UNIVERSITY of the WESTERN CAPE

SURVEILLANCE STRATEGIES USED TO MONITOR INJURIES IN AMATEUR AND PROFESSIONAL CRICKET PLAYERS: AN INTEGRATIVE REVIEW

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DECLARATION

I declare that "**SURVEILLANCE STRATEGIES USED TO MONITOR INJURIES IN AMATEUR AND PROFESSIONAL CRICKET PLAYERS: AN INTEGRATIVE REVIEW"** is my own work, that it has not been submitted for any degree or examination at any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Name: Umar Farouk Jacob

Date: 25/03/2024

Signed: 

DEDICATION

To my caring parents for all the sacrifices you made to get me to where I am today, I will never be able to repay you for all that you have done for me, but this is for you.

To my amazing wife Sabeehah, thank you for always supporting my dreams, providing advice and being the pillar of support in our family.

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LIST OF ABBREVIATIONS

TERM	ABBREVIATION
AMS	Athlete Management System
CASP	Critical Appraisal Skills Programme
CINAHL	Cumulative Index of Nursing and Allied Health
CSA	Cricket South Africa
ECB	England and Wales Cricket Board
HSSREC	Humanities and Social Sciences Research Ethics Committee
ICC	International Cricket Council
JBI	Joanna Briggs Institute
OATD	Open Access Thesis and Dissertations
ODI	One-Day International
OSICS	Orchard Sports Injury and Illness Classification System
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
TIP	Team Sport Injury Prevention
TRIPP	Translating Research into Injury Prevention Practice
T20	Twenty20 Match Format
T20I	Twenty20 International Match
UWC	University of the Western Cape

GLOSSARY OF TERMS

TERM	DEFINITION
Abrasion	An abrasion is a superficial rub or wearing off the skin, usually caused by a scrape or a brush burn and are usually minor injuries that can be treated at home. The skin may bleed or drain small amounts at the time of the injury or at times over the next few days if rubbed or scratched (Nationwide Children's Hospital, 2022).
All-Rounder	The special classing of an all-rounder was not promoted, as all bowlers are required to bat. If required, a cut of 25 as a batting average was needed to be classified as an all-rounder. Non-bowlers could be subdivided into "wicket-keepers" and "batsmen" based on whether they kept wicket in at least 50% of games played each season (Orchard et al., 2005). According to the updated version, the position of “all-rounder” is not recommended for surveillance purposes, as every bowler is required to bat at times and many batsmen may occasionally bowl. However, the suggestion of using batting average as a cut-off (made in the previous recommendations) has been rendered unwieldy by the rise of Twenty20 cricket (Orchard et al., 2016b). A preferred definition now is that an “all-rounder” is a regular bowler (i.e., someone who regularly bowls at least 10% of a team’s overs) who, for most of the innings, bats in the top seven batting positions (Orchard et al., 2016b).
Amateur	A sports player that does not receive a salary for playing the sport, including junior players and semi-professional players (Yeban, 2023).
Bowler	A bowler is defined at the start of each season as a player who averaged more than five overs bowled in matches played during any of the previous two seasons (Orchard et al., 2005). Bowlers can be rated as “fast,” “fast medium,” “medium,” or “slow” according to their profiles on Cricinfo application. It is also suggested that bowlers can be divided into full-time and part-time bowlers depending on average workload (Orchard et al., 2005).
Bowler	The updated statement advised that the player should be classified according to the phase in which the injury occurred for match-injury incidence purposes, e.g., a bowler who gets injured when batting, should be reported as a batting injury. The criteria of needing to have bowled five overs has been updated as players are only allowed to bowl a maximum of four overs in a Twenty20 match. They are now best defined as cricketers who have bowled more than 10% of the overs bowled by their team in matches that they played in, for either of the two previous seasons (Orchard et al., 2016b). The categorisation between the two is usually clear-cut, with a key difference that the wicket-keeper will always stand directly behind the stumps for slow/spin bowlers. Bowlers can be categorised within the pace spectrum as “fast,” “fast-medium,” and “medium” and within the spin category as off/finger spin and leg/wrist spin. The updated consensus also states that the player roles on the Cricininfo application are widely accepted (Orchard et al., 2016b).

Glossary of Terms continued

TERM	DEFINITION
Club Cricket	An amateur form of cricket in which local clubs play formal cricket at night or over the weekend. Players in this category may be sub elite or junior cricket players who aspire to become elite cricketers, may also be grouped as "community cricketers" (Soomro et al., 2018).
Community-Level Cricketer	A cricketer that plays at levels below those directly controlled by national and/or state/province/county cricket bodies (McLeod et al., 2020).
Cricket Squad	The squad may consist of any number of players, with 25 being considered the standard squad size. All contracted players should be included in the team, with outsiders who are chosen to play also being added into the cohort at any point in the season (Orchard et al., 2005). If a player retires due to injury, they should be considered unavailable for selection due to injury for the rest of the season. If they retire due to other reasons, they should be considered unavailable for the rest of the season due to these other reasons and not injury (Orchard et al., 2005). Squad size and number may be adjusted for different reasons; however, it is recommended that annual injury incidence should be used instead of seasonal injury incidence (i.e., exposure of 365 days). The recommended new incidence unit is annual injuries per 100 players per year. No squad is as big as 100 cricketers; however, this unit of injuries can easily be recalculated for any squad size. The authors recommend that this can be done when surveying multiple teams in a competition.
Cricket Team	A team consists of 12 players, with 11 active players and one 12th man (Orchard et al., 2005).
Epidemiology	The study of the distribution and the causes of health-related states and events within a population (Dicker et al., 1992).
First-Class Match	First-class matches are those with a duration of three or more days between two sides of 11 players played on natural turf pitches and substantially conforming to the International Cricket Council standard playing conditions (International Cricket Council, 2020).
General Time-Loss Injury	Injury (or illness) that results in a player being considered unavailable for match play, irrespective of whether a match or training had been scheduled (Orchard et al., 2016b).
Imaging-Abnormality Injuries	Condition(s) which give rise to abnormal findings on specific medical imaging. This definition is not recommended for general injury surveillance. It should only be used in studies that examine a specific body part or cricket injury type (e.g., lumbar bone stress injuries) in conjunction with other (clinical) definitions (Orchard et al., 2016b).

Glossary of Terms continued

TERM	DEFINITION
Injury Incidence	According to the updated international consensus statement on injury surveillance in cricket, injury incidence analyses the number of new injuries (or new plus recurrent) occurring over a given time. These time periods include match, training, seasonal, and yearly injury incidence (Orchard et al., 2016b).
Injury Prevalence	According to the initial consensus, injury prevalence considers the average number of squad members unavailable for selection through injury or illness for each match divided by the total number of squad members. It should be expressed as a percentage, representing the number of players missing through injury on average for that cohort for the season in question. It is calculated using the numerator of missed player games with a denominator of number of games multiplied by squad members. According to the initial statement, it should be calculated separately for the different formats of cricket. When combined, the units should be converted from missed player games into missed player days, so, for example, that each test match contributes more to overall injury prevalence than each one-day match. The injury surveillance coordinator should keep records of all matches played by squad members and ensure that each team provides an explanation to the survey whenever one of their players was not selected (Orchard et al., 2005). The common reasons for missing games (with summary codes) are: I – injury; U - unavailable due to national team commitments (for domestic squads); T - selected as 12th man; N - not selected (including when rested); and O - not available for other reasons (Orchard et al., 2005). The updated consensus states that injury prevalence, as calculated according to the initial consensus statement, should be considered as match-injury prevalence. The method of calculation has remained the same with a match-injury prevalence of 10%, indicating that 10% of players were not available for selection due to injury or illness for matches played during the surveyed period (Orchard et al., 2016b). General injury prevalence can be calculated by considering the daily status of a 365-day period or over the time frame of a tournament, as it considers injuries that occur during training as well as matches.
Injury Rate	Injury rate can be defined as the number of injuries per athletic hour of exposure (Soomro et al., 2018).
Injury Surveillance	Injury surveillance is the ongoing collection of data that describes the occurrence and factors associated with injury (Finch, 1997).

TERM	DEFINITION
Match-Injury Incidence	The initial consensus statement only considers injuries occurring during matches, and can be calculated with a time-based unit (denominator) or a delivery-based denominator when considering batting or bowling injuries separately (Orchard et al., 2005). The stayed the same as the previous consensus except that the denominator can be stated as injuries per number of player hours or number of player days. Match injuries are also encouraged to be calculated separately for the different phases of play (batting, bowling, fielding). The delivery-based calculation was also maintained. The new recommended incidence unit is match injuries per 1000 player days. The calculation of bowling or batting injuries should be performed with a delivery-based denominator of per 10 000 deliveries bowled or faced. Bowling calculations can also be converted into injuries per 1000 overs as one over equals to six deliveries. Guidelines suggested for match-injury incidence in total, with a time-based denominator. The numerator should be the number of new match injuries or new and recurrent match injuries (Orchard et al., 2005). The denominator should be the number of player hours of exposure per team. The authors have given specific guidelines for different types of cricket matches. These standardised rates do not consider days in which the game is shortened or has a slow over rate. However, the authors did note that in cases in which whole days of play are lost, this should be accounted for in exposure (Orchard et al., 2005). These rates did not provide guidelines for Twenty20 cricket. For the calculation of batting or bowling match-injury incidence using a delivery-based denominator, the numerator should be the number of new injuries or total injuries (new plus recurrent injuries). The denominator for bowling match injuries should be overs bowled, with a preferred unit of injuries per 1000 overs bowled. The denominator for batting match injuries should be deliveries faced, with a preferred unit of injuries per 10 000 balls faced (Orchard et al., 2005). A specific incidence for fielding was not recommended by the authors, with wicket-keeping injuries being the exception.
Match Time-Loss Injury	A match time-loss cricket injury was defined in 2005 as any injury or other medical condition that either prevents a player from being fully available for selection for a major match or, during a major match, causes a player to be unable to bat, bowl, or keep wicket when required by either the rules or the team's captain (Orchard et al., 2005).
Medical Attention Injuries	Any health-related condition that required medical attention and had the potential to affect cricket training or playing. Includes time-loss and non-time-loss injuries (Orchard et al., 2016b).
One-Day International Match (ODI)	Played in accordance with the International Cricket Council (ICC) standard One-day International (ODI) playing conditions and other ICC regulations pertaining to ODI matches, and are between any teams participating in and as part of the ICC Cricket World Cup or the Asia Cup, or full-member teams, or a full-member team, and any of the 'Top 8' associate teams or 'Top 8' associate and a composite team selected by the ICC as representative of the best players from the rest of the world (International Cricket Council, 2020).

TERM	DEFINITION
Player-Reported Injuries	A condition which was considered to represent an injury by the player or parent or teacher in the case of junior players in the absence of medical staff. A highly subjective definition which requires player engagement with injury surveillance. Only recommended for community cricket where there are no medical staff (Orchard et al., 2016b).
Prevalence	Injury prevalence considers the average number of squad members not available for selection through injury or illness for a given time, divided by the total number of squad members (Orchard et al., 2016b).
Professional Athlete	A player that receives a salary for playing the sport and includes players that take part in international and first-class games (Yeban, 2023).
Seasonal- and Yearly-Injury incidence	The updated consensus statement advised that the previously recommended squad size and number of days in a season was no longer representative of international cricket with the calendar now 9-12 months long for majority of teams (Orchard et al., 2016b).
Seasonal-Injury Incidence	Seasonal incidence considers the number of defined injuries occurring per squad per season. This can consider gradual onset injuries, training injuries and match injuries in the one measurement.,
Sprain	A sprain is an injury to the band of collagen tissue i.e., a ligament, which connects two or more bones to a joint (Bahr et al., 2012).
Squad	A squad is defined as 25 players and a season is defined as 60 days of scheduled match play (Orchard et al., 2005).
Strain	A strain to muscle or muscle tendon is the equivalent of a sprain to ligaments. A muscle strain occurs when muscle fibers cannot cope with the demands placed on them by exercise overload and leads to tearing of the fibers (Garrett Jr, 1996).
Test Match	Test matches are those which are played in accordance with the International Cricket Council (ICC) standard test match playing conditions and other ICC regulations pertaining to test matches and are between teams selected by full-members of the ICC as representative of the member countries (full member teams) or a full-member team and a composite team selected by the ICC as representative of the best players from the rest of the world (International Cricket Council, 2020).
Training-Injury Incidence	To be measured separately to match injury incidence, can be measured in units of injuries per 1000 overs bowled or injuries per 1000 balls bowled if this information is available. An alternate unit that may be developed is bowling injuries per 100 days of training bowling exposure (Orchard et al., 2005). The updated consensus promoted the quantification of bowling loads (counting the number of deliveries bowled at training and at matches). They also advised using the same units of calculation, per 10 000 deliveries bowled.

TERM	DEFINITION
Twenty20 International Match	Played in accordance with the International Cricket Council (ICC) standard Twenty20 international playing conditions and other ICC regulations pertaining to Twenty20 matches between any teams participating in and as part of the ICC Men's T20 World Cup or between teams both of whom are either Full or Associate Members. Any other matches between a full member and a world XI of suitable calibre that the ICC Board, by exception and in advance, decides to award T20I status (International Cricket Council, 2020).
Wicket-Keeper	A player who has kept wicket for more than 10% of overs that they have been on the field for, meaning that part-time wicket keepers are defined as wicket keepers rather than batters (Orchard et al., 2016b).

ABSTRACT

Background

Sports injuries have been reported to place pressure on global health systems. To lessen this pressure, sports medical staff play an important role in injury prevention. Injury surveillance is the starting point for injury prevention. To date, there are two consensus statements on injury surveillance in cricket. There are no studies that have reviewed the strategies used to monitor injury among amateur and professional cricketers. Reviewing the current strategies may provide guidance to future researchers and role players on the status of injury surveillance among amateur and professional cricketers.

Aims

- The overall aim of the present study was to review the existing literature regarding injury surveillance strategies used to monitor injury among amateur and professional cricketers, as well as to assess the reporting of these findings according to both of the cricket injury surveillance consensus statements. In addition to this, this study set out to achieve the following objectives: to describe the surveillance strategies currently used to monitor injuries in amateur and professional cricket players; to assess the methodological quality of the included studies; to assess the reporting of injury surveillance data for amateur and professional cricket players according to the 2005 and 2016 injury surveillance consensus statements; and to make recommendations for future surveillance studies based on the findings of the present study.

Methods

This study employed an integrative review methodology. The following databases were searched independently by two reviewers (UJ and BB): PubMed through Medline, SPORTDiscus, the Cumulative Index to Nursing and Allied Health (CINAHL), Scopus, and ScienceDirect. The researchers searched for publications using a combination of search terms, which were identified by performing a preliminary search of the above-mentioned databases and by discussing the proposed search terms with the university's librarian. Searches were conducted to find keywords within the full text and not only within the title. These keywords included a combination of the following terms: "surveillance," "strategy," "amateur," "professional," "cricket," and "injury." Following, a more comprehensive search of these databases was performed. This included relevant Boolean operators such as "AND" and "OR." Truncation was used for the words "strateg*" and "injur*" to provide a wider range of results (see Appendix A for the final search terms per database). Finally, the researcher searched for grey literature on Google Scholar and Open Access Thesis and Dissertations (OATD). The search strategy was documented according to the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram (Appendix A).

The review process was informed by the 2020 PRISMA statement. A three-step process was followed, namely: Identification (title reading), Screening (abstract reading), and Eligibility (full-text reading; Page et al., 2021a). This process allowed for the removal of publications that did not meet the inclusion criteria. The methodological quality of the eligible publications was also assessed independently by two researchers (UJ and TS) to reduce bias and maximise validity.

The 2018 version of the Critical Appraisal Skills Programme (CASP) tool for cohort studies was used to appraise all prospective publications and an adapted version was used for retrospective publications (Appendix B).

For publications from 2006 to 2015, a self-developed data extraction table was used based on the initial consensus statement of 2005 (Appendix C). For those published from 2016 onwards, a data extraction form based on the 2016 consensus statement was used (Appendix D). The data extraction tables allowed the researcher to achieve the research aims and objectives. Data was presented via a narrative synthesis methodology. Both injury consensus statements were employed as a guideline for this integrative review. Ethical approval and permission to conduct this study was obtained from the University of the Western Cape's (UWC) Humanities and Social Sciences Research Ethics Committee (HSSREC; Appendix E).

Results

A total of 37 publications were included in this study, comprising of 33 journal articles and four theses. Sixteen publications were published in the period of the initial consensus statement and 21 were published after the updated consensus statement. Most publications only surveyed professional cricketers (89%, 33/37). Only two publications (5.5%) surveyed amateur cricketers exclusively, with the remainder of the publications surveying both amateur and professional cricketers. The majority of included publications surveyed male athletes exclusively (78%, 29/37), while 11% (4/37) exclusively reported on female cricketers. The remaining 11% of publications surveyed both male and female cricketers. The included publications were published in six different countries.

Although one publication included cricketers from Sri-Lanka, it was published in Australia. The United Kingdom had the greatest total number of publications (35%, 13/37). Australia and South Africa had 11 (30%) and six publications (16%) respectively, while India and New Zealand had three (8%) publications each. The West Indies only had one (3%) publication.

Two major strategies of monitoring injury in cricketers were identified from the included publications. The most common overall strategy was via medical staff entering injury data into the national injury surveillance system (35%, 13/37). This strategy was also most used in publications that surveyed injury among professional cricketers (39%, 13/33). The second most common overall strategy was via medical staff entering data into an online database (27%, 10/37). The most common strategy of monitoring injury in amateur cricketers was via self-administered questionnaires (75%, 3/4), while one publication reported medical staff entering injury data into an online database (25%, 1/4). Two publications failed to mention their injury surveillance strategy (5%, 2/37). The two least used injury surveillance strategies were telephonic and self-reported strategies (3%, 1/37).

Regarding the methodological quality of the included publications, 37 publications underwent a methodological quality assessment via the 2018 CASP for cohort's checklist. All publications addressed a clearly focused issue as well as recruited participants in an acceptable manner. In seven publications, the researchers were unsure of the accuracy of the exposure measurement. Furthermore, six publications exhibited ambiguity regarding outcome measure bias.

Nine publications lacked design or the identification confounding factors, while uncertainty surrounding subject follow-up completeness and duration was identified in prospective studies, affecting 34% of the publications.

Majority of the publications (59%, 22/37) did not mention following consensus guidelines when classifying players, while several authors followed their own guidelines when classifying cricketers into roles (11%, 4/37). Others divided players into the activity being performed when injured (14%, 5/37). Only 8% (3/37) of authors followed the consensus guidelines when classifying players. Regarding the compliance to consensus injury definitions, there was an increased variability in injury definitions used after the publication of the second consensus statement, with most authors following the consensus injury definitions (59%, 22/37). Of the publications that used the updated consensus statement, the medical attention and general time-loss injury definitions were used by 27% (6/22) of the authors. While the match time-loss injury definition was used by 47% (7/15) of the publications using the initial consensus, it was used less often as the sole injury definition after the updated consensus was published (14%, 3/22).

Of the two publications that surveyed injury among amateur cricketers exclusively, only one measured injury incidence using the consensus guidelines. Publications that surveyed injury among amateur and professional cricketers and did not follow consensus guidelines, also did not have a unit of calculation.

Of the 14 publications that exclusively surveyed injury among professional cricketers, five (38%) did not have a consensus injury incidence method.

Match-injury incidence was calculated 57% of the time in the initial group for professional cricketers. The consensus unit of calculation was used for all, with days of exposure measured in three publications (38%) as well.

After the publication of the updated cricket injury surveillance consensus statement, match-injury incidence was still the most used injury incidence measure (58%). There was a slight decrease in the number of publications that did not follow a specific injury incidence measure (32%, 6/19). The updated unit of measurement was used 73% of the time that match-injury incidence was used. The older unit of measurement (i.e., per exposure hours) was used by two publications, with only one using it as the exclusive unit of calculation. The new unit for calculating seasonal-injury incidence was used 21% of the time (4/19). All of these times it was used correctly. Medical-complaint injury incidence was used once only. Non-time loss and time-loss injury incidence was each measured once, with the unit of calculation being per 100 and 1000 player days, respectively. Regarding injury prevalence measures in amateur cricketers, only one (25%) of the studies used a consensus measure of injury prevalence (i.e., match-injury prevalence).

Conclusion

The injury surveillance consensus statement should be followed by studies that survey injury among professional cricketers. Regarding the methodological quality of the included publications, concerns were raised regarding the accuracy of exposure measurement and outcome measure bias in several publications. Confounding factors such as identification and design were often overlooked by authors. The usage of standardised injury rate measures will allow for easier comparison across studies.

Individual cricketing nations do have long-term injury surveillance systems, which make up most injury surveillance data in professional cricket. The publications that focus on amateur cricketers are primarily shorter-term independent research projects. Key role players in cricket injury surveillance should develop clear guidelines for the surveillance of injury among adult amateur cricketers. Narrow injury definitions that require less personnel and republications are recommended for injury surveillance among amateur cricketers. Self-reported measures may be most appropriate when surveying injury among amateur cricketers.

CHAPTER ONE: INTRODUCTION

1.1 Background

Cricket is a global sport that is played by both amateur and professional players. An amateur athlete is one that does not receive payment for participating in their respective sport, while a professional athlete refers to a player that is 18 years and older who receives payment for participating in their sport (Yeban, 2023). Cricket has three major formats, namely test cricket (i.e., 5-day cricket or multi-day cricket), one-day cricket (i.e., 50 overs), and the Twenty20 (T20) format. Cricket has become an increasingly popular sport at both amateur and professional levels (Orchard et al., 2009). Each format requires different physical demands. The T20 format is arguably the most intense and is restricted to 20 overs per side, which is far less than the 50 over format and the multi-day matches (Dovbysh et al., 2021; Petersen et al., 2009). The T20 format requires players to execute their skills with precision, under high levels of fatigue, and requires 50-100% more maximal sprints per hour for all players when compared to multi-day matches (Petersen et al., 2010). Players also have less recovery time between overs due to the shorter format (Petersen et al., 2009).

An increase in physical demands can increase injury risk and incidence of injury among athletes (Gabbett, 2016). Cricketers are exposed to varying workloads across formats and higher playing intensities, regardless of their playing roles (Orchard et al., 2009). Spikes in workloads are difficult to manage due to the varying formats of cricket and fewer rest days in a season (Gabbett, 2016), with T20 cricket having the highest new match-injury incidence at both domestic and international levels compared to the other formats of the game (Dovbysh et al., 2021).

