, confidence interval; IIR, injury incidence rate; N/A, not applicable; ODI, one-day international; T20, 20 overs per side.