Across all formats, international players also have a higher injury incidence when compared to their domestic counterparts (Dovbysh et al., 2021; Mansingh et al., 2006). Global leagues often recruit players of international status, which may result in international players participating in higher intensity and more physically demanding matches throughout the season (Dovbysh et al., 2021).

To increase their income, many players have opted to play international shorter format tournaments throughout the year, instead of only playing for one team. This has increased the number of matches being played by elite cricketers. The increased number of matches played increases the cricketers' risk of injury (Gabbett, 2016).

Cricket players of different ages and gender suffer different injuries within the different levels and formats of the game (Stretch, 2015). Publications that surveyed amateur cricketers have reported differences in injury rates and causative factors (Finch et al., 2010; Soomro et al., 2018; Stretch, 2015). These differences may be due to more injuries occurring in specific bodily regions in certain populations, contrasting biomechanics, levels of conditioning, or age (Dennis et al., 2005; Soomro et al., 2018). Amateur cricketers also have different injury locations in comparison to elite cricketers (Soomro et al., 2018).

Among cricketers, batsmen (41.6%) and bowlers (54.3%) are mostly injured (Dovbysh et al., 2021). This may be due to the fact that fast bowling in cricket is a unique and complex movement pattern which consists of extreme trunk movements (Ranson et al., 2008), large vertical ground reaction forces (Worthington et al., 2013), and high repetitive workloads (Orchard et al., 2015a; Petersen et al., 2010).

In addition, fast bowlers play the most physically demanding position compared to other cricketing positions, thereby further amplifying their risk of injury (Petersen et al., 2010).

Sport governing bodies and professional teams strive to prevent the occurrence of injury to reduce the number of missed days for a player during a season and to optimise performance throughout the season (Finch & Staines, 2018). Injury surveillance is an important initial component in the prevention of injury. Injury surveillance is the standardised, routine, and ongoing process of collecting data relating to injury occurrence and its causes (Finch, 1997). It seeks to collect injury data in a standardised method, to form the basis of providing safe opportunities for all sports players. There have been far fewer publications that have investigated injury surveillance in amateur cricketers in comparison to professional players (Olivier et al., 2022). In 2002, cricket was the first sport to publish recommended methods for injury surveillance (Orchard et al., 2002). This provided an outline as to what information should be collected. The initial consensus statement on injury surveillance in cricket was later updated in 2016, in line with the progression of the sport (Orchard et al., 2016a).

Key role players, such as cricket management members, need to be aware that different populations of cricket players are more prone to specific types of injuries at different points in time. For instance, a female cricketer may be more prone to shoulder and ligamentous type injuries; therefore, injury prevention strategies should be specific to the athlete (Orchard et al., 2023).

Furthermore, it is of utmost importance that studies regarding injury surveillance in amateur and professional cricketers are reviewed to determine whether they adhere to the current consensus statements relating to injury surveillance, and to formulate recommendations for future research regarding injury surveillance.

1.2 Problem Statement

The major roles of modern sports medicine include the mitigation of injuries and the process of making sports safer for all, regardless of age or level of participation (Emery & Pasanen, 2019). Recent studies have suggested that injuries suffered during participation in sports are preventable (Emery & Meeuwisse, 2010; Nouni-Garcia et al., 2018; Stephenson et al., 2021). It is also clear that cricket players of different ages and levels of participation suffer different types of injuries (Stretch, 2015). These injuries may have long- and short-term implications on the lives of cricketers. Short-term effects include being unavailable for selection and the associated negative psychological impact thereof (Clement et al., 2015). Injuries within a team may also affect the performance of the team during a competition and may play a role in the team being relegated from a division (Hägglund et al., 2013). Professional athletes depend on their bodies to attain an income. Long-term effects include that sports injuries may decrease the duration of an athlete's professional career, their ability to earn a livelihood, and their quality of life (Secrist et al., 2016). Cricket is often viewed as a sport that has very little risk of injury due to it being a non-contact sport. Hence, the prevalence and risk of injuries is very often overlooked by players and coaches alike (Orchard et al., 2016a). The growing interest in cricket has created a greater demand for players to participate throughout the year.

An increase in the number of matches played has also been linked to an increase in overuse injuries (Soomro et al., 2018).

The lack of injury prevention programmes may be partially due to the absence of standardised injury surveillance strategies as well as the lack of standardised reporting of injury data, which forms the basis of these programmes (Ekegren et al., 2016). Capturing of injury data at community level is often performed by volunteers and is not mandatory due to financial constraints (Ekegren et al., 2014). At a professional level, injury data is captured by the team medical staff, who perform this role as part of their contractual obligations (Olivier et al., 2022). These challenges contribute to the lack of standardised injury surveillance strategies and reporting of injury data (Olivier et al., 2022). There have been far fewer publications that have reported on injury surveillance in amateur cricketers in comparison to professional players. Therefore, the present study seeks to compare injury surveillance strategies across amateur and professional cricketers. In addition, this integrative review will also provide a narrative of both the previous and current injury surveillance strategies used in cricket at both amateur and professional levels, while using the two published consensus statements as a guideline.

1.3 Rationale and Significance of the Study

Sports injuries are a known concern to the public, as it places pressure on health systems as well as on the athletes themselves (Timpka et al., 2006). Furthermore, they are the leading cause of injury among the youth (Emery & Tyreman, 2009). Professional cricketers have been playing an increased number of matches throughout the year and more individuals are playing amateur cricket, which may expose both groups of players to a higher injury risk.

To prevent injury among cricketers, there needs to be a focus on high-quality practical injury surveillance strategies. However, most injury surveillance strategies exist within professional sports settings only (Ekegren et al., 2016). The present study will identify the injury surveillance strategies currently being employed in both groups of cricketers and expand on the high-quality practical injury surveillance strategies that can be employed in each respective group.

Although consensus statements can provide a useful starting point for injury surveillance strategies, they often fail to acknowledge the challenges of implementing these guidelines at an amateur level (Ekegren et al., 2016). Data from injury surveillance systems are a prerequisite for the development and evaluation of injury prevention strategies (Ekegren et al., 2016). Therefore, injury prevention strategies need to be underpinned by high-quality injury surveillance data. It is of utmost importance that the strategies employed in injury surveillance as well as the way data is reported are reviewed. The findings of this review may assist in improving the quality of injury surveillance data being collected and the standardisation of injury reporting to obtain more accurate measures of injury frequency. This may assist with the development of appropriate evidence-based injury prevention strategies in both amateur and professional cricket.

1.4 Research Questions and Specific Objectives

The primary research question for the present study is: What surveillance strategies are being employed to monitor injuries in amateur and professional cricket players? The specific objectives included, to:

- describe the surveillance strategies currently used to monitor injuries in amateur and professional cricket players;
- assess the methodological quality of the included studies assessing injury surveillance in amateur and professional cricket players;
- assess the reporting of injury surveillance data of amateur and professional cricket players according to the 2005 and 2016 injury surveillance consensus statements; and
- make recommendations for future surveillance studies based on the findings of this study.

1.5 Overall Aim of the Study

The aim of the present study was to review existing literature regarding the injury surveillance strategies being used in amateur and professional cricket, as well as to assess the reporting of these findings according to the 2005 and 2016 injury surveillance consensus statements.

1.6 Outline of Chapters

Chapter One has introduced the topic of injury surveillance in cricket, the context of the study, the problem statement, and the rationale for the study. It has also outlined the study's aims and specific objectives. Finally, definitions of the terms employed throughout the dissertation have also been explained.

Chapter Two includes the literature review which discusses the incidence and prevalence of injuries among amateur and professional cricketers. In addition, injury prevention and surveillance strategies within cricket is also discussed.

Chapter Three describes the methodology employed to conduct the integrative review and outlines the steps used to include and exclude cricket injury surveillance publications. It also explains the systematic methods used to extract data from the included publications and details the ethical considerations employed in the data extraction process.

Chapter Four pertains to the presentation of results and their subsequent discussion. These include presenting the characteristics of the included studies, cricket injury surveillance strategies, and their comparison to the two injury surveillance consensus statements in cricket.

Chapter Five discusses the main findings outlined in Chapter Four (Results). In addition, it outlines the practical implications of these results.

Chapter Six discusses the concluding points and limitations of this study. It also makes practical and research-based recommendations based on the study's findings.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter discusses the incidence and prevalence of injuries among both amateur and professional cricketers, common injuries in cricket, cricket-specific injury prevention strategies, injury surveillance in cricket, and the two cricket injury surveillance consensus statements, which are the framework of the review. The injury prevention strategies that will be discussed includes the Van Mechelen Model (Van Mechelen et al., 1992), the Translating Research into Injury Prevention Practice framework (TRIPP; Finch, 2006), and the Team Sport Injury Prevention cycle (TIP; O'Brien et al., 2019).

2.2 Injury Incidence in professional cricketers.

Injury incidence relates to the occurrence of a new or recurrent sports injury in an athlete within a specified period (Nielsen et al., 2019). Injury incidence measures may assist coaches and clinicians in answering important sports injury questions. These questions include why sports injuries occur and what can be done to prevent them (Nielsen et al., 2019). Furthermore, they assist in determining whether current preventive measures are effective. The original cricket injury surveillance consensus statement recommends that injuries should be calculated as injuries per 10 000 player hours. This unit of calculation was problematic as it occasionally over-estimated injury incidence in the T20 format (Goggins et al., 2021). The initial definition of injury only included those that caused a player to miss match playing time (i.e., match time-loss injury).

This focus on match-injury incidence was later refined within the updated international consensus statement on injury surveillance in cricket to the number of new injuries (or new plus recurrent injuries) occurring over a given period (Orchard et al., 2016b). These time periods include match, training, seasonal, and yearly injury incidence. Injury incidence can also be calculated for non-time loss injuries that includes medical attention injuries (Orchard et al., 2016b). The increase in workload variations due to T20 cricket being added led to the need for revised consensus definitions. Perhaps the most important of the new definitions was match-injury incidence being measured in injuries per 1 000 days of play, which better enabled comparisons between the different forms of cricket (Orchard et al., 2016b).

Data from injury surveillance in cricket has been reported from South Africa, England, West Indies, Australia, India, and New Zealand (Dhillon et al., 2012; Dovbysh et al., 2021; Leary & White, 2000; Mansingh et al., 2006; Orchard et al., 2002; Orchard et al., 2016a; Stretch & Venter, 2003). Four of the publications included in Table 2.1 below were from the developing countries of South Africa, West Indies, and India (Cowan, 2006; Dhillon et al., 2012; Mansingh et al., 2006; Stretch & Raffan, 2011). The majority of publications came from developed countries including Australia, New Zealand, and the United Kingdom.

The incidence of cricket injuries between players at domestic and international level differs significantly, evident in Table 2.1 below (Dovbysh et al., 2021). International cricketers have an injury incidence 1.7 times higher than that of their domestic counterparts for total new and recurrent match-injury incidence (Dovbysh et al., 2021).

This is because international cricketers are sought after in physically demanding global T20 tournaments (Dovbysh et al., 2021; Petersen et al., 2010). This exposes the international cricketer to a higher cumulative overall workload, which decreases the total amount of resting days in a season and increases the physical demands on the player.

The New Zealand international cricket team had a match-injury incidence of 58 injuries per 10 000 hours/277.6 per 1000 player days. Domestic cricketers in New Zealand had a match injury incidence of 37 injuries per 10 000 hours/162.8 per 1000 player days (Dovbysh et al., 2021). Domestic cricketers in South Africa had a higher injury incidence of 90 per 10 000 hours, while domestic cricketers in India had a much lower injury incidence of 3.27 injuries per 10 000 hours – which can be considered an outlier in the data (Dhillon et al., 2012; Stretch & Raffan, 2011). The high injury incidence in Australian cricketers is possibly due to their calculations being based on injuries sustained only during international and first-class matches, with the assumption that elite players play more intense cricket and have higher injury rates (Soni et al., 2015). The highest match-injury incidence rate per 10 000 player hours has been reported in the T20 format (144.2 injuries), compared to one-day international cricket (92.7 injuries), and test cricket (23.4 injuries; Dovbysh et al., 2021). This is also the case in elite women's cricket, with T20 matches having a match-injury incidence of 122.1 per 10 000 player hours (Panagodage Perera et al., 2019).

This may be due to the restrictive nature of the 20-over format that places more pressure on players and a higher intensity of play is required. This also depends on the unit used to measure injury incidence, as mentioned previously.

As reported in Table 2.1 below, when measuring injury incidence according to the updated consensus recommendation (i.e., injuries per 1000 player days), the injury rates change. International one-day cricket has the highest injury incidence (486 injuries per 1000 days), followed by T20 cricket (400 injuries per 1000 days), and test cricket (118.3 injuries per 1000 days; Dovbysh et al., 2021). This may be due to fewer overs being played compared to one-day and multi-day matches (Orchard et al., 2010). Measuring the number of injuries per 1000 player days is therefore recommended to better represent the actual risk (Orchard et al., 2016a). In elite female cricketers, the injury incidence measured in a single T20 international tournament was 14.3 injuries per 100 match days (Warren et al., 2019).

The average match-injury incidence for match time-loss injuries among elite cricketers is 155 injuries/1000 days of play (Orchard et al., 2016a). The highest daily rate of injury occurred in the 50-over format, followed by the T20 format, and first-class matches (Orchard et al., 2016a). As reported in Table 2.1, non-time loss injury incidence measures have consistently yielded a higher injury incidence when compared to time loss measures (Goggins et al., 2021; Panagodage Perera et al., 2019). Possible reasons for this include the overreporting of chronic injuries and, conversely, improved injury surveillance. Authors have chosen various injury definitions and measures of injury incidence, making comparison across the publications challenging.

Table 2.1 Incidence of Injury in Professional Cricketers.

SOURCE & COUNTRY OF PUBLICATION	GENDER & AGE OF POPULATION	INJURY INCIDENCE IN PROFESSIONAL CRICKETERS
Cowan (2006) RSA	Females Age not reported	Only counted the total amount of injuries
Dhillon et al. (2017) IND	Males 19-34 years	3.27 per 10 000 player hours
Dovbysh et al. (2021) NZ	Males Age not reported	37.0 match injuries per 10 000 player hours per season for all domestic formats in elite cricket
Dovbysh et al. (2021) NZ	Males Age not reported	58 match injuries per 10 000 player hours per season across all international formats in elite cricket
Dovbysh et al. (2021) NZ	Males Age not reported	277.6 injuries per 1000 player days across all international formats
Dovbysh et al. (2021) NZ	Males Age not reported	162.8 injuries per 1000 player days across all domestic formats
Goggins et al. (2020a) UK	Males Age not reported	Average match injury incidence of 102 injuries per 1000 days of play for domestic cricket across all formats
Goggins et al. (2020a) UK	Males Age not reported	254 injuries per 1000 days of play for one-day domestic cricket, 136 injuries/1000 days of play for T20 cricket, and 68/1000 days of play for first-class cricket
Goggins et al. (2021) UK	Females Age not reported	7.0 match time loss injury per 1000 player match days. Medical complaint incidence per 100 players per year per body region: 47.4 per 100 players for time loss and 182.1 per 100 players for non-time loss
Mansingh et al. (2006) WI	Males 18-37 years	48.7 per 10 000 player hours in international test cricket
Mansingh et al. (2006) WI	Males 18-37 years	40.6 per 10 000 player hours in one-day international cricket
Mansingh et al. (2006) WI	Males 18-37 years	13.9 per 10 000 player hours for first-class cricket
Mansingh et al. (2006) WI	Males 18-37 years	25.4 per 10 000 player hours for one-day domestic cricket
Orchard et al. (2006) AUS	Males Age not reported	24.2-37 match injuries per 10 000 player hours across all formats including international and domestic cricket
Orchard et al. (2016a) AUS	Males Age not reported	33-80.3 per 10 000 player hours for one-day international cricket

Table 2.1 continued

SOURCE & COUNTRY OF PUBLICATION	GENDER & AGE OF POPULATION	INJURY INCIDENCE IN PROFESSIONAL CRICKETERS
Orchard et al. (2016a) AUS	Males Age not reported	19.8-32.3 per 10 000 player hours in first-class domestic cricket
Orchard et al. (2016a) AUS	Males Age not reported	8.8-62.9 per 10 000 player hours in test cricket
Orchard et al. (2016a) AUS	Males Age not reported	Annual injury incidence among elite male cricketers of 64injuries/100 players per season
Panagodage Perera et al. (2019) AUS	Females 24.2+- 4.5 years	79.3 injuries per 10 000 player hours for time-loss injuries and 424.7 injuries per 10 000 player hours for all injuries (medical attention) for elite cricketers
Stretch and Raffan (2011) SA	Males Age not reported	Average match injury incidence of 90 injuries per 10 000 player hours
Stretch and Raffan (2011) SA	Males Age not reported	79 injuries per 10 000 player hours for one-day international cricket
Stretch and Raffan (2011) SA	Males Age not reported	95 injuries per 10 000 player hours for test match cricket
Warren et al. (2019) UK	Females 16-38 years	Overall incidence of injury among elite T20 cricket in a single tournament study of 14.3 per 100 match days

AUS - Australia, IND - India, NZ - New Zealand, SA - South Africa, UK - United Kingdom, WI - West Indies.

2.3 Injury Incidence in Amateur Cricketers

As presented in Table 2.2 below, the shorter match formats (i.e., T20 and 50 over) had a higher injury incidence per 10 000 player hours compared to longer formats (Soomro et al., 2018). It is noteworthy that while several publications surveyed injury among amateur cricketers, injury incidences were not measured (Bullock et al., 2020; Cai et al., 2019; Olivier et al., 2014). As with professional cricketers, various injury definitions and measures of injury incidence have been used, which makes it difficult to compare this across studies (Dutton et al., 2019; McLeod et al., 2020). Further, publications that made use of hospital registers used different injury incidence rates by calculating injury per 100 000 of the population (McLeod et al., 2020).

The publications included in Table 2.2 below are all independent research projects and were not part of continuous injury surveillance systems within amateur cricket. Furthermore, only one of the publications from the table below was from a developing country (Olivier et al., 2014).

Table 2.2 Incidence of Injuries in Amateur Cricket Players.

SOURCE & COUNTRY OF PUBLICATION	GENDER & AGE OF POPULATION	INCIDENCE OF INJURIES AMONG AMATEUR CRICKETERS (RECREATIONAL)
Bullock et al. (2020) UK	Males & Females 51.7 years (mean)	Not reported - looked at number of players who played with pain
Cai et al. (2019) UK	Male & Female 59-64 years	Pain incidence instead of injury (48%)
McLeod et al. (2020) AUS	Males 5-64 years	54.6 per 100 000 (Population) – emergency department visits
McLeod et al. (2020) AUS	Males 5-56 years	14.2 per 100 000 (Population) – hospital admission
Olivier et al. (2014) SA	Males 18-26 years	Note reported - number of injuries only
Soomro et al. (2018) AUS	Gender not reported 14-53 years	35.54 injuries per 10 000 playing hours for grade cricketers/club
Soomro et al. (2018) AUS	Gender not reported 14-53 years	32.56 (mean) injuries per 10 000 player hours for shorter formats (1 day and T20)
Soomro et al. (2018) AUS	Gender not reported 14-53 years	16,67 (mean) injuries per 10 000 player hours for longer formats

AUS - Australia, SA - South Africa, UK - United Kingdom.

2.4 Prevalence of Cricket Injuries

Injury prevalence is calculated by dividing the average number of players unavailable for a match by the total number of squad members. This is important as it gives the proportion of cricketers who are injured at any point within a season. As with injury incidence, prevalence is dependent on the type of injury definition that is employed. Injury prevalence is usually measured across levels and formats of the game with domestic and international players (Dovbysh et al., 2021).

As reported in Table 2.3 below, cricket has an injury prevalence of approximately 5% for batsmen, wicket-keepers, and slow bowlers, increasing to between 15–20% for fast bowlers (Frost & Chalmers, 2014; Orchard et al., 2016a). The most prevalent injury among professional male cricketers has been reported as lumbar stress fractures (Orchard et al., 2016a).

One-day international (ODI) cricket has the highest injury prevalence (14.9%), followed by test cricket (13.6%), domestic 50-over cricket (12.3%), domestic first-class cricket (12.2%), and T20 cricket (11.6%; Orchard et al., 2016a). The reasons for these variations in injury prevalence may be due to the higher workloads associated with the longer formats of cricket (Orchard et al., 2016a). Although the injuries in T20 cricket may be more in number, their recovery times are generally quicker compared to bone stress injuries that disproportionally affects injury prevalence (Orchard et al., 2016a). International cricket also has a higher injury prevalence (10%) compared to domestic cricket (7%; Dovbysh et al., 2021).

As reported in Table 2.3 below, an injury prevalence in community cricketers who are also considered amateur cricketers of approximately 4-5% is in line with injury prevalence rates in elite cricketers (Soomro et al., 2018). The highest prevalence among amateur cricketers was 35%. However, the study used a questionnaire regarding pain and injury, and included non-time loss injuries thereby increasing injury prevalence (Dube et al., 2018). Researchers have thoroughly described the prevalence of cricketing injuries that includes: prevalence of injury and availability for selection, non-availability for selection prevalence, and injury but modification of activity prevalence (Warren et al., 2019).

Table 2.3 Injury Prevalence in Amateur Cricketers.

SOURCE & COUNTRY OF PUBLICATION	GENDER & AGE OF POPULATION	PREVALENCE OF INJURIES AMONG AMATEUR CRICKETERS
Dube et al. (2018) ZIM	Males Adolescent	5% for adolescent (high school) cricketers
Olivier et al. (2014) SA	Males Adult	Not reported - looked at the number of injuries for club cricketers
Soomro et al. (2018) AU	Males 24.1 years (mean)	Average weekly prevalence of 4.06% for community level cricketers

AU – Australia, SA - South Africa, ZIM – Zimbabwe.

Table 2.4 Injury Prevalence in Professional Cricketers.

SOURCE & COUNTRY OF PUBLICATION	GENDER & AGE OF POPULATION	PREVALENCE OF INJURIES AMONG PROFESSIONAL CRICKETERS
Mansingh et al. (2006) WI	Males 18-37 years	11.3% for international test cricketers
Mansingh et al. (2006) WI	Males 18-37 years	8.1% for one-day international cricketers
Orchard et al. (2006) AUS	Males Age not reported	5.8%-11.3% for domestic one-day cricketers
Orchard et al. (2006) AUS	Males Age not reported	4.8%-11.2% for domestic first-class cricketers
Orchard et al. (2006) AUS	Males Age not reported	3.8%-13.7% for one-day international cricketers
Orchard et al. (2006) AUS	Males Age not reported	3.3%-11.5% for test cricketers
Orchard et al. (2006) AUS	Males Age not reported	1.6%-9.5% for batsmen
Orchard et al. (2006) AUS	Males Age not reported	0.4%-3.7% for wicket-keepers
Orchard et al. (2006) AUS	Males Age not reported	9.3%-19.5% for pace bowlers
Orchard et al. (2006) AUS	Males Age not reported	0.6%-10% for spin bowlers
Ranson et al. (2008) UK	Males 17-39 years (mean age = 27)	23% for all disciplines
Orchard et al. (2009) AUS	Males Age not reported	7.2%-11.4% for all disciplines

Table 2.4 continued

SOURCE & COUNTRY OF PUBLICATION	GENDER & AGE OF POPULATION	PREVALENCE OF INJURIES AMONG PROFESSIONAL CRICKETERS
Stretch and Raffan (2011) SA	Males Age not reported	4% for all disciplines
Ranson et al. (2013) UK	Males Age not reported	4.8% match injury prevalence
Frost and Chalmers (2014) NZ	Male Age not reported	12% for international cricketers, 9.7% for domestic cricketers
Orchard et al. (2016a) AUS	Males Age not reported	12.5% for elite cricketers, 20.6% for elite fast bowlers
Warren et al. (2019) UK	Females 16-38 years (mean age = 23.4 +/-4.8)	4.6% for elite injured T20 cricketers not available for selection
Rao et al. (2020) IND	Males 18-24 years	10.97% annual injury prevalence
Tysoe et al. (2020) UK	Males Mean age: 27 +/- 5.	14.6% match time loss
Goggins et al. (2021) UK	Females 14-31 years (mean age = 19.75 +/-4.03)	4.1% match time loss
Dovbysh et al. (2021) NZ	Males 18-38 years (mean age = 28.2)	7.6% for domestic cricket, 10% for international cricket

AUS - Australia, IND - India, NZ - New Zealand, SA - South Africa, UK - United Kingdom, WI - West Indies.

2.5 Common Injuries in Cricketers

Cricketers engage in the skills of batting, bowling, and fielding that require a wide range of movements (Pardiwala et al., 2018). Traditionally, most injuries in cricket have been attributed to overuse and non-contact type injuries (Chesterton & Tears, 2021). Adolescent pace bowlers are prone to injuries during their developmental years (Arnold et al., 2018). However, it is difficult to determine common injuries for batsmen, wicket-keepers, and slower bowlers in comparison to pace bowlers.

Majority of studies on all levels of cricket have given great importance to the pace bowler, and very few articles have related injury to other positions. Across nations, fast bowlers are the most prone to injuries, followed by batsmen, and fielders (Pote & Christie, 2018).

2.6 Most Common Injuries Related to Professional Cricketers

It is important to understand that limited research has been conducted on specific cricket disciplines (i.e., spin bowlers, batsmen, and wicket-keepers) other than fast bowlers (Pote & Christie, 2018). Therefore, an accurate understanding of the injury risks associated with batting, fielding, and wicket-keeping is lacking (Pote & Christie, 2018). Elite male pace bowlers have been most likely to sustain an injury (20.6%), followed by batsmen (7.4%), spin bowlers (6.7%), and wicket-keepers (4.7%; Orchard et al., 2016a). In contrast to the above, Dovbysh et al. (2021) reported that elite male spin bowlers were the least likely to sustain an injury, followed by wicket-keepers (Dovbysh et al., 2021). Both of the above-mentioned articles reported that elite pace bowlers were most likely to sustain an injury, followed by batsmen. Lower limb injuries are common among batsmen (Pote & Christie, 2018), while upper limb injury are common among wicket-keepers, which may be due to the nature of their role within the team that includes repetitive catching and diving (Pote & Christie, 2018).

Fast bowlers perform the most intensive cricketing activity, with less recovery time than any other activity in a T20 match (Petersen et al., 2009). The overall shorter duration of the T20 format reduces chronic workload, which may subsequently result in an acute workload spike when players are required to compete in longer formats (Hulin et al., 2013; McNamara et al., 2017; Petersen et al., 2009).

Across formats, repetitive strain injuries, projectile injuries, and fielding ground contact injuries are the most common (Orchard et al., 2016a; Pardiwala et al., 2018). Fast bowlers suffer lower back and abdominal injuries more than other disciplines (Pote & Christie, 2018). Common causes of lumbar stress fractures include workload and technique factors such as excessive shoulder counter-rotation and trunk lateral flexion associated with side-on, front-on, or mixed bowling actions (Elliott, 2000; Orchard et al., 2009).

The most common injury types among elite female cricketers are muscular injuries (31.8%) and ligamentous sprains (16%; Panagodage Perera et al., 2019). Panagodage Perera et al. (2019) reported that lumbar stress fractures caused 110 missed days per year on average and resulted in the most games missed per single injury.

2.7 Most Common Injuries Related to Amateur Cricketers

In amateur cricketers, the different disciplines (i.e., bowler, batsman, or fielder) present with similar injury sites and type of injury (Pote & Christie, 2018). Community cricketers most commonly suffer injuries to the lower back (19.8%), foot (14%), hand/wrist (12.8%), knee (10.5%), abdomen (9.3%), and calf (7%; Soomro et al., 2018). The top four injury regions among junior players include fingers (24.2%), shoulders (15.9%), ankle (11.9%), and back (11.9%; Das et al., 2014). In addition, Finch et al. (2010) reported that the most common injury regions among junior club cricketers were the upper leg (17%), hands/fingers (15%), back (13%), knee (11%), and hip/groin (10%). The most common nature of injury was bruising (32%), and half of all injuries were caused by being struck by the ball (Finch et al., 2010).

Interestingly, Stretch (2015) reported that under 15-year old and under 17-year old players suffered more injuries over five seasons compared to under 18-year olds. Possible reasons for this included that the under 15-year old players participated in less school cricket matches and their injuries were primarily recurrent (Stretch, 2015).

The causative factors for the increased rates of lower back injury in junior and community cricketers may be related to bone maturation, physical conditioning, previous injury profile, and playing surface (Soomro et al., 2018). However, there is not enough evidence on the nature and mechanism of injuries to help inform injury preventative strategies (McLeod et al., 2020). Junior bowlers are at the greatest risk of injury, and their lower limbs are the most common injury location (Stretch, 2015). However, injury patterns for schoolboy cricketers differed to those of adult cricketers (Stretch, 2015). Lower back injuries are concerning, as well as lower limb injuries, for all ages and roles of amateur cricketers (McLeod et al., 2020).

2.8 Common Locations of Injury in Professional Cricketers

In this section, it is worthwhile to note that not all authors divided common injuries among the disciplines (Warren et al., 2019). The rate of injuries in male cricketers was highest for bowling (43.1%), closely followed by fielding and wicket-keeping (28.6%), and batting (17.1%; Stretch & Venter, 2003). Among cricketers, the lower limbs, upper limbs, and torso were most injured in descending order (Stretch & Venter, 2003). The most severe injury in fast bowlers was a lumbar stress fracture, which is usually season ending (Orchard et al., 2010; Orchard et al., 2016a).

A more recent study reported that the most common injury location among professional male cricketers (from most common to least) was hamstring, side strain, wrist and hand fractures, groin injuries, and other lumbar injuries (Orchard et al., 2016a).

The most common injury location among elite female cricketers included the shoulder (12.4%), lower back (11.7%), knee (11.7%), ankle (8.8%), elbow (8.8%), foot (8.8%), hand (8.8%), hip (6.6%), thigh (6.6%), medical (5.8%), thoracic (4.4%), wrist (2.9%), head and face (2.9%), and neck (1.2%; Warren et al., 2019). Another study on elite female cricketers reported that the most common time-loss injury locations were the hand and wrists (19.8%), lumbar spine (16.5%), and knee (14.9%; Panagodage Perera et al., 2019). The majority of wrist and shoulder injuries occurred during fielding; while catching and throwing during fielding was the most common mechanisms for traumatic and non-contact injuries to the wrist/hand (13.7%) and shoulder (9.1%; Panagodage Perera et al., 2019).

Hamstring injuries are the most common injury among cricketers (Orchard et al., 2016a). Annual hamstring strain incidence increases with more short-form matches compared to longer multi-day formats (Orchard et al., 2016a). Fast bowlers are of greatest risk of suffering a hamstring injury compared to other disciplines. These injuries are more likely to occur among bowlers when involved in longer formats (Orchard et al., 2017). This may be related to the duration and intensity of bowling in the longer format (Constable et al., 2021). The delivery aspect of bowling is the most common injury mechanism in female bowlers, with 16.5% of injuries sustained during bowling being non-contact in nature (Panagodage Perera et al., 2019).

Conversely, batsmen are more likely to be injured during the shorter formats (Orchard et al., 2017). Female batsmen sustained muscular injuries (9.7%), with the most common mechanism of injuries being insidious (8.1%), running (6.6%), ball collision (5.8%), diving (4.0%), and fall/slip/lunge (2.0%). Female wicket-keepers suffered injuries while catching (2.3%) and without a known mechanism (2.3%; Panagodage Perera et al., 2019). Professional adult cricket players displayed the same characteristics as amateur cricketers with bowlers having the highest risk of injury (Stretch, 2015).

2.9 Injury Surveillance in Cricket

2.9.1 Cricket Specific Sports Injury Surveillance Systems

Data from sports injury are a requirement for the development of injury prevention strategies (Ekegren et al., 2016). Sports injury surveillance systems for cricket, within South Africa and other countries, have been well established at a professional level (Olivier et al., 2022). Within South Africa, medical personnel from respective domestic and national cricket teams use online standard injury surveillance software to report injury data among professional cricketers (Olivier et al., 2022). However, only one cricket-specific injury surveillance system among professional cricketers was included in a systematic review that reviewed methods and data quality in sports injury surveillance systems (Ekegren et al., 2015). The reason for this may be because only a few ongoing injury surveillance systems have reported on the quality of their data (Ekegren et al., 2015).

Injury data capturing in amateur settings is often performed by volunteers, and injury surveillance is often not mandatory (Ekegren et al., 2014).

Only a few standardised injury surveillance databases exist at an amateur level (Dhillon et al., 2014; Stretch, 2015). This may be since professional teams have access to injury surveillance systems; however, amateur sides often do not have the finances or the expertise to survey injuries. Recently, there has been an increased interest in the development of injury surveillance strategies in the amateur cricketing setting (Ekegren et al., 2014; Olivier et al., 2022; Soomro et al., 2019). These strategies include mobile applications (Soomro et al., 2019) and a proposed research practice partnership model (Olivier et al., 2022). The latter includes the development of an online specific injury surveillance system for amateur cricket (Olivier et al., 2022).

2.9.2 Non-Cricket Specific Strategies of Injury Surveillance

Several countries do not have access to injury surveillance systems in which injury data is collected and compared across sports (Åman et al., 2014). Alternatively, cricket injury data may then be collected from insurance claims (McLeod et al., 2020), hospital emergency departments (Forrester, 2021; Panagodage Perera et al., 2019), national well-being questionnaires (Bullock et al., 2020; Cai et al., 2019), and independent research publications from institutions (Cowan, 2006; Walter, 2020).

2.9.3 Injury consensus statements in cricket (Orchard et al., 2005; Orchard et al., 2016)

In recent years, there has been an increased focus on injury surveillance in junior and female cricket players (Gamage, 2019; Warren et al., 2019). Injury surveillance methods provide essential data that forms the foundation for the development and implementation of injury prevention strategies (Finch, 2006).

The varying methods of injury surveillance in cricket has made it impossible to compare data between studies and countries. In 2005, cricket was one of the first sporting codes to provide a recommended method of surveying and documenting cricket injuries (Orchard et al., 2005). Since then, there have been changes in the format of cricket and injury surveillance methods (Orchard et al., 2016a). Since the emergence of this consensus statement, certain authors (Hodgson et al., 2007; Ranson et al., 2013) deviated from the original injury definitions due to concerns such as the exclusion of non-time-loss injuries from the main injury definition. Other authors have provided updated definitions due to the emergence of the T20 format, as the original definitions were based on the longer format of the game (Orchard et al., 2010). Furthermore, the earlier published consensus statement has been criticised for limitations in its definition of an injury (Clarsen & Bahr, 2014; Mitchell & Hayen, 2005). These limitations include: no account for non-time loss injuries, no consideration of exceptional cases, and an imprecise description of “other medical conditions” which may cause a player to miss a game (Soomro et al., 2018). An updated consensus statement was published in 2016 (Orchard et al., 2016b).

The updated 2016 version aimed to offer greater flexibility to researchers by allowing them to choose definitions and methods from the consensus statement which suits their study type (Orchard et al., 2016b). It also aims to encourage greater rigor in the reporting of injuries, which would allow for comparison across studies and sports (Orchard et al., 2016b).

Since the updated consensus statement was published, there has only been two systematic reviews comparing epidemiological data between injury surveillance studies in cricket in detail (Jacobs et al., 2022; Soomro et al., 2018). The aim of the above-mentioned study was to meta-analyse the cricket injury rates in the twenty-first century.

The information about the extent and types of injuries sustained by females and juniors is required to support appropriate injury prevention strategies. One cannot simply translate the knowledge gained from professional cricketers and apply it to injury prevention methods in junior cricketers, as they have different injury incidence rates and patterns (Stretch, 2015). Consensus statements provide an initial guideline for injury reporting but fail to acknowledge the challenges of implementing injury surveillance systems within amateur settings (Ekegren et al., 2015).

2.10 Injury Prevention Models

Sports injury prevention programmes can be effective in reducing the extent, severity, and duration of injuries (Emery et al., 2015). The three areas of focus regarding injury prevention in sport includes: training strategies, modification of sport rules, and equipment recommendations. Injury prevention strategies need to be sustainable and must be adopted by coaches, athletes, and sporting bodies alike (Emery & Pasanen, 2019). The biggest challenge is to develop strategies that are cost effective and can be used in real life scenarios (Timpka et al., 2006). Although there is existing data on the nature and incidence of cricket-related injuries, limited literature is available in terms of injury prevention programmes and strategies (Pote & Christie, 2018).

Strategies to reduce the incidence of hamstring injuries in cricket have focused on exercise interventions. These include strategies such as eccentric knee flexor strengthening (Soomro et al., 2018), and focussed eccentric training in junior fast bowlers (Forrest et al., 2018). Effective injury prevention programmes that are structured and multifaceted with frequent, stable, and consistent implementation over a long-term period have been proven to reduce injury risk (Soomro et al., 2016). According to Pote and Christie (2018), the injury prevention strategies available in cricket are not multifactorial in nature and only focus on separate aspects. These aspects only include core strength or repeat sprint ability (Pote & Christie, 2018). Each cricketer requires their own individualised training programme to address specific weaknesses (Mukandi et al., 2014). This is where injury surveillance would be required to determine the extent, severity, and duration of injuries in various populations.

2.10.1 Van Mechelen Model

In 1992, Van Mechelen developed a four-step model for injury prevention in sports (Van Tiggelen et al., 2008). This model, presented in Figure 2.1 below, has been the foundation for the development and evaluation of injury prevention programmes since its inception.

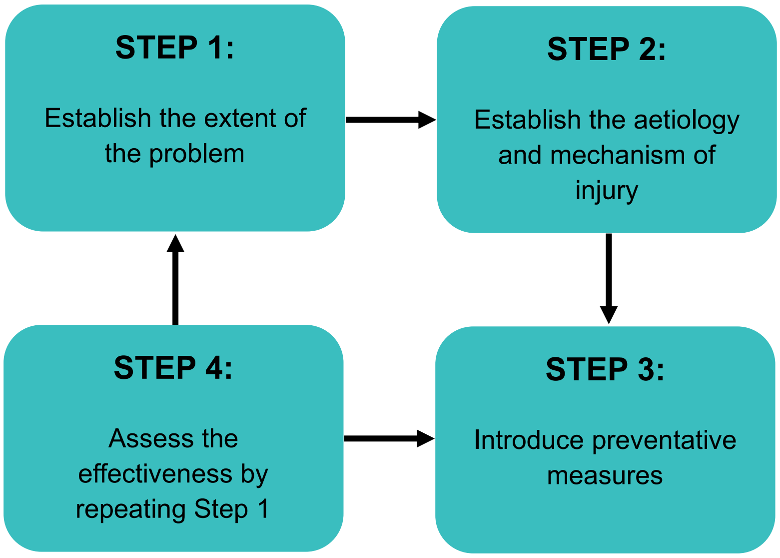

Figure 2.1 The Van Mechelen Model (Van Mechelen et al., 1992).

In the first step, data is collected to establish the extent of the injury in the population. The location and extent of injuries in athletes is position-specific in team sports and therefore the boundaries of the population need to be clearly defined (Faude et al., 2006; Gabbett, 2005). In the second step, the aetiology and mechanisms of the injury are identified before introducing preventive measures in the third step. These preventive measures must be based on the aetiology and injury mechanism data collected in the previous step. Most sports overuse injuries are multifactorial in causation, which complicates the identification of mechanisms and risk factors (van Poppel et al., 2021). The effectiveness of the preventive measure is then assessed by repeating the first step (step 4).

The four-stage model of sports injury prevention has been a valuable tool to guide injury research over the past decade. It clearly outlines the direction of required evidence needed to build a knowledge base regarding sports injuries and their causes (Finch, 2006).

However, the model fails to adequately describe the directions required for research that could lead to direct injury prevention. The most serious limitation is that it does not consider implementation issues once prevention measures are proven effective (Finch, 2006). To prevent injuries, sports injury prevention measures need to be acceptable, adopted, and compiled in consultation with the athletes and sports bodies they target (Finch, 2006).

2.10.2 Translating Research into Injury Prevention Practice (TRIPP) Framework

The Translating Research into Injury Prevention Practice (TRIPP) framework includes two additional steps in relation to the Van Mechelen model. The first is the need for understanding the implementation context (i.e., personal, environmental, societal, and sports delivery factors), and the second is the evaluation of the implementation process of preventive measures (Finch, 2006). There are also implementation challenges in the sports injury context compared to other injury settings, such as road trauma or firearms use, that justify a context-specific model such as the TRIPP (Eime et al., 2004; Finch, 2006).

The TRIPP framework (presented in Figure 2.2 below) recognises that a complete evidence base for prevention requires:

- a detailed understanding of the aetiology of injuries;
- the development of interventions to directly address the identified mechanisms of injury;
- formal testing of these interventions under controlled conditions (i.e., efficacy research);

- an understanding of the context of the sporting and individual athlete behaviours in which the interventions are to be implemented;
- a potential modification of interventions to take this implementation context into account;
- the assessment of potential factors associated with the real-world introduction and application of safety measures, and the development of implementation strategies to accompany the real-world “roll-out” of the interventions; and
- the formal evaluation of the effectiveness of injury prevention measures within the implementation context.

Both the TRIPP and Van Mechelen models require the researcher to establish the extent of the problem, which is injuries in cricket in the present context. Barriers to the implementation of injury prevention programmes in amateur sports include a lack of knowledge, lack of time, player fatigue, lack of equipment, and the notion that other athletes do not perform injury prevention techniques (Nasr, 2018). A recent study surveyed the barriers to the implementation of the Nordic hamstring injury prevention programme among professional cricketers and reported that the exercise was not positively perceived by players (60%), and that the exercises resulted in muscle soreness (53%; Chesterton & Tears, 2021). An adaptive approach to injury prevention programmes is also required with cricketers as their playing schedule often changes, with up to four consecutive days of play (Chesterton & Tears, 2021).

Facilitators to the implementation of injury prevention programmes in amateur sports teams include the presence of medical personnel, availability of medical facilities, and the presence of a quality injury management protocol (Nasr, 2018).

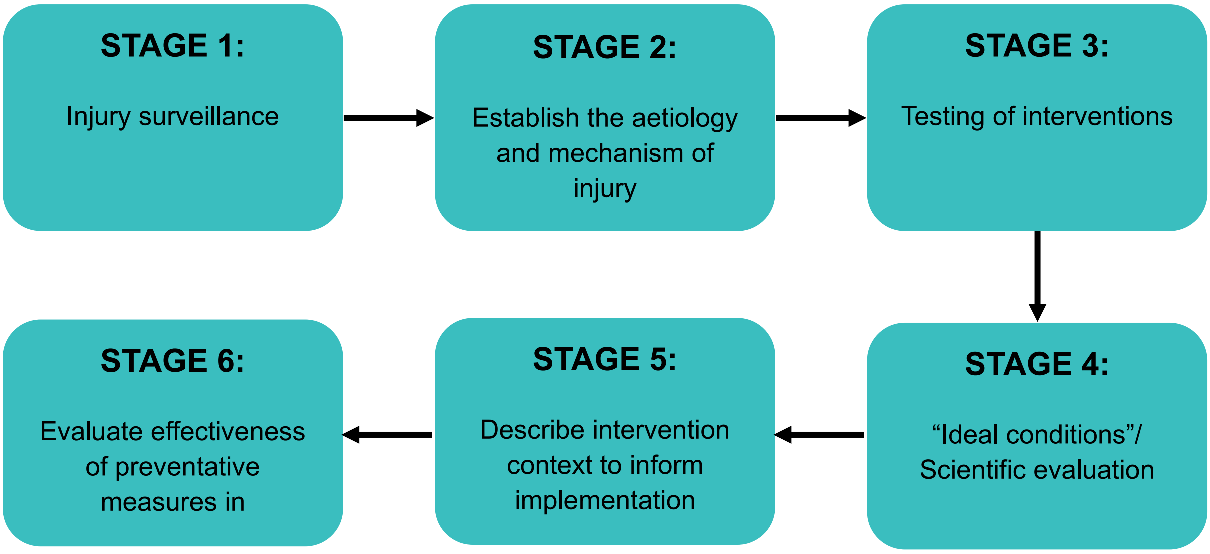

Figure 2.2 The Translating Research into the Injury Prevention Practice (TRIPP) Model (Finch, 2006).

2.10.3 Team-Sport Injury Prevention Cycle (TIP)

The TIP is the most recent model of sports injury prevention (O'Brien et al., 2019). The model includes three stages, namely: Re-evaluate, Identify, and Intervene. The first phase aims to capture and understand the current injury and prevention status. Injury risk factors and mechanisms of injury are identified in the second phase to form preventative strategies. These preventative strategies are introduced in the third and final phase. The TIP cycle was created to provide clinicians with a recurring process for the dynamic nature of injury prevention in the context of professional team sports and requires continuous progression through the phases. Therefore, a team's injury prevention strategy may evolve and be dynamic, responding to constant changes in the team's environment.

2.11 Framework for the Review

The two consensus statements on injury surveillance in cricket was used as the guiding framework for the present integrative review.

The data extraction tools (see Appendix C & D) based on these consensus statements were used to extract data from the eligible studies. These frameworks were used to guide the writing of the researchers results.

2.12 Summary of the Chapter

In this chapter, the incidence and prevalence of injuries among both amateur and professional cricketers was discussed. To this, international cricketers have been reported to exhibit a higher incidence of injury compared to their domestic counterparts (Dovbysh et al., 2021). Among amateur cricketers, different measures have been employed to assess injury incidence. It has been observed that injury prevalence tends to be lower in shorter formats of the game compared to longer formats, with rates typically approximating 4-5% for amateur cricketers, mirroring the rates reported for elite players (Soomro et al., 2018).

Lumbar stress fractures are the most prevalent injury among professional male cricketers (Orchard et al., 2016a). Interestingly, both professional adult players and their amateur counterparts share similar injury patterns, with bowlers facing the highest risk (Stretch, 2015). However, while discussing injury prevention and surveillance, it was apparent that strategies in cricket predominantly focussed on singular aspects rather than employing multifactorial approaches (Pote & Christie, 2018).

Moreover, the chapter highlighted a gap in injury surveillance systems between amateur and professional cricketers. While professional cricket boasts more robust and established surveillance mechanisms within middle- to high-income countries, there is a growing interest in developing comprehensive injury surveillance systems within the amateur cricketing context (Olivier et al., 2022). This signifies a potential area of improvement, and future research in safeguarding the well-being of cricket players across all levels is required.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

The following chapter describes the methodology employed to achieve the objectives of the present study. The integrative review research design will be discussed in detail. The review process, search strategy, eligibility criteria, and quality assessment tools will also be explained. The chapter will also address the data extraction tools, data synthesis, and ethical considerations.

3.2 Research Design

This study employed an integrative review methodology. The primary difference between integrative reviews and other types of reviews is that it allows for the inclusion of diverse methodologies (i.e., experimental, and non-experimental research; Whittemore & Knafl, 2005). Integrative reviews have the potential to play a greater role in evidence-based practice as it may allow for the review of broader spectrums of research for treatment options (Boell & Cecez-Kecmanovic, 2015; Whittemore & Knafl, 2005). The inclusion of experimental and non-experimental research provided the researcher with a more diverse data source for the review. However, noticeable limitations do exist when using this methodology, which may include complexity in combining diverse methodologies that may contribute to a lack of rigour, inaccuracy, and bias (Beck, 1999; O'Mathúna, 2000).

3.3 Inclusion Criteria

The present study was not confined to a specific geographical location and included both international and national research.

Full-text peer-reviewed publications written in: (1) English only, due to financial and time barriers (Rockliffe, 2022); (2) having a length of at least one season or tournament; (3) with participants 18 years old and above; (4) that surveyed injuries in amateur and professional cricket players through both experimental and non-experimental methods; and (5) that reported on surveillance strategies used to monitor injuries in amateur and professional cricket players were considered.

3.4 Exclusion Criteria

Publications that were not considered for inclusion were those: (1) not available in the University of the Western Cape's (UWC) databases; (2) not available as full-text versions; (3) not published within the present timeline of 2006-2022; (4) published systematic reviews; and (5) that collected data from a hospital registry. Systematic reviews were excluded as the researcher was of the opinion that they may not provide adequate depth into the specific injury surveillance strategies employed within the respective studies.

3.5 Review Process

The review process was informed by the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Page et al., 2021a). This is a three-step process that includes, Identification (i.e., title reading), Screening (i.e., abstract reading), and finally Eligibility (full-text reading; Page et al., 2021a). The aim of the PRISMA statement is to assist authors to improve the reporting of systematic reviews and meta-analyses. This process was initially piloted by two researchers (UJ and BB).

3.5.1 Step One: Identification

The following databases were independently searched by two reviewers (UJ & BB): PubMed through Medline, SPORTDiscus and the Cumulative Index to Nursing and Allied Health (CINAHL), Scopus, Google Scholar, Open Access Thesis and Dissertations (OATD), and ScienceDirect. The titles were assessed for suitability and inclusion (i.e., title screening). The literature from the search strategy was retrieved and recorded on an evaluation table (see Appendix F). The extracted information included the publication title, year of publication, the names of the author(s), and the publication title.

3.5.2 Step Two: Screening

The initial screening process involved screening the titles and abstracts included in the first step. All abstracts were evaluated according to the inclusion and exclusion criteria and a decision was recorded on the evaluation table (see Appendix F). Therefore, a list of potentially relevant publications was generated.

3.5.3 Step Three: Eligibility

The full texts of publications identified for potential inclusion from the abstract screening process were retrieved. During this process, after applying the eligibility criteria, eligible full-text articles were appraised using the Critical Appraisal Skills Programme (CASP) 2018 cohort study checklist (see Appendix B). A total of 37 publications were appraised for their methodological quality.

For the present study specifically, the CASP tool was used purely as a means to assess methodological quality, identify strengths and weaknesses, and determine the possible impact of these limitations on the study's results (Porritt et al., 2014). It was not used to include or exclude publications.

3.6 Search Strategy

The following databases were searched independently by two reviewers (UJ and BB): PubMed through Medline, SPORTDiscus, CINAHL, Scopus, Google Scholar, OATD, and ScienceDirect. Language and year of publication were used as search limiters. The first step was to search for publications using a combination of search terms which were identified through a preliminary search of the above-mentioned databases and discussing the proposed search terms with the university librarian (Aromataris & Riitano, 2014). Searches were conducted to find keywords within the full text and not only within the title. These keywords included a combination of the following: "surveillance," "strategy," "amateur," "professional," "cricket," and "injury." The specific grouping and usage of the key search terms used within the respective databases is included in Appendix A. Once all relevant search terms were identified, a more comprehensive search of these databases was carried out. This included relevant Boolean operators such as "AND," strateg*, and injur* to provide a wider range of results. The words "cricket injuries" were used in a phrase search method in databases without an advanced search option. The search strategy was supplemented by reviewing the reference lists of injury surveillance reviews in cricket and included publications in this study. This was performed independently by the two reviewers (UJ and BB) and included pearl growing (Hadfield, 2020), a process of citation mining (refer to Appendix G).

The final step included searching for grey literature on Google Scholar and OATD, as this provides an alternative source of information that may assist in reducing publication bias and produce a more accurate account of the evidence in question (McAuley et al., 2000). The first 100 results of the Google Scholar search were screened for inclusion (Haddaway et al., 2015). The search strategy was documented according to the 2020 PRISMA flow diagram (see Appendix H), as a well-defined search strategy that would allow readers to judge the methodology and credibility of the review (Kitchenham, 2004; Page et al., 2021b). Consensus was reached between both researchers (UJ and BB) during the data search process. The list of publications that were excluded after full-text review have been included in Appendix I.

3.7 Quality Assessment Tool

The methodological quality of the eligible publications was assessed independently by two researchers (UJ and TS) to reduce bias and maximise validity. The 2018 version of the CASP tool for cohort studies was used to appraise all prospective publications (Appendix B). The tool was adapted by removing question six, which pertains to the follow up of participants when appraising retrospective publications. The tool is educational in nature and does not incorporate a scoring system by which high-quality and low-quality studies can be differentiated. Rather, it employs 12 questions that can be answered via comments and a tick-box section with options being "yes," "can't tell," and "no." The CASP tool allows for the systematic identification of strengths and weaknesses of various publication types (Singh, 2013).

This improves the usefulness of a study and its findings. It also assisted in assessing study design and the applicability of publications to the context of low- and middle-income cricketing countries in an economical manner (Singh, 2013). Consensus was reached by both researchers to include or exclude publications (see Appendix J for the critical appraisal of the included publications).

3.8 Data Extraction Tools

For publications between 2006 and 2015, a data extraction table was used based on the initial consensus statement of 2005 (see Appendix C). For publications after 2015, a data extraction form based on the 2016 consensus statement was used (see Appendix D). These data extraction forms were self-developed and piloted on a set of publications. The researchers specifically assessed injury definitions, injury incidence, injury prevalence, and how each publication reported these variables. This was achieved by comparing the extracted data of the included publications to the guidelines and definitions provided by the relevant consensus statements. Based on each study's methodological requirements, aims, and objectives, it was challenging to deduce whether an article complied with the respective consensus statement. Most studies were not required to use all recommendations of the consensus statement to answer their research question. Other studies needed to adapt the consensus statement guidelines to answer their research question. The researchers specifically considered injury definitions, injury incidence, injury prevalence, and how each source reported these variables. Injury incidence and prevalence were selected as they are the two major injury rates that should be calculated (Orchard et al., 2005). Figure 3.1 provides a summary of the data extraction process.

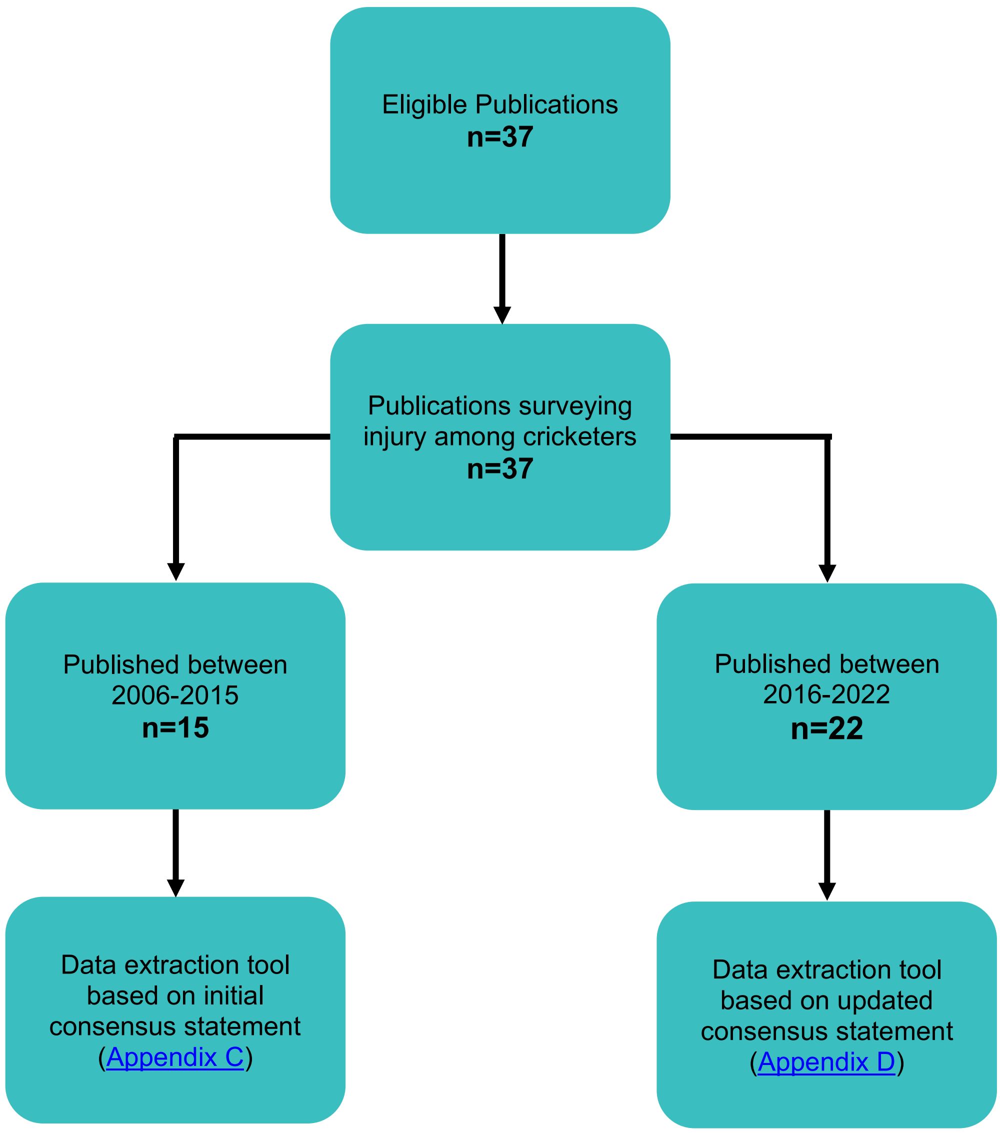

Figure 3.1 Flow Diagram Representing the Data Extraction Process.

3.9 Data Synthesis

The interpretation and presentation phases were the final stages of this integrative review (Souza et al., 2010). The presentation of findings from an integrative review is paramount to the development of the knowledge base. However, there is no accepted template for reporting integrative research (Souza et al., 2010). Due to no known recognised reporting template being available, a narrative synthesis was employed.

This is a synthesis of findings from multiple studies that primarily relies on the use of words and text to explain the findings from the included publications (Popay et al., 2006). The narrative approach allowed for the description and comparison of cricket injury surveillance strategies that have been used among publications of varying methodologies. The data from the publications was imported into the relevant tables and then analysed for similarities and differences. During this stage, the domains within the consensus statements were used as themes under which the data from the publications were categorised, summarised, and grouped. These findings were arranged into a cohesive and integrated conclusion regarding injury surveillance strategies in cricket, which is explained in the results, discussion, and conclusion chapters (Souza et al., 2010).

3.10 Data Analysis

In this integrative review, the data analysis consisted of data reduction, data display, data comparison, conclusion drawing, and verification (Souza et al., 2010).

3.10.1 Data Reduction

Data reduction includes the division of publications into subgroups. For this study, publications were divided into date of publication (i.e., either 2006-2015 or after 2015). These two groups were further divided into publications that reported on either amateur or professional cricketers.

The second phase of data reduction involved techniques of extracting and coding data from primary sources to simplify, abstract, focus, and organise data into a manageable framework.

Predetermined and relevant data from each publication was compiled into the relevant data extraction tables (see Appendix C and Appendix D). Each publication was reduced to a few pages with similar data extracted from each. This approach allowed for the systematic organisation and comparison of the publications. Researchers also noted and sorted publications into groups that reported on injury among either amateur cricketers, professional cricketers, or both amateur and professional cricketers. The gender of the participants included in each study was also noted.

3.10.2 Data Display

Data display involved converting the extracted data from the individual publications into a display that assembled the data from the subgroups. The researcher used tables and graphs to compare the data from all included cricket publications. These displays enhanced the representation of injury surveillance patterns, the relationships between data sources, and served as the starting point for interpretation.

3.10.3 Data Comparison

Data comparison involved the process of examining the data from the publications and identifying patterns and themes. This process was facilitated by comparing the data imported into Appendix C and Appendix D to the guidelines provided by the respective consensus statements (Orchard et al., 2005; Orchard et al., 2016b). Examples of the identified category patters included “compliance to consensus guidelines,” “no compliance to consensus guidelines,” and “partial compliance to consensus guidelines.” The publications’ findings were compared to each other in the results section via the usage of figures and tables (see Chapter Four).

3.10.4 Conclusion Drawing and Verification

Conclusion drawing and verification was the final phase of data analysis. It involved a narrative synthesis of the data (i.e., the results and discussion sections). On completion of each subgroup analysis (1. Publications from 2006-2015; 2. Publications from after 2015; 3. Publications that surveyed injury among professional cricketers; 4. Publications that surveyed injury among amateur cricketers; and 5. Publications that surveyed injury among amateur and professional cricketers), the final data analysis step for this integrative review was the synthesis of important conclusions on injury surveillance strategies in amateur and professional cricket (see Chapter Six).

3.11 Ethical Considerations

Ethical approval to conduct this study was obtained from the UWC's Humanities and Social Science Research Ethics Committee (HSSREC reference number: HS21/10/6; see Appendix E). The study collected data from publicly accessible publications and did not include any personal or confidential information from participants. Considerations were made for the impact of potential publication and search bias by the inclusion of grey literature. Data gathered for this study was only accessible by the researcher and the respective research supervisors. Each publication included in this study would be referenced appropriately.

3.12 Summary of the Chapter

In this chapter, the integrative review methodology was discussed, and the following processes were outlined, namely: problem identification, literature search, data evaluation, data analysis, and presentation of findings.

After the eligibility criteria were expanded upon, the three-step review process was discussed (i.e., Identification, Screening, and Eligibility). In addition, the chosen search strategy was unpacked as well as the 2018 CASP tool selected by the researchers as a quality assessment tool. Furthermore, the data extraction tools, based on the cricket injury surveillance consensus statements, were explained. This was followed by an explanation of the data synthesis steps. The chapter concluded with the ethical considerations applicable to this study.

CHAPTER FOUR: RESULTS

4.1 Introduction

In this chapter, the results of the review relating to the injury surveillance strategies used to monitor injuries in amateur and professional cricketers is presented. The results are presented according to the study's objectives, that were to:

- describe the surveillance strategies currently used to monitor injuries in amateur and professional cricket players (Section 4.5);
- assess the methodological quality of the included studies (Section 4.12);
- assess the reporting of injury surveillance data of amateur and professional cricket players according to the 2005 and 2016 injury surveillance consensus statements (Sections 4.6, 4.7, 4.8, 4.9, 4.10, and 4.11); and
- make recommendations for future surveillance studies based on the findings of the present study (Chapter Six).

4.2 Literature Search

As presented Figure 4.1 below, the literature search yielded 721 publications, while the grey literature searches accounted for an additional 148 publications. The following databases were searched from inception until the end of July 2022: Scopus (18 publications), PubMed (40 publications), CINAHL (70 publications), SPORTDiscus (67 publications), and Science Direct (426 publications). Given the focus on injury surveillance within sports medicine, the researcher consulted the UWC faculty librarian who recommended these databases as they are commonly employed in healthcare reviews. To ensure a manageable workload, while adhering to established protocols in reviews, the researcher included the first 100 search results from Google Scholar.

Furthermore, it is a characteristic of some systematic reviews to screen the first 50 to 100 hits (Hughes et al., 2014; Reed et al., 2015). The researcher included 48 publications from the OATD. These articles (677), theses (43), and book chapters (1) were then exported to CADIMA (2017, Germany), an Open Access online tool supporting the reporting and conduct of systematic reviews. Prior to the publications and reports being screened, 374 duplicates were electronically removed by CADIMA, including 328 database and 46 grey literature duplicates. This process was carried out by two independent reviewers (UJ and BB). After screening the abstracts and titles, a further 283 publications were excluded. The full-text versions of 64 potentially relevant publications were sought for retrieval. Two were not retrieved, as the university library did not have access. Therefore, 62 full-text publications were screened against the eligibility criteria. A further 25 publications did not meet the inclusion criteria (refer to Appendix I), which left 37 publications as part of this integrative review (refer to Appendix J).

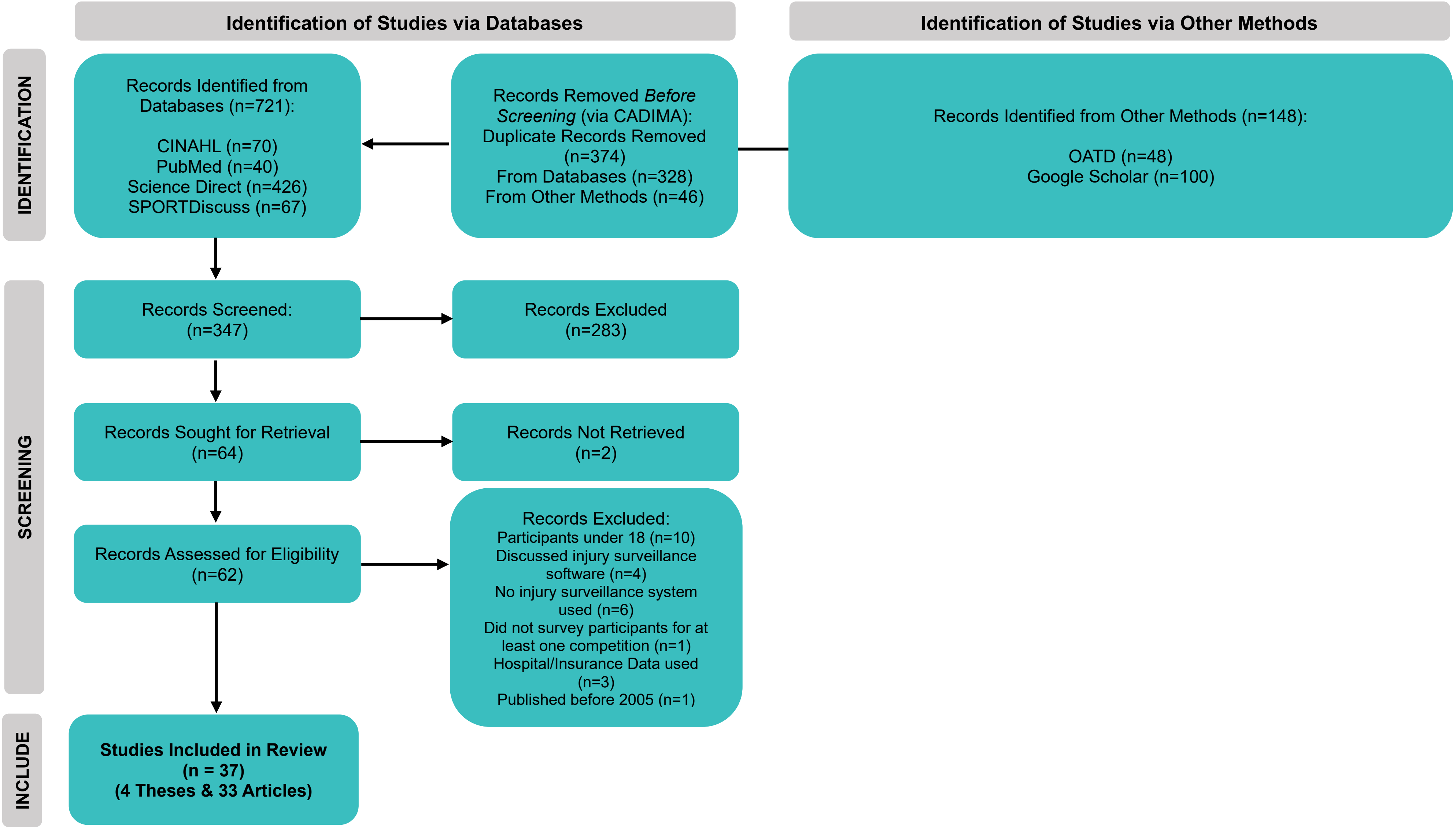

Figure 4.1 PRISMA Flow Diagram.

4.3 Initial Consensus Publications (Publications Released Between 2006-2015)

Of the 37 publications included in this review, a total of 15 were published during 2006-2015. Only one publication in this group reported on injury among amateur cricketers (Soomro et al., 2015), and 14 reported on injuries among professional cricketers. Eight publications did not mention the mean age of their study participants. Furthermore, all publications followed a prospective research design, as presented in Table 4.1 below.

Sixteen of the 37 publications were published between 2006 (i.e., initial consensus statement) and 2016 (i.e., updated consensus statement). The number of publications conducted in Australia and South Africa were six and four, respectively. However, the majority of these publications primarily focused on male cricketer players. A similar trend was observed in four publications, two from the United Kingdom (Ranson & Gregory, 2008; Ranson et al., 2013), and two published in India (Dhillon et al., 2012; Soni et al., 2015). Only one South African publication by Cowan (2006), surveyed injuries in female cricket players. The remaining countries included the West Indies (Mansingh et al., 2006) and New Zealand (Frost & Chalmers, 2014), with one publication each. All the publications mentioned above are from “cricketing” nations, which may explain the high emphasis on injury surveillance within these countries.

Table 4.1 Publications Between 2006-2015 Arranged by Date of Publication.
(Unless it stated that it used the updated consensus definitions).

AUTHOR	LEVEL OF CRICKET & FORMAT(S)	GENDER & POPULATION SIZE	PARTICIPANTS MEAN AGE IN YEARS	STUDY DESIGN	INJURY SURVEILLANCE STRATEGY	COMPLIANCE TO CONSENSUS
Cowan (2006) SA	Professional International only ODI	Females n=26	22.6-31.2	Prospective	Subjective open-ended questionnaire, entered by team staff/physio	No
Dhillon et al. (2012) IND	Professional Not reported	Males n=95	18.9	Prospective	Entered into electronic database by coaches/trainers/physiotherapists	Yes, with modification to injury definition
Frost and Chalmers (2014) NZ	Professional International and Domestic All formats, including T20	Males n=248	Not reported	Prospective	Entered into the New Zealand injury monitoring system	Yes, OSIICS used for injury classification
Kountouris et al. (2012) AUS	Professional ODI and Test	Males n=49	25.2	Prospective	Collected by national team physiotherapist	Partially, aims different and consensus not published when data was collected
Mansingh et al. (2006) WI	Professional International and Domestic Excludes T20	Male n=195	Not reported	Prospective	Entered by team physio/medical staff, then into a database by author	Yes
Olivier et al. (2014) SA	Amateur Not reported	Males n=32	21.8	Prospective	Self-administered questionnaire at the start of each month in season and at end of season	Yes, for injury definition
Olivier et al. (2015) SA	Professional Not reported	Males n=17	Between 18-26	Prospective	Self-administered questionnaire	Yes, for injury definition

Table 4.1 continued

AUTHOR	LEVEL OF CRICKET & FORMAT(S)	GENDER & POPULATION SIZE	PARTICIPANTS MEAN AGE IN YEARS	STUDY DESIGN	INJURY SURVEILLANCE STRATEGY	COMPLIANCE TO CONSENSUS
Orchard et al. (2006) AUS	Professional International and Domestic Excludes T20	Males Not reported	Not reported	Prospective	Entered by team doctor/physiotherapist into a database	Yes
Orchard et al. (2010) AUS	Professional International and Domestic All formats	Males n=175	Not reported	Prospective	Cricket Australia survey, injury details entered by team physiotherapists/doctor into a database	Yes
Orchard et al. (2015b) AUS	Professional International and Domestic All formats, including T20	Males n=235	Not reported	Prospective	Initially reported to the author, then entered into the Australia cricket system	Yes, updated consensus used
Ranson and Gregory (2008) UK	Professional Domestic All county formats, no T20	Males n=158	27	Prospective	Questionnaire administered by county physiotherapists	Yes, modified some definitions to attain study objectives
Ranson et al. (2013) UK	Professional ODI	Males n/a	Not reported	Prospective	Entered into a database by team medical staff	Yes, included non-time loss injuries as well
Stretch and Raffan (2011) SA	Professional International ODI and Test, excludes T20.	Males n=36	Not reported	Prospective	Questionnaire filled out for each injury by team physiotherapist	Yes
Soni et al. (2015) IND	Professional Not reported	Males n=95	23 and 24	Prospective	Telephonic follow-up with players during training camps and every 3 months	Yes, OSIICS used for location

AUS - Australia, IND - India, NZ - New Zealand, ODI – One-day International, OSIICS – Orchard Sports Injury & Illness Classification System, SA - South Africa, T20 – Twenty20 Match Format, UK - United Kingdom, WI - West Indies.

4.3.1 Injury Surveillance Publications (Publications released between 2016-2023)

As presented below in Table 4.2, 22 out of the 37 publications were included in this group. Two retrospective studies surveyed injury among amateur and professional cricketers concurrently (Bullock et al., 2020; Cai et al., 2019), while only one publication surveyed injury among professional cricketers exclusively (Soomro et al., 2018). Ten publications did not mention their mean participant age and six publications followed a retrospective design (Brooks et al., 2020; Bullock et al., 2020; Dovbysh et al., 2021; Orchard et al., 2017; Rao et al., 2020; Walter, 2020).

A total of 21 publications published in the five-year period after the publication of the updated consensus statement met the study inclusion criteria. As presented in Table 4.2 below, 11 publications (52%, 11/21) that surveyed injuries in cricketers had been published in the United Kingdom. Of these 11 publications, 64% (7/11) surveyed injuries among males only, while 18% (2/11) reported on cricket-related injuries in both male and female cricketers. The remaining 18% (2/11) surveyed female cricketers exclusively.

A total of five (24%, 5/21) publications had been published in Australia. Of these five publications, 40% (2/5) surveyed injury among male cricketers exclusively, while two (40%, 2/5) publications studied both male and female cricketers. The remaining 20% (1/5) surveyed female cricketers exclusively. Publications from South Africa (2/21), New Zealand (2/21), and India (1/21) surveyed injuries among male cricketers only.

Table 4.2 Injury Surveillance Publications from 2016-2022.

AUTHOR	LEVEL OF CRICKET & FORMAT(S)	GENDER & POPULATION SIZE	PARTICIPANTS MEAN AGE IN YEARS	STUDY DESIGN	INJURY SURVEILLANCE STRATEGY	COMPLIANCE TO UPDATED CONSENSUS
Ahmun et al. (2019) UK	Professional International	Males n=39	17.5	Prospective	Entered into electronic system by team physiotherapist daily	Yes
Alway et al. (2019) UK	Professional Domestic All formats	Males n=368	24.87	Prospective	ECB injury surveillance system used and physiotherapists required to record time-loss injuries	Yes
Brooks et al. (2020) AUS	Professional International All formats	Males and Females n=70	Not reported	Retrospective	AMS used by regional physiotherapist	Yes
Bullock et al. (2020) UK	Amateur and Professional Various formats	Males and Females n=2233	Players above 30	Retrospective	Cricket health and wellbeing study questionnaire used	No
Cai et al. (2019) UK	Amateur and Professional Various formats	Males and Females n=846	Not reported	Prospective.	Data from Cricket health and wellbeing study was used with “RedCap” software	No
Dovbysh et al. (2021) NZ	Professional International and Domestic All formats	Males n=268	Not reported	Retrospective	Entered into New Zealand injury surveillance system by physiotherapists, then analysed in Excel	Partially, used original consensus in certain cases then new incidence for comparability
Dutton et al. (2019) SA	Professional Domestic 4 day, 1 day, and T20	Males n=105	27	Prospective	Not reported	No
Goggins et al. (2020b) UK	Professional International and Domestic All formats	Females n=83	19.75	Prospective	Entered into ECB by physiotherapists	Yes

Table 4.2 continued

AUTHOR	LEVEL OF CRICKET & FORMAT(S)	GENDER & POPULATION SIZE	PARTICIPANTS MEAN AGE IN YEARS	STUDY DESIGN	INJURY SURVEILLANCE STRATEGY	COMPLIANCE TO UPDATED CONSENSUS
Goggins (2021) UK	Professional Domestic All formats	Males n=507	Not reported	Prospective	Entered into ECB by team physiotherapist or medical officer	Yes
Goggins et al. (2021) UK	Professional Domestic All formats	Males n=402 (annually)	Not reported	Prospective	Entered into Central online medical records system by “Profiler” and “Cricket Squad”	Yes
Hill et al. (2019) AUS	Professional International and Domestic All formats	Males (n=172) Females (n=106) (Year 1) Males (n=179) Females (n=98) (Year 2)	Not reported	Prospective	Entered by physiotherapist into AMS	Yes
Olivier and Gray (2018) SA	Professional Domestic All formats	Males n=97	26.8	Prospective	Entered by team physiotherapist into CSA electronic system. Researcher recorded in parallel	Yes
Orchard et al. (2016a) AUS	Professional All formats, used combined injury measures for T20.	Males Not reported	Not reported	Prospective	Entered by team doctor/physiotherapist into electronic system for every game	Yes
Orchard et al. (2017) AUS	Professional International All formats	Males Not reported	Not reported	Retrospective	Entered by team physiotherapist into Cricket Australia system	Yes
Panagodage Perera et al. (2019) AUS	Professional International and Domestic	Females n=121	24.2	Prospective	Cricket Australia system	Yes

Table 4.2 continued

AUTHOR	LEVEL OF CRICKET & FORMAT(S)	GENDER & POPULATION SIZE	PARTICIPANTS MEAN AGE IN YEARS	STUDY DESIGN	INJURY SURVEILLANCE STRATEGY	COMPLIANCE TO UPDATED CONSENSUS
Rao et al. (2020) IND	Professional Domestic All formats	Males n=319	24.71	Retrospective	Entered into Excel by team physiotherapist	Yes
Soomro et al. (2018) AUS	Amateur Not reported	Males n=408	24.1	Prospective	Used electronic system and looked at website records for changes in playing 11 weekly. Then contacted coach, physiotherapist, or captain	No, followed initial consensus as study planned in 2015
Tallent et al. (2020) UK	Professional International All formats	Males n=47	26	Prospective	Not reported	Partially, used scale of availability
Tysoe et al. (2020) UK	Professional Domestic All formats	Males n=49	27	Prospective	By team physiotherapist (nothing else reported)	Partially, included training in definition
Walter (2020) NZ	Professional Not reported	Males n=35	Not reported	Retrospective	Self-reported electronic injury surveillance system	No
Warren et al. (2019) UK	Professional International and Domestic T20	Females n=84 (Year 1) n=87 (Year 2)	23.4	Prospective	Entered into Excel by team physiotherapist	Yes

AMS – Athlete Management System, AUS - Australia, CSA – Cricket South Africa, ECB – England & Wales Cricket Board, IND - India, NZ - New Zealand, SA - South Africa, T20 – Twenty20 Match Format, UK - United Kingdom, WI - West Indies.

4.4 Number of Injury Surveillance Publications Per Year between 2006 – 2022

Figure 4.2 below presents an overview of the number of publications between 2006 and 2022 relating to injury surveillance in amateur and professional cricket players. For noting, the years 2008, 2009, and 2022 were void of any publications that met the study's inclusion criteria. Furthermore, the years 2007, 2010, 2011, 2012, 2016, and 2017 only had one publication each. It's worth highlighting that the year 2022 was not complete at the time of the database search. Majority of the publications included in this review were published in 2019 (6/37) and 2020 (8/37), respectively.

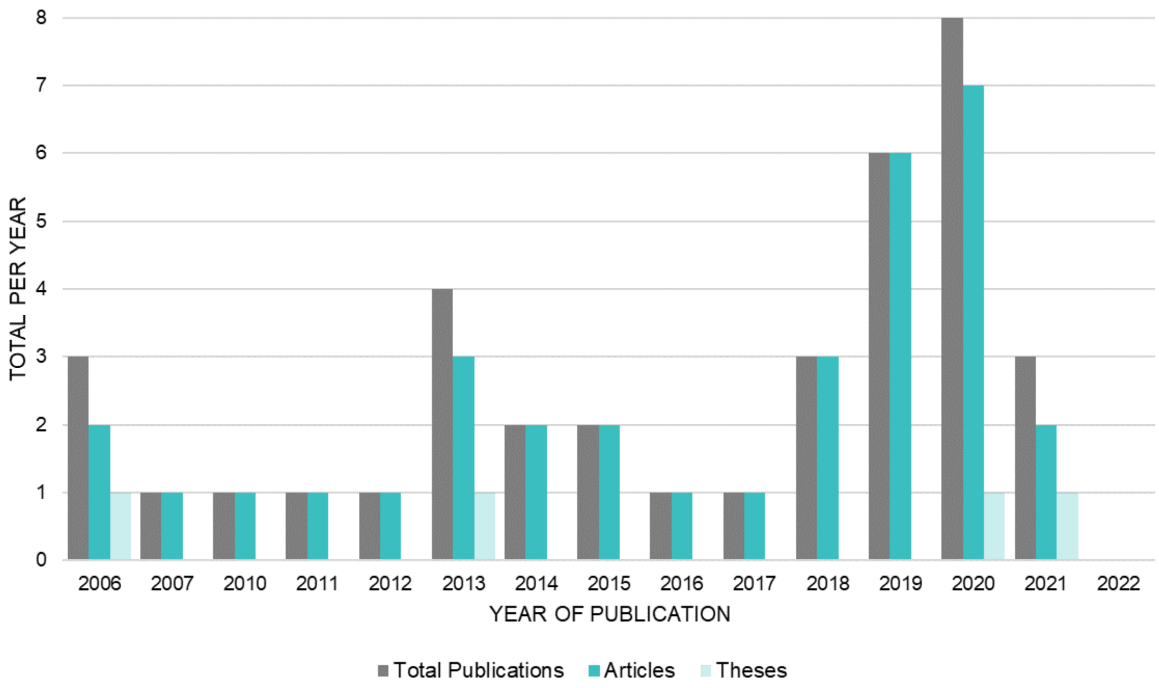

Figure 4.2 Number of Injury Surveillance Publications per Year.

4.5 Surveillance Strategies Used to Monitor Injuries in Amateur and Professional Cricketers

Significantly, only two of the 37 included publications surveyed amateur cricketers exclusively, and a further two (2/37) publications did not mention the strategy used to monitor injuries (Dutton et al., 2019; Tallent et al., 2020). Twenty-two (63%) of all publications mentioned using a physiotherapist as part of the injury surveillance strategy. However, while only one of these publications surveyed amateur cricketers, two major strategies of injury surveillance were noted and are detailed in the following sub-sections.

4.5.1 Strategy One: Injury Data Collected by Medical Staff and Modes of Collection

Twenty-nine of the 37 publications mentioned medical staff collecting data (see Figure 4.3 below). Among the 29 publications, all but one surveyed professional cricketers. Ten publications recorded injuries using an online database. Nine of the 10 publications used medical staff to record injuries via an online database, while one publication used medical staff and coaches. In addition, nine publications using this strategy surveyed professional cricketers, while only one surveyed amateur cricketers (Dhillon et al., 2012). Two of the 37 publications mentioned that injury surveillance data had been recorded by medical staff with no other information provided (Kountouris et al., 2012; Tysoe et al., 2020). Another mode involved surveys/questionnaires administered by medical staff. Four (4/37) publications adopted this strategy, surveying injuries in professional cricketers (Bullock et al., 2020; Cowan, 2006; Ranson & Gregory, 2008; Stretch & Raffan, 2011).

The most prevalent strategy for monitoring injury among cricketers was by medical staff entering data into a national injury surveillance system (13/37), exclusively targeting professional cricketers. Four (4/13) publications included female cricketers, with one including female cricketers in a mixed gender study (Hill et al., 2019).

4.5.2 Strategy Two: Self-Reported Injury Surveillance Strategies and Modes of Collection

As illustrated in Figure 4.3 below, six publications made use of self-reported injury surveillance strategies. Among these, three publications surveyed injury among professional cricketers (Olivier et al., 2015; Soni et al., 2015; Walter, 2020). One of the three publications that surveyed injury among amateur cricketers did so exclusively (Olivier et al., 2014), while the remaining two publications surveyed injury among both amateur and professional cricketers (Bullock et al., 2020; Cai et al., 2019).

The utilisation of self-reported questionnaires was particularly prominent among amateur cricketers and had been employed by three of the four publications that monitored injury among amateur cricketers. One of these three publications only surveyed male amateur cricketers, while the other two publications surveyed both male and female amateur and professional cricketers. Two publications used data from the same self-administered survey (Bullock et al., 2020; Cai et al., 2019), while the third publication monitored injury among professional male cricketers (Walter, 2020).

Furthermore, variations in the self-reported strategy included a self-reported injury surveillance system as well as a telephonic system, each employed by one study.

The former, conducted in South Africa (Olivier et al., 2014), collected injury data via a self-reported questionnaire administered monthly and at the end of the season. The latter, conducted in Australia (Soomro et al., 2018), involved the lead researcher examining website records for weekly changes in the starting 11. Subsequently, team members such as the captain, coach, or physiotherapist were contacted to confirm these changes and ascertain the causes of injury.

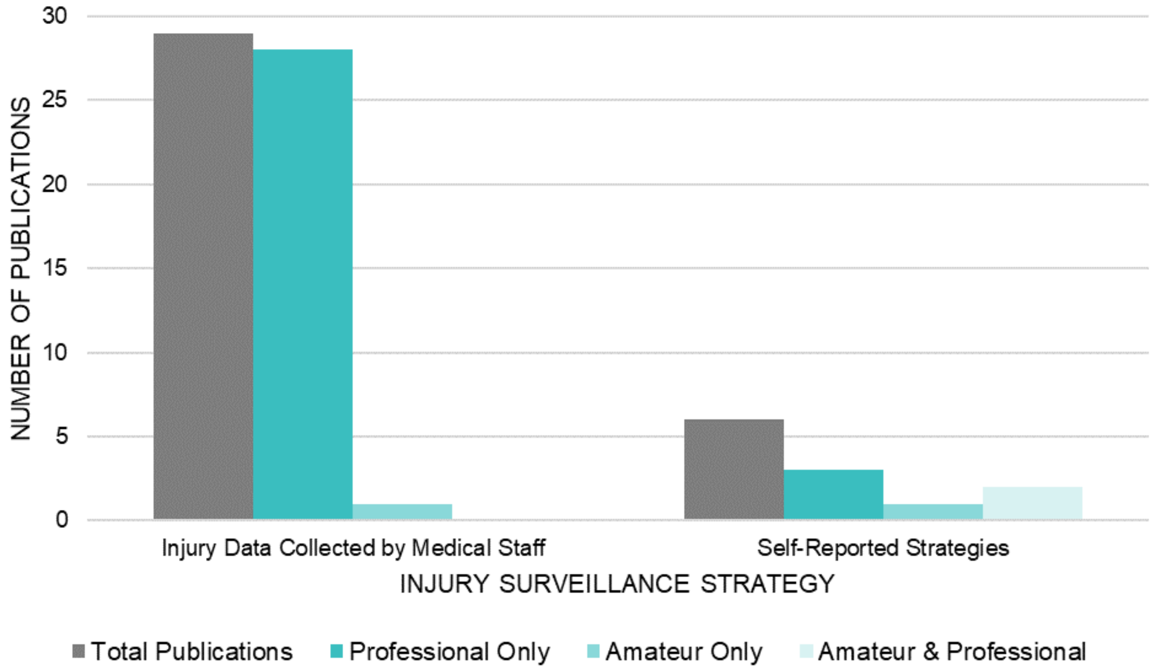

Figure 4.3 Identified Strategies of Injury Surveillance in Amateur and Professional Cricketers.

4.6 Compliance with Respective Injury Surveillance Consensus Statement

4.6.1 Compliance to Injury Definition(s) (Publications between 2006-2015)

Regarding the compliance to the initial injury definition, as presented in Table 4.3 below, 47% (7/15) of the initial 15 publications (i.e., between 2006-2015) followed the initial consensus statement and four (27%) followed a different injury definition (Cowan, 2006; Olivier et al., 2014; Olivier et al., 2015; Ranson & Gregory, 2008).

Three publications (20%) followed the initial consensus definition with a deviation (Dhillon et al., 2012; Ranson et al., 2013; Soni et al., 2015). One (7%) of the publications did not have access to injury definition guidelines at the time of data collection (Kountouris et al., 2012).

Table 4.3 Initial Consensus Publications, their Compliance, and Differences to Consensus Statement Injury Definition (2006-2015).

AUTHOR	COMPLIANCE TO INITIAL INJURY DEFINITION (Yes/No)	DIFFERENCES
Cowan (2006)	No	Used pain and medical attention issues as injury
Dhillon et al. (2012)	Yes, with deviation	Included training injuries
Frost and Chalmers (2014)	Yes	No difference
Kountouris et al. (2012)	Yes, with deviation	Included surgeries and did not have guidelines during data collection
Mansingh et al. (2006)	Yes	No difference
Olivier et al. (2014)	No	Loss of at least 1 day of sporting activity constituted an injury
Olivier et al. (2015)	No	Loss of at least 1 day of sporting activity constituted an injury
Orchard et al. (2006)	Yes	No difference
Orchard et al. (2010)	Yes	No difference
Orchard et al. (2015a)	Yes	No difference
Orchard et al. (2015b)	Yes	No difference
Ranson and Gregory (2008)	No	Used pain and instability as injury, also included non-time loss and training injury
Ranson et al. (2013)	Yes, with deviation	Included non-time loss injury by including medical attention injuries
Stretch and Raffan (2011)	Yes	No difference
Soni et al. (2015)	Yes, with deviation	Added missed training hours and grouped injuries into significant and insignificant

4.6.2 Compliance to Updated Consensus Statement for Injury Definition(s)

Twenty-two publications (22/37) were published after the updated injury surveillance cricket consensus statement (i.e. from 2016-2022). As previously mentioned in Sub-section 2.2 of Chapter Two, the updated consensus statement recommended that authors should be explicit and describe the exact method used, instead of only mentioning that consensus definitions were followed. The initial consensus definition for injury was retained in the updated statement, but is now referred to as a match time-loss injury (Orchard et al., 2016a). This category, and all other new definitions of injury, is inclusive of illness. Therefore, the term injury includes injury and illness (Orchard et al., 2016a). This shift in injury definitions was necessary to allow for comparisons between studies within cricket and across sports (Orchard et al., 2016a). Alternative injury definitions to the match time-loss definition were optional and injury surveillance systems were encouraged to report injury rates across multiple formats (Orchard et al., 2016a). These definitions have been elaborated in the Glossary of Terms above.

As presented in Table 4.4 below, a greater variety in the types of injury definitions used was noted. The "medical attention injury" definition was used by seven of the 22 publications (Ahmun et al., 2019; Goggins et al., 2020b; Hill et al., 2019; Olivier & Gray, 2018; Panagodage Perera et al., 2019; Tallent et al., 2020; Warren et al., 2019). The "general time-loss injury" definition was exclusively used by 27% (6/22) of these publications. The "match time-loss" injury definition was used exclusively by 14% (3/22) of these publications. Fourteen percent (3/22) of publications did not mention using consensus definitions (Brooks et al., 2020; Bullock et al., 2020; Dutton et al., 2019).

The remaining percentage of publications was split equally among those who used their own definitions (Walter, 2020), those who did not use the definitions at all (Cai et al., 2019), and those who added a deviation to the consensus definitions (Soomro et al., 2018).

Table 4.4 Updated Consensus Publications, their Compliance, and Differences to Consensus Statement Injury Definition (2016-2022)

AUTHOR	DEFINITIONS USED	DIFFERENCES
Ahmun et al. (2019)	Used medical attention injury definition and match time loss injury definition. Included time-loss and non-time loss injuries	• Fully available for training and matches, with no injury or illness • Fully available for training and matches, but with an injury or illness • Available for selection in a major match, but with modified activity due to injury or illness • Unavailable for selection in a major match due to injury or illness Non time-loss injuries were category 2 and 3 and time-loss injuries were category 4
Alway et al. (2019)	Used general time loss definition, included imaging abnormality	Included symptomatic reporting and imaging abnormality as this is required for lumbar stress fracture diagnosis
Brooks et al. (2020)	Did not mention which definition was used, however looked at fractures specifically	Assessed fractures, i.e. would require symptomatic reporting, clinical assessment, and imaging
Bullock et al. (2020)	Did not mention which definitions were used	Used cricket health and wellbeing study data
Cai et al. (2019)	Did not use any of the consensus definitions	Used joint pain and being diagnosed with OA as an indicator
Dovbysh et al. (2021)	Used original consensus statement definition, match time-loss (match-time loss)	No differences
Dutton et al. (2019)	Did not mention which definitions were used	Mentioned that only non-contact, non-traumatic injuries to the dominant shoulder was included
Goggins et al. (2020b)	Used medical attention injury definition	No differences
Goggins (2021)	Used general time loss injury definition	No differences
Goggins et al. (2021)	Used general time loss injury definition	No differences
Hill et al. (2019)	Used match time loss and non-time loss measures, medical attention injury definition followed. Did not mention if consensus was followed	Assessed head impacts and concussion rates, used non time loss to get a better idea of incidence

Table 4.4 continued

AUTHOR	DEFINITIONS USED	DIFFERENCES
Olivier and Gray (2018)	Used 'medical attention' injury definition only	Assessed at non-contact lower back and lower quarter injuries only
Orchard et al. (2016a)	Used 'match time loss' injury definition only	Only used this definition as records for other injury types do not stretch over the entire study period
Orchard et al. (2017)	Used 'match time loss' injury definition only	Did not use imaging abnormality as a definition as imaging was not routinely done in that time for diagnostic purposes for hamstring injuries
Panagodage Perera et al. (2019)	Used the medical attention injury definition only Injuries further divided into match time-loss and match non-time loss injuries	Available: not injured, and could play/train unrestricted Modified: available to play but restricted from some match or training activities due to the injury (e.g. shoulder impingement can bat/bowl/field in a match but limited to throwing over shorter distance than usual), Unavailable: not available to play a match due to injury (e.g. shoulder dislocation, unable to bat, field and/or bowl as required in a match). (Athlete management system)
Rao et al. (2020)	Looked at general time loss injury, mentioned using the time loss definition in training and matches	No difference
Soomro et al. (2018)	Used 'match time loss' injury definition only with deviation	Not able to fully comply with this definition as they did not have the resources to note injury that did not allow the player to do his role during a game
Tallent et al. (2020)	Used medical attention injury and match injury definition. Includes time loss and non-time loss injury	Team injury status expressed on a 1–4 scale from "fully available" to "unavailable"
Tysoe et al. (2020)	Used general time loss injury definition	No differences
Walter (2020)	Used other injury definitions	Had an acute and chronic injury definition
Warren et al. (2019)	Used their own classification system. Looked at non-time loss and time loss injuries for match days (medical attention injuries)	Included match time loss and non-match time loss injuries; Available for match selection, no injury or illness Available for match selection but with injury/illness not causing modified activity Available for match selection, but with modified activity due to injury or illness Unavailable for match selection due to injury or illness

4.6.3 Compliance to Role Guidelines for Initial Consensus Publications (2006-2015)

Of the 15 initial publication (i.e., from 2006-2015), 67% did not mention whether the consensus guidelines were used to classify players into their roles (see Table 4.5 below). Twenty-seven percent (4/15) of the publications used their own method of classifying players and described the method that was used (Cowan, 2006; Dhillon et al., 2012; Kountouris et al., 2012; Stretch & Raffan, 2011). Twenty percent (3/15) of the publications used an all-rounder as one of their categories of classification. One publication that surveyed amateur cricketers included bowlers only. In the publication by Olivier et al. (2014), bowlers were either grouped as fast, medium, or fast medium.

Table 4.5 Initial Consensus Publications and their Compliance to Role Guidelines.

AUTHOR	DETAILS REGARDING GROUPING OF PLAYERS	COMPLIANCE TO ROLE GUIDELINES (Yes/No)
Cowan (2006)	Allocated player roles by asking them their respective role was in the team. Own methods mentioned	No
Dhillon et al. (2012)	Classified players according to coaches and players descriptions using their own definitions.	No
Frost and Chalmers (2014)	Did not mention how players were classed. Grouped players into specific roles within wider classifications	No
Kountouris et al. (2012)	Grouped players according to batsmen, fast bowlers, spin bowlers and wicket-keepers with own definitions	No
Mansingh et al. (2006)	Did not mention how they classified players or if they followed consensus guidelines	No
Olivier et al. (2014)	Classified bowlers into fast, fast-medium, and medium pace. Did not mention how bowlers were differentiated	No
Olivier et al. (2015)	Only assessed pace bowlers, did not classify them	No (bowlers only)
Orchard et al. (2006)	Did not mention if they followed consensus guidelines regarding player roles	No
Orchard et al. (2010)	Did not mention how players were classed	No
Orchard et al. (2015a)	Only assessed fast bowlers, did not mention how they were classified as ‘fast’	No
Orchard et al. (2015b)	Only assessed at fast bowlers, did not mention how they were classified	No
Ranson and Gregory (2008)	Did not mention how they classed player roles	Yes
Ranson et al. (2013)	Players grouped to batters, fast bowlers, slow bowlers, and wicket-keepers. Did not mention how they were classed	No
Soni et al. (2015)	Assessed batsmen, bowlers, wicket-keepers, and all-rounders. Did not mention how players were classed	No
Stretch and Raffan (2011)	Did not mention how player roles were allocated, looked at mechanism of injury and associated activity (batting, bowling, and fielding)	No

4.7 Compliance to Updated Role Guidelines (Publications between 2016-2022)

The updated consensus statement suggested new guidelines for classifying bowlers, batsmen, and all-rounders into their respective roles (as outlined in the Glossary of Terms above). The main changes were to the bowler definition, and the encouragement to group players according to the role in which they suffered their injury.

As presented in Table 4.6 below, 41% (9/22) of the total updated consensus publications did not mention whether the consensus guidelines were employed to classify players. However, only one (1/22) publication used their own classification system Panagodage Perera et al. (2019), compared to studies published using the initial (i.e., from 2006-2015) consensus statement (4/15). Three (14%, 3/22) publications did not separate players according to their cricketing roles (Bullock et al., 2020; Cai et al., 2019; Soomro et al., 2018). A further three (3/22) publications followed the consensus guidelines (Ahmun et al., 2019; Dovbysh et al., 2021; Warren et al., 2019). Twenty-three percent (5/22) of publications divided players into the activity they were performing at the time of injury. All three publications that surveyed amateur cricketers did not separate players into their respective roles (Bullock et al., 2020; Cai et al., 2019; Soomro et al., 2018).

Table 4.6 Updated Consensus Publications and their Compliance to Role Guidelines (Publications 2016-2022).

AUTHOR	DETAILS REGARDING GROUPING OF PLAYERS	COMPLIANCE TO ROLE GUIDELINES (Yes/No)
Ahmun et al. (2019)	Followed updated consensus guidelines and mentions them	Yes
Alway et al. (2019)	Does not mention what was the criteria to be classified as a fast bowler	No
Brooks et al. (2020)	Divided according to the role that they were in when injured (batting, bowling, wicket-keeping, fielding)	No
Bullock et al. (2020)	Did not class players into their roles	No
Cai et al. (2019)	Did not class players according to their roles	No
Dovbysh et al. (2021)	Divide players into spin bowlers, pace bowlers, wicket-keepers, and batsmen, but did not mention how they were classified	No
Dutton et al. (2019)	Split players into batsmen, spin, and pace bowlers, but did not mention how they were classified	No
Goggins (2021)	Divided players into the activity that they were doing when injury occurred	No
Goggins et al. (2020b)	Classified players according to the activity they were doing when suffering the injury (batting, bowling, fielding, wicket-keeping)	No
Goggins et al. (2021)	Did not divide player into positions, but rather looked at the activity that they were doing at time of injury	No
Hill et al. (2019)	Divided players who were injured into the activity that caused the injury	No
Olivier and Gray (2018)	Noted that the updated consensus does not recommend the all-rounder classification. Did not mention how players were classed	No
Orchard et al. (2016a)	Did not mention how they classified players, but did use the preferred positions	Yes
Orchard et al. (2017)	Used preferred positions, did not mention how they classified	Yes

Table 4.6 continued

AUTHOR	DETAILS REGARDING GROUPING OF PLAYERS	COMPLIANCE TO ROLE GUIDELINES (Yes/No)
Panagodage Perera et al. (2019)	Players split into batsmen, wicket-keepers, allrounders, pace, and spin bowlers, and by national administrators - own definition	No
Rao et al. (2020)	Divided into more specific roles, including hand and leg dominance and stated they followed the updated consensus	Yes
Soomro et al. (2018)	Did not class players according to their roles	No
Tallent et al. (2020)	Divided players into batsmen, wicket-keepers, fast bowlers, spinners, and all-rounders, but did not mention how they were classified	No
Tysoe et al. (2020)	Only assessed fast bowlers, did not mention how they were classified	No
Walter (2020)	Assessed fast bowlers only. Did not have a set criterion for classification, but assessed activity during injury onset	No
Warren et al. (2019)	Players were classified according to updated consensus statement namely, batsmen, wicket-keepers, slow, and fast bowlers	Yes

4.8 Compliance with Injury Incidence Definition(s) and Unit of Calculation (Initial Consensus Publications)

4.8.1 Injury Incidence Measures and Unit of Calculation Used in Amateur Cricketers (Initial Consensus Publications)

There was only one publication that surveyed injury among amateur cricketers within the first group of publications. This publication did not calculate injury incidence and only assessed the number of injuries for the study period, with no unit of calculation provided (Olivier et al., 2014).

4.8.2 Injury Incidence Measures and Unit of Calculation Used in Professional Cricketers (Initial Consensus Publications)

As presented in Table 4.7 below, 14 (93%) publications surveyed injury among professional cricketers and of these, two were theses. Five of the 14 (36%) publications did not investigate a specific injury incidence measure and did not report a unit of calculation. Four of the 14 (29%) publications assessed the number of injuries that occurred in the study period (Olivier et al., 2015; Orchard et al., 2015a, 2015b; Ranson & Gregory, 2008).

Only two publications used three or more injury incidence measures (Orchard et al., 2010; Ranson et al., 2013). Match-injury incidence was employed 57% (8/14) of the time. The unit of calculation per 10 000 hours for match-injury incidence was used in all eight aforementioned publications. Three of the eight publications used "per days of exposure" as a unit of calculation as well (Orchard et al., 2010; Ranson et al., 2013; Soni et al., 2015).

Seasonal-injury incidence was used 29% (4/14) of the time (Frost & Chalmers, 2014; Kountouris et al., 2012; Orchard et al., 2006). The consensus unit of calculation was used differently for seasonal-injury incidence in one publication only (Kountouris et al., 2012). In the publication by Kountouris et al. (2012), the authors noted their deviation from the consensus unit of calculation, as they surveyed international cricketers. These cricketers compete throughout the year, instead of only for six months of the year (i.e., a season length). Two (14%) of the 14 publications assessed training-injury incidence (Dhillon et al., 2012; Soni et al., 2015). On both occasions where a delivery-based unit of calculation was used, it was done correctly (Orchard et al., 2010; Ranson et al., 2013).

Table 4.7 Initial Consensus Publications, Incidence Measures, and Unit of Calculation Used.

ARTICLE	INCIDENCE MEASURES USED	UNIT OF CALCULATION	COMPLY WITH CONSENSUS STATEMENT (Yes/No)
Cowan (2006)	• General injury incidence	• Did not follow consensus	Yes
Dhillon et al. (2012)	• Injury incidence (match and training)	• Per 10 000 hours	Yes
Frost and Chalmers (2014)	• Match injury incidence • Seasonal injury incidence	• Per 10 000 hours • Per squad per season	Yes
Kountouris et al. (2012)	• Injury incidence (match) • Seasonal incidence	• Per 10 000 hours • Deviates due to international cricket (12 months)	Yes
Mansingh et al. (2006)	• Match injury incidence	• Per 10 000 hours	Yes
Olivier et al. (2014)	• Assessed the number of injuries, not injury incidence	• Not reported	No
Olivier et al. (2015)	• Assessed the number of injuries, not injury incidence	• Not reported	No
Orchard et al. (2006)	• Match injury incidence • Seasonal injury incidence	• Injuries per 10 000 hours • Injuries per squad per season	Yes
Orchard et al. (2010)	• Match injury incidence • Seasonal injury incidence • Bowling match incidence	• Per 10 000 hours and per 1000 days of play • Injuries per team per season • Per 1000 overs bowled	Yes
Orchard et al. (2015a)	• Assessed the number of injuries and injury risk but did not look at incidence	• Not reported	No
Orchard et al. (2015b)	• Did not assess injury incidence, only number of injuries and injury risk	• Not reported	No
Ranson and Gregory (2008)	• Only assessed the number of injuries	• Not reported	No
Ranson et al. (2013)	• Time-loss injury incidence • Match-injury incidence • Match-bowling incidence • Match-batting incidence	• Per 100 player days • Per 10 000 hours and per 1000 days • Per 1000 tournament overs bowled • Per 10 000 tournament balls faced	Yes
Soni et al. (2015)	• Assessed match and training injury incidence	• Per 100 days of exposure and 10 000 hours of play	Yes
Stretch and Raffan (2011)	• Assessed injury occurrence at training, not incidence	• Per 10 000 hours (match only)	Yes

4.9 Updated Consensus Definitions: Incidence and Unit of Calculation

4.9.1 Injury Incidence Measures and Unit of Calculation Used in Amateur Cricketers (Updated Consensus Publications)

Only one article surveyed injury among amateur cricketers within the second group of publications. This publication only measured match-injury incidence and used 10 000 match exposure hours as the unit of calculation (Soomro et al., 2018). Two publications surveyed injury among amateur and professional cricketers concurrently, and both did not use any injury incidence measures or units of calculation (Bullock et al., 2020; Cai et al., 2019).

4.9.2 Injury Incidence Measures and Unit of Calculation Used in Professional Cricketers Exclusively (Updated Consensus Publications)

As presented in Table 4.8 below, 19 (86%) publications surveyed injury among professional cricketers. Six (32%) of the publications did not have a specific measure of injury incidence or a specific unit of calculation (Ahmun et al., 2019; Dutton et al., 2019; Olivier & Gray, 2018; Rao et al., 2020; Tallent et al., 2020; Walter, 2020). All of these publications only counted the number of injuries occurring within the given period. Match-injury incidence was the measure most employed in these publications (58%, 11/19). The updated unit of measurement (per days of play) was used eight out of the 11 times that match-injury incidence was used. The older unit of measurement (i.e., per exposure hours) was used in two publications (Dovbysh et al., 2021; Panagodage Perera et al., 2019), while only one publication used it as the exclusive unit of calculation (Panagodage Perera et al., 2019). The new unit for calculating seasonal-injury incidence (per 100 players per season) was used four times. Each time it was used correctly.

One study, by Goggins et al. (2021), used per 100 players per season as the unit of calculation for seasonal-injury incidence as their season was only six months in duration and multiplying it by two would not provide an accurate representation of the annual injury incidence. Medical-complaint injury incidence was used once (Goggins et al., 2021). Non-time loss and time-loss injury incidence was measured once each with the unit of calculation being per 100 and 1000 player days respectively (Tysoe et al., 2020; Warren et al., 2019). Thirty-two percent (6/19) of publications did not use a consensus-based injury incidence measure or unit of calculation. These studies counted the number of injuries within the group but did not calculate injury incidence (Ahmun et al., 2019; Dutton et al., 2019; Olivier & Gray, 2018; Rao et al., 2020; Tallent et al., 2020; Walter, 2020).

Table 4.8 Updated Consensus Publications, Incidence Measures, and Unit of Calculation Used.

AUTHOR	INCIDENCE MEASURES USED	UNIT OF CALCULATION	COMPLY WITH CONSENSUS STATEMENT (Yes/No)
Ahmun et al. (2019)	• Assessed the quantity of injuries	• Not reported	No
Alway et al. (2019)	• Match-injury incidence • Annual-injury incidence	• Per 10 000 deliveries • Per 100 fast bowlers	Yes
Brooks et al. (2020)	• Match-injury incidence by position and gender	• Per 100 000 balls per player • Per 100 000 balls per team	Yes
Bullock et al. (2020)	• Assessed pain in former cricketers	• Not reported	No
Cai et al. (2019)	• Assessed pain in former cricketers.	• Not reported	No
Dovbysh et al. (2021)	• Match-injury incidence	• Per 10 000 player hours and 1000 player days	Yes
Dutton et al. (2019)	• Counted amount of shoulder injuries in cohort only	• Not reported	No
Goggins et al. (2020b)	• Match-injury incidence • Medical complaint incidence	• Per 1000 player days • Per 100 players per year (annual)	Yes
Goggins (2021)	• Match-injury incidence • Seasonal-injury incidence	• Per 1000 days of play. • Per 100 players per season (Did not use annual due to the 6-month season in UK)	Yes
Goggins et al. (2021)	• Match-injury incidence • Match-injury burden	• Per 1000 days of play • Overall match injury incidence rate x mean absence per match injury, expressed per 1000 days of play	Yes
Hill et al. (2019)	• Match-injury incidence	• Per 1000 player match days, converted into injuries per number of deliveries per 1000 player match hours	Yes
Olivier and Gray (2018)	• Only looked at the quantity of injuries	• Not reported	No
Orchard et al. (2016a)	• Match-injury incidence across formats and combined • Seasonal-injury incidence	• Injuries per 1000 player days • Injuries per 100 players per year	Yes

Table 4.8 continued

AUTHOR	INCIDENCE MEASURES USED	UNIT OF CALCULATION	COMPLY WITH CONSENSUS STATEMENT (Yes/No)
Orchard et al. (2017)	• Match-injury incidence (hamstrings) combined across formats	• Injuries per 1000 days of play	Yes
Panagodage Perera et al. (2019)	• Match injury incidence	• Injuries per 10 000 match exposure hours	Yes, with old consensus
Rao et al. (2020)	• Assessed total number of injuries, injuries per anatomical region, injuries per role	• Not reported	No
Soomro et al. (2018)	• Match injury incidence	• Injuries per 10 000 match exposure hours	Yes
Tallent et al. (2020)	• Assessed the quantity of injuries	• Not reported	No
Tysoe et al. (2020)	• Time-loss injury incidence	• Per 1000 days	Yes
Walter (2020)	• Assessed the number of injuries, not incidence	• Not reported	no
Warren et al. (2019)	• Time-loss injury incidence • Non-time loss injury incidence • Calculated for match days, body location, skill group, squad, mode of injury, and activity during injury	• Calculated per 100 player match days	Yes

4.10. Compliance to Injury Prevalence Definition(s) and Method of Calculation (Initial Consensus Publications)

4.10.1 Injury Prevalence Measures and Unit of Calculation in Amateur Cricketers (Initial Consensus Publications)

The one (1/15) publication that surveyed injury among amateur cricketers did not follow the initial consensus guidelines regarding the unit of calculation for prevalence. Instead, it calculated the percentage of new injuries occurring within the cohort (Olivier et al., 2014). This may have been due to varying methodological aims and objectives.

4.10.2 Injury Prevalence Measures and Unit of Calculation in Professional Cricketers (Initial Consensus Publications)

As presented in Table 4.9 below, 71% (10/14) of the publications that used the initial consensus statement measured match-injury prevalence. Sixty percent of the 10 (6/10) publications that measured match-injury prevalence did so exclusively. Twenty-two percent (3/14) of all initial publications that surveyed professional cricketers did not measure any type of injury prevalence, and therefore did not have an accepted unit of calculation (Olivier et al., 2014; Orchard et al., 2015a; Orchard et al., 2016a). Training-injury prevalence was measured by 14% (2/14) of all publications that surveyed professional cricketers (Dhillon et al., 2012; Soni et al., 2015). One of these publications did not follow the initial consensus guidelines for the unit of calculation (Soni et al., 2015).

Table 4.9 Initial Consensus Publications, Prevalence Measures, and Unit of Calculation Used.

ARTICLE	PREVALENCE MEASURES USED	UNIT OF CALCULATION
Cowan (2006)	• Injury prevalence	• Follows consensus
Dhillon et al. (2012)	• Injury prevalence (match and training)	• Deviates from consensus
Frost and Chalmers (2014)	• Injury prevalence (match only)	• Follows consensus
Kountouris et al. (2012)	• Injury prevalence (match only)	• Follows consensus
Mansingh et al. (2006)	• Injury prevalence (match only)	• Follows consensus
Olivier et al. (2014)	• Looked at percentage of injuries	• Not reported
Olivier et al. (2015)	• Did not measure injury prevalence	• Not reported
Orchard et al. (2006)	• Injury prevalence for match type, body region, and player role	• Follows consensus
Orchard et al. (2010)	• Injury prevalence (match only)	• Follows consensus
Orchard et al. (2015b)	• Did not measure prevalence	• Not reported
Orchard et al. (2015a)	• Did not measure prevalence	• Not reported
Ranson and Gregory (2008)	• Injury prevalence (match only	• Follows consensus
Ranson et al. (2013)	• Tournament injury prevalence • Match-injury prevalence	• Number of missed days due to time- loss injury divided by number of Tournament player days multiplied by100. • Number of missed matches due to time loss injury divided by Match player days multiplied by 100 • Deviates from consensus
Soni et al. (2015)	• Looked at training and match prevalence together Different to consensus	• Different method of calculating injury prevalence (missed player days x no of injured players/ missed player days x total no of players)
Stretch and Raffan (2011)	• Injury prevalence (match only)	• Follows consensus

4.11 Compliance to Injury Prevalence Definition(s) and Unit of Calculation (Updated Consensus Publications)

4.11.1 Injury Prevalence Measures and Unit of Calculation in Amateur Cricketers (Publications 2017-2022)

The one publication that surveyed injury among amateur cricketers exclusively, measured time-loss injuries only (see Table 4.10). Soomro et al. (2018) followed the updated consensus statement unit of calculating injury prevalence and replaced player days with player weeks to simplify calculations. The two publications that surveyed both amateur and professional cricketers did not use any injury prevalence measures or unit of calculation (Bullock et al., 2020; Cai et al., 2019). This may be due to the varying methodological aims and objectives.

4.11.2 Injury Prevalence Measures and Unit of Calculation in Professional Cricketers (Publications from 2017-2022)

Nineteen studies surveyed injury among professional cricketers after the publication of the updated consensus statement (i.e., from 2017-2022). Fifty-eight percent (11/19) of the publications did not use any injury prevalence measures or unit of calculation, which may be due to different methodological aims and objectives. Match-injury prevalence was measured by 15% (3/19) of publications (Dovbysh et al., 2021; Orchard et al., 2016a; Warren et al., 2019). Eleven percent (2/19) of publications measured two or more injury prevalence measures ((Goggins et al., 2020b; Warren et al., 2019). While 42% percent (8/19) of publications followed the updated consensus statement for the unit of calculation. Seasonal-injury prevalence was only calculated in one publication (Goggins et al., 2021).

Twenty-one percent (4/19) of publications calculated time-loss injury prevalence. The latter was the only study that examined non-time loss injury prevalence (Goggins et al., 2020b).

Table 4.10 Updated Consensus Publications, Prevalence Measures, and Unit of Calculation Used.

AUTHOR	PREVALENCE MEASURE USED	UNIT OF CALCULATION (PERCENTAGE)
Ahmun et al. (2019)	Not reported	Not reported
Alway et al. (2019)	Time-loss Injury prevalence	As consensus (percentage)
Brooks et al. (2020)	Not reported	Not reported
Bullock et al. (2020)	Not reported	Not reported
Cai et al. (2019)	Not reported	Not reported
Dovbysh et al. (2021)	Match-injury prevalence	As consensus (percentage)
Dutton et al. (2019)	Not reported	Not reported
Goggins et al. (2020b)	Match-complaint and general-complaint prevalence	As consensus (percentage)
Goggins (2021)	Seasonal-injury prevalence	As consensus (percentage)
Goggins et al. (2021)	Not reported	Not reported
Hill et al. (2019)	Not reported	Not reported
Olivier and Gray (2018)	Not reported	Not reported
Orchard et al. (2016a)	Match injury prevalence	As consensus (percentage)
Orchard et al. (2017)	Not reported	Not reported
Panagodage Perera et al. (2019)	Not reported	Not reported
Rao et al. (2020)	Not reported	Not reported
Soomro et al. (2018)	Time-loss injury prevalence	As consensus, player days replaced by weeks, to simplify calculations
Tallent et al. (2020)	Not reported	Not reported
Tysoe et al. (2020)	Time-loss injury prevalence	Not reported

Table 4.10 continued

AUTHOR	PREVALENCE MEASURE USED	UNIT OF CALCULATION (PERCENTAGE)
Walter (2020)	Injury prevalence	Days missed per injury per bowler per year
Warren et al. (2019)	Injury prevalence (match days, body location, skill group, squad, mode of injury, and activity during injury)	As consensus (percentage)

4.12 Quality Appraisal/Methodological Quality of Included Publications

Thirty-seven publications were appraised for methodological quality using the 2018 CASP for cohort's checklist (see Appendix B). All 37 publications included in this review addressed a clearly focused issue and recruited participants in an acceptable manner. In seven of the publications, the reviewers could not tell if the exposure was accurately measured (Bullock et al., 2020; Cowan, 2006; Goggins, 2021; Kountouris et al., 2012; Olivier et al., 2014; Tysoe et al., 2020; Walter, 2020). For this study, exposure was defined as the amount of time cricketers spent performing cricket-related activities per injury. Where the researchers had doubts about the accuracy of exposure measurement, they were uncertain regarding the measurement of the frequency and duration of cricket practice sessions, cricket matches, and gym sessions. In addition, it was unclear whether outcome measure bias existed in six of the 37 publications included in this review (Ahmun et al., 2019; Brooks et al., 2020; Kountouris et al., 2012; Olivier et al., 2014; Olivier et al., 2015; Tysoe et al., 2020).

The identification and design confounding factors caused the most uncertainty as very few authors mentioned these factors directly (see Appendix J). Nine publications included in this study did not mention of any design or identification confounding factors (Dhillon et al., 2012; Orchard et al., 2017; Ranson & Gregory, 2008; Ranson et al., 2013; Rao et al., 2020; Soni et al., 2015; Tallent et al., 2020; Tysoe et al., 2020). Areas such as length and completeness of subject follow up were not applicable for six (16%, 6/37) of the retrospective publications included in this review (Brooks et al., 2020; Bullock et al., 2020; Dovbysh et al., 2021; Orchard et al., 2017; Rao et al., 2020; Walter, 2020).

The researchers were unsure of the completeness of subject follow up for 34% (10/29) of the prospective publications (Dhillon et al., 2012; Frost & Chalmers, 2014; Goggins et al., 2020a; Olivier & Gray, 2018; Olivier et al., 2014; Ranson & Gregory, 2008; Ranson et al., 2013; Soni et al., 2015; Tysoe et al., 2020; Warren et al., 2019), and were also unsure of the length of follow up for five publications (Dhillon et al., 2012; Frost & Chalmers, 2014; Goggins et al., 2021; Tysoe et al., 2020; Warren et al., 2019). Uncertainty regarding follow up related to the doubt that authors had revisited participants regarding any injuries sustained during the study.

The researchers could not determine whether the results of seven publications could be applied to the local population, and whether 14 publications correlated with other available cricket injury surveillance publications (Cowan, 2006; Goggins et al., 2021; Goggins et al., 2020b; Kountouris et al., 2012; Orchard et al., 2006; Ranson & Gregory, 2008; Ranson et al., 2013). In addition, the researchers were also unsure whether the results from 15 publications had implications for practice as they were not clearly stated. Both prospective and retrospective publications were included in this review; therefore, preventing the researchers from further limiting the number of included publications.

4.13 Summary of Chapter

In relation to the objectives of this study, several results were noted. Two major strategies of injury surveillance were employed to survey injury among cricketers. The strategy most often used was the collection of injury data by medical staff. Self-reported injury surveillance strategies were used less frequently. However, the latter was more commonly used in the amateur cricketing context.

Most publications were conducted in developed countries. Based on the results of this review, there was an increase in the number of publications that met the inclusion criteria on an annual basis. The researchers also noted a lack of publications that surveyed injury among amateur cricketers. Compliance to the initial injury definition was fair, with 7 of the 15 publications following this. After the publication of the updated consensus statement, there was a greater variability in the injury definitions used. Compliance to the updated injury definitions was also good, with only six of the 22 publications not using a consensus injury definition.

Most (19/37) publications did not mention whether they followed consensus guidelines to classify cricketers into their respective roles. After the publication of the updated consensus statement, there was an increase in the number of publications (5/22) that used the activity-based system to arrange players into their respective roles. Only one (1/4) amateur cricketing publication calculated injury incidence and prevalence using the consensus guidelines. Match-injury incidence was mostly measured among the initial publications and the consensus unit of calculation was used consistently. Match-injury incidence was still the most used injury incidence measure after the publication of the updated consensus statement. The uptake of the updated consensus unit of calculation among professional cricket publications was also good (8/11). Match-injury prevalence was the most measured unit of calculation among the publications following the initial consensus statement (10/14). After the publication of the updated consensus statement, more studies did not follow the consensus guidelines or unit of calculation for injury prevalence (11/19).

Finally, the findings of the appraisal of the methodological quality of the included publications were discussed. All 37 publications underwent a methodological quality assessment via the 2018 CASP for cohort’s checklist. All publications addressed a clearly focused issue as well as recruited participants in an acceptable manner. The researchers were unsure about seven publications regarding the accuracy of exposure measurement, particularly in quantifying the time spent on cricket-related activities per injury. Furthermore, six publications exhibited ambiguity regarding outcome measure bias. Nine publications lacked design or identification of confounding factors. In addition, 34% of publications were uncertain about completeness of subject follow-up and duration (prospective studies).

CHAPTER FIVE: DISCUSSION

5.1 Introduction

The aim of this integrative review was to review the injury surveillance strategies being used in amateur and professional cricketers, as well as to compare these strategies to the two-cricket injury surveillance consensus statements. The researchers noted that the most common strategy (78%) for monitoring injury among professional cricketers was via the collection of injury data by medical staff (i.e., by physiotherapists and doctors). The most common strategy of monitoring injury among amateur cricketers was via self-reported measures (75%). Furthermore, an explanation for the popularity of self-reported measures in the amateur sporting context is primarily due to their cost effectiveness and simplicity (Halson, 2014).

Very few publications surveyed amateur cricketers (see Table 4.1 and Table 4.2). This scarcity of publications may be due to financial and practical barriers (Olivier et al., 2022). The compliance to consensus recommended injury definitions and injury measures by publications that surveyed amateur cricketers was sub-standard. This may be due to the updated consensus statement not having specific guidelines for amateur cricketers and potential variability in injury surveillance strategies within these publications. The latter may be due to a lack of medical professionals, absence of resources, time limitations, and informal cricketing structures (Singh, 2022). The researchers also noted variability in the injury definitions and injury measures used by the publications that surveyed professional cricketers, (see Table 4.3, Table 4.4, Table 4.5, and Table 4.6).

Furthermore, publications that surveyed injury among professional cricketers had better compliance with the cricket injury surveillance consensus guidelines compared to studies of amateur cricketers (see Table 4.3, Table 4.4, Table 4.5, and Table 4.6). However, this may be due to amateur studies not setting out to measure injury incidence and prevalence.

Chapter Four (Sections 4.8-4.9) highlighted a disparity in injury incidence reporting. Only one publication that surveyed injury among amateur cricketers measured match-injury incidence and employed the updated consensus unit of calculation (Soomro et al., 2018). Contrastingly, match-injury incidence was calculated most in publications involving professional cricketers. Furthermore, the uptake of the updated injury incidence calculation unit (i.e., per 1000 days) was good in the professional cricketing context.

Similarly, injury prevalence (Sections 4.10-4.11) was measured by only one publication in the amateur cricketing context (Soomro et al., 2018). While an earlier publication by Olivier et al. (2014) investigated the percentage of injuries, they did not measure injury prevalence. Conversely, among the professional cricketing context, match-injury prevalence was investigated the most. Of note, only two publications made use of two or more injury prevalence measures measures (Goggins et al., 2020b; Warren et al., 2019). The latter also stands out for being the only publication to measure non-time loss injury prevalence.

The prospective study design was employed by most (31/37) of the included publications (refer to Section 4.12).

Furthermore, the researchers were unsure of the calculation of cricketing activity exposure in seven of the publications. Confounding factors caused the most uncertainty as many publications did not mention them directly.

The following discussion is outlined according to the objectives this study set out to achieve, that included to:

- describe the surveillance strategies currently used to monitor injuries in amateur and professional cricket players (Section 5.2);
- assess the methodological quality of the included studies (Section 5.3); and
- assess the reporting of injury surveillance data of amateur and professional cricket players according to the 2005 and 2016 injury surveillance consensus statements (Sections 5.7 to 5.10).

5.2 Surveillance Strategies Used to Monitor Injuries Among Amateur and Professional Cricketers

5.2.1 Injury Surveillance by Medical Staff

To date, injury surveillance strategies in amateur and professional cricketers have not been reviewed. This study observed that the most common strategy of monitoring injury in professional cricketers was via the collection of injury data by medical staff (see Section 4.5). It could be debated that injury data collected by qualified medical personnel would be more reliable and accurate compared to data collected by a person without medical expertise, as these qualified medical personnel undergo intensive training in anatomy and injury assessment (Fuller et al., 2007; Shead et al., 2018). Furthermore, they often follow standardised injury evaluation and management protocols (Duncan et al., 2019; Silvers-Granelli et al., 2021).

Professional athletes require continuous medical care of the highest standard. The role of a team's medical staff is to reduce the risk of the athlete being harmed and to optimise their athletic performance (Ekegren et al., 2016). Therefore, collecting accurate and reliable data will assist in formulating appropriate intervention plans. This highlights the importance of medical staff and their role in injury monitoring within sports teams at all levels. Some noticeable disadvantages of ongoing injury surveillance by medical staff includes financial and operational costs (Ekegren et al., 2016). From the available literature, it may be suggested that developing countries do not have the funding or operational resources for these systems. This was evidenced in the present study by the majority of publications (17/37) that used ongoing injury surveillance originating from developed countries. Amateur cricket operations do not have the means to employ medical staff to operate these injury surveillance systems (Olivier et al., 2022). They also have a lack of resources and less frequent contact with medical professionals (Olivier et al., 2022; van Beijsterveldt et al., 2015). Furthermore, this lack of resources may explain the popularity of self-reported measures for injury surveillance in developing countries due to their cost effectiveness.

It is interesting that injury surveillance by medical staff is the most common strategy, as Ekegren et al. (2016) identified only one injury surveillance system in cricket in their study. The study also reported that most of these ongoing injury surveillance systems had been present within professional sport, a finding that coincides with that of the present study. This may be due to a lack of information regarding these systems as these injury surveillance systems cannot be used in their current form in an amateur cricket setting (Olivier et al., 2022).

As noted in Chapter Four (Sections 4.1 and 4.2), there has been a clear attempt to gather injury surveillance data in developed countries through the presence of well implemented injury surveillance systems in their professional cricket operations (Olivier et al., 2022). The presence of established injury surveillance systems in developed countries may be linked to appropriate knowledge and availability of finances. Developed countries often have more sports medicine technologies, including the expertise to develop and implement these systems (Ekegren et al., 2015; Theilen et al., 2021; West et al., 2022).These countries also have the availability of finances to invest in injury surveillance technology (Alanazi et al., 2015; West et al., 2022).

5.2.2 Self-Reported Injury Surveillance Strategies

Self-reported strategies are assumed to be cost- and time-effective measures to monitor an athlete's response to training and competition (Saw et al., 2015). Therefore, it is not surprising that the most common strategy of surveying injury among amateur cricketers was the self-reported questionnaire.

Due to the nature of amateur cricket, access to medical professionals varies greatly, depending on factors including funding, location, type of institution, and age of cricketers (Olivier et al., 2022). Therefore, it's difficult for amateur cricketing organisations to implement the same injury surveillance strategies as their professional counterparts. In the present study, it was evident that there was limited involvement of physiotherapists in the recording of injuries among amateur cricketers, as only one publication reported this (Soomro et al., 2018).

In addition, the other three publications that surveyed amateur cricketers did not report the involvement of medical personnel. Physiotherapists may be preferred to other team staff members as they may engage with players more often and also have a medical background (Brukner, 2012). However, the most appropriate sports medicine member is highly dependent on the setting in which the sport occurs (Magee et al., 2010). In many amateur settings, the physiotherapist may be the only medical professional working with the team (Magee et al., 2010). However, in professional sports the physiotherapist has become an integral figure in the sports medicine team and plays a pivotal role in injury prevention methods during competition (Srivastava et al., 2022). Studies that are not able to utilise medical professionals to collect injury surveillance data may use self-reported injury surveillance strategies as an alternative due to their cost-effectiveness (Halson, 2014).

A systematic review of injury among all levels of female cricketers reported the use of the following strategies of injury surveillance: self-administered questionnaires, data from cricket seasons or tournaments, observational methods, and hospital records (Jacobs et al., 2022). The systematic review noted that the self-administered questionnaire was the most common strategy of injury surveillance among female cricketers.

Within the current study, telephonic and self-reported injury surveillance strategies were the least used as it may be difficult to implement ongoing electronic and telephonic injury surveillance systems within amateur cricket, possibly due to financial constraints and perceived importance of injury surveillance in this population.

To date, there are no amateur-based standardised injury surveillance systems to the researcher's knowledge. All studies that surveyed injury among amateur cricketers were authored by independent researchers from academic institutions (see Table 4.1 and Table 4.2). This may be due to a lack of funding and interest from professional cricketing bodies. Authors should be cognizant of the recall bias and greater subjectivity of assessment associated with self-reported injury surveillance strategies, as athletes may perceive their own injuries as more severe due to their perception of match performance (Finch, 1997; Goes et al., 2020).

5.3 Methodological Quality of Included Publications

The present study made use of the 2018 CASP for cohort's checklist to appraise the methodological quality of the included publications (see Appendix B). It is the most used tool for quality appraisal in health-related qualitative and quantitative evidence syntheses (Long et al., 2020). All included publications addressed a clearly focused issue, indicating that the research topic was clear to the authors.

Six of the 37 included publications were retrospective in nature. However, retrospective studies are generally inherently flawed due to their design. These flaws include recall bias and the usage of data that may have been collected with a different intention (Talari & Goyal, 2020). It is therefore recommended that more studies employ a prospective research methodology when exploring injury rates among cricketers. This will allow for the investigation of all injury rates that meet the study's aims and objectives (Wang & Kattan, 2020).

The authors of these prospective studies would have then also been able to control data collection and follow-up methods to ensure alignment with the consensus statements on injury surveillance in cricket (Wang & Kattan, 2020).

In seven of the publications, the researchers were unsure whether player exposure time had been accurately measured. This was primarily due to the lack of reporting of how player exposure had been calculated, or whether the study had calculated exposure to other sports, training, and recreational cricket games. Readers are not able to ascertain player exposure to recreational activities and conditioning, and these injuries may have been caused by non-cricketing activities.

Identification and design confounding factors caused the most uncertainty, as many publications had not reported this directly. The researchers were unsure of the implications of practice of 15 of the 37 publications included in the current study as these studies merely stated injury rates and measures. A lack of clear implications of practice can be considered a missed opportunity to translate research findings into practice. Implications for practice need to be clear to assist medical professionals to educate and prepare athletes to decrease injury incidence (Srivastava et al., 2022). A good example of this was from Tallent et al. (2020) who assessed injury rates in specific cricketing roles and compared them to team success, a clear practical implication.

The above findings highlight the importance of the standardisation of research methodologies when assessing cricket injuries. Standardisation can be achieved with the presence of medical personnel at training and matches (Fuller et al., 2007).

The varying methods of surveying injury may influence comparability and quality of the collected data (Tabben et al., 2020; Yeomans et al., 2018). For example, where the injury incidence of injuries that require medical attention increases within a population, this may not be due to deteriorating injury prevention methods. Instead, this may be due to the improvement of feedback and data control. Conversely, an increase in injury incidence within a population may also be attributed to questionable diagnosis due to the lack of follow-up with a medical professional after reporting injury via a self-reported injury questionnaire (i.e., an incorrect player self-diagnosis; Yeomans et al., 2018).

5.4 Number of Publications per Year

The present study observed a steady increase in the number of publications over the 16-year period from the publication of the initial consensus statement. In the first five years post the initial consensus statement (i.e., 2006-2011), only six publications met the researchers' inclusion criteria (refer to Section 3.3). This may be due to a slow adoption of the initial consensus statement. The following five years (i.e., 2012-2017) produced 11 publications, and the final five years (i.e., 2018-2022) produced 20 new publications. These findings are consistent with the increased interest in cricket and research in women's cricket (Jacobs et al., 2022). Furthermore, the researchers also noted an increase in the number of publications that assessed injury among female cricketers exclusively (Goggins et al., 2020a; Panagodage Perera et al., 2019; Warren et al., 2019). However, this increase in cricketing publications is not entirely consistent with the findings of a systematic review of cricket injury epidemiology (Soomro et al., 2018).

The systematic review by Soomro et al. (2018) employed different inclusion criterion, namely: all junior, amateur, and professional studies published from 2000 to 2016. The difference may be due to methodological dissimilarities as the present study did not include publications on junior cricketers. The increase in the number of publications noted in the present study highlights that there is an increase in the perceived importance of injury surveillance and the collection of epidemiological data, particularly in professional cricket (Olivier et al., 2022). This may be due to injury surveillance data being considered as a prerequisite for the development and evaluation of strategies to prevent injury (Ekegren et al., 2015; Olivier et al., 2022).

5.5 Level of Cricketers (i.e., Amateur or Professional)

The lack of publications that surveyed adult amateur cricketers was highlighted in the present study. Only 11% (4/37) of the included publications assessed amateur cricketers. This is consistent with the findings of Soomro et al. (2018), who grouped their included publications into amateur, junior, elite, and club level. The present study also noted the scarcity of publications that surveyed amateur cricketers above the age of 18. This may be since these players participate outside organised structures such as a school or cricket governing body. This may present challenges for the continuous injury surveillance of these cricketers, as there may be financial challenges. Furthermore, there is a need for a standardised injury surveillance system within school and club cricket (Olivier et al., 2022). This sentiment is shared by the researchers, to improve performance and safety outcomes.

5.6 Country of Publication and Gender of Participants (Publications from 2006-2015)

The United Kingdom had the greatest number of publications included in this review. Female cricketers were also studied mostly in the United Kingdom. Australia was a close second in both regards. These findings are similar with those of Soomro et al. (2018), as many of their included publications were published in Australia. It is important to note the increase in publications from the United Kingdom after the publication of their systematic review. This may be due to increased injury prevention and player welfare initiatives by the England and Wales Cricket Board (2021).

A total of four studies explored injury among female cricketers. These findings are consistent with a narrative review by Munro and Christie (2018) that reported a lack of research pertaining to women cricketers. A recent systematic review assessed injury incidence and prevalence in female cricketers and included 21 publications (Jacobs et al. (2022). Their inclusion criteria included female cricketers of all ages from all levels of play, which is a possible explanation for the inclusion of a greater number of publications in their study. The majority of their included publications were from Australia and the United Kingdom, which is consistent with the findings of the present study. This finding echoes the results of Dhillon et al. (2012) who highlighted that there was a large body of research from developed countries and a scarcity of cricket-related research from Asian and developing countries. These findings highlight that more research is being conducted within developed cricketing nations. It is a possibility that these developed nations have existing cricket governing bodies that have implemented long-standing injury surveillance in cricket.

In addition, cricket governing bodies may put aside a financial budget for the publication of cricket-related research to uphold the public image of being evidence based and acting in the best interests of their athletes (England and Wales Cricket Board, 2021).

5.7 Compliance to Injury Definition(s)

The success of any sports injury surveillance system is highly dependent on reliable and valid injury definitions (Brooks & Fuller, 2006; Finch, 1997). These definitions should be standardised across the sport to improve the comparability and interpretation of data (Finch, 1997). Therefore, it is concerning that injury definitions differed across the included publications. The present study observed that the majority of studies published within the timeframe of the initial consensus did not follow the exact injury definition (8/15).

There was a greater variability in the injury definitions being used after the second consensus statement was published in 2016. This leads to vast discrepancy in the injury incidence rates, making comparison across studies difficult. “Medical attention” and “non-time loss” definitions were used more frequently. These broad injury definitions increase the rate of injury recording, but also may not have much clinical relevance to medical professionals (Cross et al., 2018). Practically, the monitoring of these minor injuries does contribute to early identification and interventions that may lessen the injury burden (Hespanhol Junior et al., 2015).

Narrow injury definitions such as time-loss are assumed to be more reliable as the inability for an athlete to participate in training or matches is easy to identify (Clarsen & Bahr, 2014). It also allows for the comparison of data across teams for multiple seasons (Clarsen & Bahr, 2014). The match time-loss injury definition can be used in the amateur setting as it does not require training or medical expertise to identify missed matches due to injury (Clarsen & Bahr, 2014). However, the utilisation of broader injury definitions may result in inconsistencies in injury data, as various recorders may have varying interpretations of an injury (Clarsen & Bahr, 2014). If different injury definitions are employed, it becomes difficult to compare across publications. Furthermore, broader injury definitions may result in an over-estimation of injury rates, as minor injuries may be included in these calculations. Within the context of professional sports, these broader terms are perhaps more suitable as they facilitate accurate reporting of injury risk and contribute to a better understanding of clinical demands (Cross et al., 2018).

Several studies did not use the consensus definitions or used their own definitions while using the injury surveillance consensus statement as a guideline (Dhillon et al., 2012; Ranson et al., 2013; Soni et al., 2015). After the publication of the updated consensus statement, there was a decrease in the number of studies that surveyed "match-time loss" injury only. This may be due to positive response to the updated consensus injury definitions, which provided more variability.

Injury definitions used for female cricketers varied greatly, and most studies use their own definitions (Jacobs et al., 2022). As this is a relatively young field of research, perhaps studies have been experimenting with different definitions to best capture injury rates among female cricketers. Furthermore, the researchers noted publications that surveyed female cricketers that did not use any injury definitions at all (Jacobs et al., 2022). Pain was included as an injury definition in only one of the four publications that surveyed female cricketers exclusively in this study (Cowan, 2006). The other three publications made use of the medical-attention injury definition, with two of the four adding their own injury grading system, which included match time-loss and non-time loss injury definitions (Panagodage Perera et al., 2019; Warren et al., 2019).

5.8 Compliance to Role Guidelines

Sports injury surveillance systems should account for the activity initiating the injury and the characteristics of the injured person (Finch, 1997; Mirani et al., 2020). Role guidelines may assist with the identification of trends within the injury data. For example, if lower limb injuries occur specifically in fast bowlers, role guidelines may assist to identify whether these injuries also occur in part-time fast bowlers, or whether they are more prominent in other cricketing positions.

It is therefore interesting that none of the initial consensus publications (from 2006-2015) included in this review reported whether they followed the injury consensus statement to classify cricketers into their specific roles. Sixteen publications reported how players were grouped into their specific roles. This raises the question of whether authors are aware of how players should be classified, and whether the data used was from injury surveillance systems that had already collected data (i.e., secondary data).

One should also consider whether the developers of an injury surveillance system were aware of the consensus guidelines. A recent study stated that strength and conditioning coaches within the professional cricketing context have placed emphasis on discipline- or role-specific injury prevention measures (Pote & Christie, 2018). Conversely, strength and conditioning coaches within the amateur cricketing context did not do so (Pote & Christie, 2016). Furthermore, amateur strength and conditioning coaches may not see value in role-specific injury prevention methods, while amateur cricketers may also have lower adherence to these injury prevention methods.

After the publication of the updated injury surveillance consensus statement, there was an increase in the number of publications classifying players according to the activity being performed when injured. This may be due to the updated consensus statement encouraging the application of specific roles when calculating injury rates. Practically, this is of great importance as it may allow medical staff to identify the cricketing roles and activities that result in injury as well as the duration of these injuries. If a batsman is more prone to being injured when running between the wickets, they may then spend more time warming up specific muscle groups prior to batting and focusing on strengthening those muscle groups throughout the season.

Twenty-one publications did not mention how players had been classified or whether the consensus statements had been followed. Again, this raises the question whether authors are aware of the role guidelines and how to apply them. An emphasis must be placed on how amateur cricketers are classified as the consensus statement does not provide specific guidelines for this group of cricketers. This may allow for a more accurate representation of injury rates among the different amateur cricketing roles.

5.9 Compliance with Injury Incidence Definitions and Unit of Calculation (2006-2022)

5.9.1 Compliance with Injury Incidence Definition(s) and Unit of Calculations for Initial Consensus

Sports injury reports have been difficult to compare across studies due to varying data collection and analysis methods (Finch, 1997). The consensus statements in cricket and other sports may be considered as an attempt to standardise these data collection methods for easier comparison across injury surveillance publications (Orchard et al., 2016b). In cricket, different injury incidence units have been implemented due to the presence of two consensus statements over a short period of time and the development of the popular shorter formats of cricket.

The only amateur study in this group did not calculate injury incidence or have a unit of calculation (Olivier et al., 2014). The researchers only tallied the number of injuries for the study period. It is presumed that this is largely because the publication primarily focused on lumbar reposition sense in pace bowlers, although the absence of injury incidence calculations may pose limitations in terms of epidemiological insights. The publication provides valuable contributions to cricket specific biomechanics and injury prevention.

Encouragingly, the definition of “match-injury incidence” and its unit of calculation was used correctly eight times within the professional cricket context. This aligns with the emphasis of standardised injury definitions as promoted by the initial injury surveillance consensus statement. Seasonal-injury incidence and training-injury incidence was used by fewer studies prior to these definitions being recommended.

This may potentially be due to the lack of clear definitions prior to the updated injury surveillance consensus statement in cricket. However, whenever a delivery-based measure was used for incidence, it was in accordance with the consensus statement. This demonstrates a positive shift toward standardisation after the initial injury consensus statement.

5.9.2 Compliance with Updated Consensus Definitions for Injury Incidence and Units of Calculation

Two of the three studies that included amateur cricketers did not use any injury incidence definitions or a unit of calculation (Bullock et al., 2020; Cai et al., 2019). The remaining article measured match-injury incidence per 10 000 match exposure hours (Soomro et al., 2018). The two studies that did not use any injury incidence definitions were both large retrospective studies. The aim of these studies was not to specifically measure injury rates (Bullock et al., 2020; Cai et al., 2019). Therefore, the results of these studies could not be compared with those that considered injury incidence directly, as they measured pain and osteoarthritis in former cricketers. The standardisation of injury surveillance methods has been suggested by multiple sporting codes, including football (Fuller et al., 2006), rugby (Fuller et al., 2007) and cricket (Orchard et al., 2006; Orchard et al., 2016a). This may allow for easier comparison of findings across studies.

Match injury incidence was calculated in most of the studies involving professional cricketers. The updated calculation unit of injuries per 1000 days was primarily used with this incidence measure. The older unit of calculation was used less frequent within the group, with only one article using it exclusively (Panagodage Perera et al., 2019).

Perhaps most authors agreed that the newer unit provided a better representation of player exposure as it provides a standardised injury rate across cricketing formats, and it inherently considers the total playing time. This is particularly useful in matches interrupted by inclement weather conditions.

Seasonal-injury incidence was calculated more often when compared to time loss, non-time loss, and medical-compliant injury incidence. It is encouraging that several studies included both units of calculating injury incidence, as this allows findings to be compared more easily across sports and time periods. The increased usage of the seasonal incidence measure may allow for a more accurate indication of incidence, as it will measure across the entire year (Orchard et al., 2016b).

Where a player plays for multiple teams, it is difficult to continue injury surveillance as they may play in a different country that has their own injury surveillance system. While individual cricket governing bodies may have standardised medical standards, encouraging collaboration between cricket governing bodies and privately owned teams is essential for the promotion of standardised medical standards.

5.10 Compliance with Injury Prevalence Definitions and Unit of Calculation (2006-2022)

5.10.1 Compliance with Injury Prevalence Definitions and Unit of Calculation for Initial Consensus

The only amateur study in this group did not use an injury prevalence definition or unit of calculation.

It is concerning that no publications calculated injury prevalence within this group of included publications, as injury prevalence is often used to report the extent of the sports injury problem (Hespanhol Junior et al., 2015). However, the above-mentioned publication did not set out to measure injury prevalence as a primary aim (Olivier et al., 2014). Therefore, the true burden of a specific injury type in amateur cricket is still unknown.

Match-injury prevalence was mostly calculated by studies that surveyed injury among professional cricketers. All these studies used a percentage-based unit of calculation in line with the recommendations of the consensus statement. One study took a more comprehensive approach and calculated training- and match-injury prevalence together (Soni et al., 2015). Unsurprisingly, this study had a higher injury prevalence (10.4%) as training injuries were included as well. Although cricketers may eventually miss a match through injury, it is important to measure training-injury prevalence as the injury may emerge earlier than reported (i.e., during training, as opposed to later which would be during/after a match). This injury may result in the cricketer missing one or more training sessions without missing any matches. Therefore, calculating training- and match-injury prevalence together may provide a better representation of injury prevalence within a team. Furthermore, one epidemiological study investigated injury prevalence per body location, playing position, and match type. While match-injury prevalence had been represented correctly, training and non-time loss injury prevalence was not considered. Non-time loss prevalence may be used less frequently in the professional cricketing context due to its subjectiveness and calculation difficulty as professional cricketers are more likely to play with pain.

5.10.2 Compliance with injury prevalence definitions and unit of calculation for updated consensus

There has been no significant increase in the number of publications that have surveyed amateur cricketers. All but one of the publications on amateur cricketers did not measure injury prevalence. Soomro et al. (2018) measured injury prevalence (i.e., time-loss only) and followed the consensus unit of calculation, albeit with a slight deviation to simplify calculations. This scarcity of publications suggests a gap in the literature concerning injury rates in this cohort (Olivier et al., 2022). Two of the publications that concurrently surveyed amateur and professional cricketers employed a methodology that assessed participation in cricket with pain, instead of injury prevalence (Bullock et al., 2020; Cai et al., 2019). The exclusive usage of pain as an injury measure is problematic as it does not truly provide insight to the severity or burden related to the injury, as noted by Hespanhol Junior et al. (2015). These studies may overlook significant injuries and their impact on a cricketer's performance. Despite the limited number of publications focusing on injury prevalence among amateur cricketers, the inclusion of at least one publication that assessed injury incidence, by Soomro et al. (2018), is seen as a positive development. The study provides valuable data on the number of injuries occurring within amateur cricket teams during a season, contributing to a better understanding of injury patterns and potential preventive measures.

Many publications on professional cricketers did not have any measure of injury prevalence, while all of these publications did not have a unit of calculation.

There was also greater variability in the number of different injury prevalence types that were measured, including time-loss injury prevalence (match and training), general complaint injury prevalence, and seasonal injury prevalence. This greater variability has been noted since more injury incidence measures were encouraged in the updated consensus statement. One study investigated injury prevalence per player role, mode of injury, squad, body location, and activity during injury (Warren et al., 2019). Fewer studies reported on match-injury prevalence in isolation, compared to the initial consensus publications. This may be expected as researchers tended to use prevalence measures derived from the injury incidence measures calculated earlier in their study. An example of this would be an author calculating non-time loss injury prevalence because they had calculated non-time loss injury incidence. The increase in the number of publications that employed the medical-compliant injury prevalence measure is beneficial. This allows for the calculation of players within a cricket team that may be suffering with a non-time loss injury at any given point and provides a comprehensive overview of player well-being, beyond just the number of players missing during a match (Hespanhol Junior et al., 2015).

5.11 Summary of the Chapter

Within this chapter, the aims and objectives of the study have been reiterated. This was followed by a discussion of the two injury surveillance strategies noted in Chapter Four above. The physiotherapist was the most common medical professional to collected injury data within the professional cricketing context, and the possible reasons for this were explained.

Regarding the popularity of self-reported strategies within the amateur cricketing context, the researcher cited financial and practical reasons. In this study, there were a greater number of publications from developed countries due to medical expertise and financial input.

Retrospective publications made up the minority of publications included in this study and the researcher elaborated on design flaws within this methodology. The standardisation of cricket injury surveillance methodology was advocated for, to improve data quality and comparability among publications.

This study identified a trend of an increase in cricket-related epidemiological publications, more so within professional cricket. There was a lack of adult amateur cricketing publications and publications that surveyed female cricketers, although the number of publications that surveyed injury among female cricketers had also increased. Furthermore, there was an increase in the amount of cricket injury surveillance publications from Australia and the United Kingdom.

The present study revealed varying injury definitions across publications, particularly after the 2016 consensus statement, indicating potential challenges in data interpretation and comparability. This variability may result from differing interpretations of injury severity, clinical relevance, and different injury surveillance strategies. While compliance with role guidelines increased post the updated injury surveillance consensus, the persistence of ambiguity in player classification raises questions about awareness and the implementation of these guidelines.

The researcher then discussed the significance of role guidelines in injury surveillance for identifying injury patterns. The initial publications (2006-2015) overlooked role classification, potentially due to a lack of awareness regarding implementation. Following the updated consensus statement, an increase in role classification suggests growing recognition of its importance in determining injury causes and guiding targeted prevention strategies, particularly in professional cricket where specific roles may face unique injury risks.

Lastly, the varying adherence to injury definitions and calculation methods employed by publications within the study was discussed. These were likely influenced by differences in resource availability and clarity of consensus guidelines. Furthermore, these discrepancies suggest challenges in standardisation and may hinder data comparability and interpretation. The limited use of standardised measures, particularly among amateur studies, emphasises the need for clearer guidelines to ensure accurate assessment of injury burden across cricket cohorts.

CHAPTER SIX: CONCLUSION, LIMITATIONS, AND RECOMMENDATIONS

6.1 Introduction

In this chapter, the limitations, recommendations, and conclusions that can be drawn from this integrative review will be discussed. The limitations of the study include shortcomings that can be attributed to the chosen study design. The recommendations section elaborates on practical suggestions identified by the research. These recommendations are promising for improving cricket injury surveillance and directly aligns with one of the study's objectives of formulating recommendations for future surveillance studies based on the current findings (Section 6.4). Finally, the conclusions that can be drawn from the results of this study will be discussed. These include the most common strategies of injury surveillance within amateur and professional cricket.

6.2 Conclusion

This study served to improve the current understanding of injury surveillance strategies used within amateur and professional cricket. To the best of the researcher’s knowledge, it is the first known review on the topic. The overall aim of the study was to review the existing literature regarding injury surveillance strategies being used in amateur and professional cricketers, as well as to assess the reporting of these findings according to the 2005 and 2016 injury surveillance consensus statements.

To achieve this objective, the researchers chose to review the existing resources on injury surveillance in both amateur and professional cricket.

These strategies were then grouped into various themes that were presented in the results section. The most common strategy of monitoring injury among amateur cricketers was via self-reported questionnaires, as three of the four publications employed this strategy. In professional cricketers, national injury surveillance systems were most commonly used by medical staff to monitor injury (39%, 13/33).

The researcher compared the reporting of injury surveillance data of amateur and professional cricket players according to key areas of the 2005 and 2016 injury surveillance consensus statements. Broader injury definitions that included non-time loss injuries were more commonly used after the updated consensus statement recommended their usage. These definitions provided a more accurate representation of the true injury burden within a team but may be better suited to studies that survey professional cricketers within a team that has full-time medical staff. The match time-loss injury definition initially suggested by the initial consensus statement is now used less frequently. Only 14 (38%) studies did not make use of exact consensus injury definitions. Therefore, the uptake of injury definitions within both consensus statements has been generally consistent.

The method of measuring injury incidence per 1000 days has been used more frequently in professional cricket since suggested by the updated consensus statement. Publications that surveyed injury among amateur cricketers did not appear to have set out to measure injury incidence and prevalence. Therefore, only one publication followed the consensus guidelines to measure injury incidence and prevalence in this group.

The methodological quality of the 37 publications was assessed using the 2018 CASP for cohort's checklist. Concerns were raised regarding the accuracy of exposure measurement and outcome measure bias in several publications, while confounding factors such as identification and design were often overlooked by authors. Uncertainty surrounded the completeness and length of subject follow-up, applicability to the local population, correlation with other cricket injury surveillance publications, and implications for practice in numerous studies (Section 4.11).

Future consensus statements on injury surveillance in cricket should consider a separate section on surveying injury among amateur cricketers. An updated international consensus on injury surveillance practices for amateur cricketers should be established to improve the standardisation and quality of injury surveillance studies within this population. To conclude, with consistent and standardised injury surveillance data, injury risk factors may be identified, and specific injury prevention measures can be put in place. In doing so, we safeguard the well-being of cricketers, ensuring their continued participation and enjoyment of the sport while minimising injury risk.

6.3 Limitations

- The current study included articles and theses that included participants 18 years and older. Studies regarding junior/adolescent cricketers were therefore excluded. This serves as a limitation as potential publications that used other injury surveillance strategies may have been missed.

- This study only included publications written in English. Studies written in other languages were excluded. This is a limitation as relevant publications published in other languages may have been missed.
- Only publications available in UWC databases were included. The researchers may have missed relevant studies which were not available. Two publications were not included due to this reason.
- The current study did not include publications that surveyed cricketers for less than one tournament or season. Hence, several publications that surveyed cricketers for less than a single season or tournament were excluded from this integrative review.
- Data collection in publications from the years 2016 and 2017 might have occurred prior to their publishing. However, many included publications did not explicitly mention the period in which data was collected. For the purposes of this study, the date of publication was used to group publications according to the respective injury surveillance consensus statement.
- Publications with a primary aim to investigate injury epidemiology are expected to comply with more aspects of the injury consensus statements, while publications with a focus on other aspects may feature less of the recommendations made in the consensus statements. Therefore, these publications should perhaps not be assessed with the same rigor.

6.4 Recommendations

- Researchers who use and collect data for cricket injury surveillance systems should ensure that the individuals who collect the data are well-trained and aware of the consensus guidelines and definitions. This may be achieved by providing team physiotherapists with basic annual training on injury surveillance within cricket. Another suggestion would be for each cricket governing body to employ an injury surveillance officer who ensures that injury data is being collected and documented correctly. This could ensure that the data collected is consistent and can be accurately compared across publications.

In certain instances, a physiotherapist working with a cricket team may lack awareness of standardised consensus injury definitions that may lead to incomplete documentation of injuries and inaccurate data used in research publications.

- Researchers and policy makers should ensure that these injury surveillance systems are developed with the updated injury surveillance consensus statement as a reference point. Researchers working with cricket governing bodies should take initiative and communicate with the developers of injury surveillance systems to identify areas that can be improved. This may ensure that these systems make it easier for the individual to collect the correct data.
- Additional research is required within amateur adult cricketers and these studies need to apply a newly developed consensus guidelines when collecting data. This newly developed consensus should focus on injury surveillance within the amateur setting. The focus on amateur cricketers may allow for guidelines that can be easily applied to the amateur cricketing setting. A suggested starting point within the adult amateur cricketer population is within higher education cricketing tournaments. These short-form tournaments may be used to gain insight into injury trends within this population, while following consensus guidelines.
- Where medical staff are available, the injury data should be accompanied by an interview of the player or a include a small section for the player to recall the injury and its mechanism of occurrence. This feature could be added onto existing injury surveillance systems within professional cricket.

The motivation behind the player interview is to obtain a player's perspective on the causative factors of the injury and possible injury prevention strategies that can be derived from the information. For example, where a player attributes their ankle injury to the condition of the bowling surface, researchers can investigate whether a correlation exists between the surface quality and the occurrence of injuries.

- Publications that focus on amateur cricketers should focus on the match-time loss injury definition. Match-injury prevalence and incidence should be a primary focus. A concerted effort is required to ensure that players are classified in accordance with their correct roles when collecting injury data. If a different classification system is used, this must be disclosed. The motivation behind the usage of narrow injury definitions within amateur cricket is because it would be easier for non-medical personnel to work with them. Cricket governing bodies could achieve this by including basic injury surveillance strategies in the amateur and professional setting, as a section within their coaching coursework.
- More research on professional and amateur cricketers is required from developing countries. These countries include International Cricket Council (ICC) full members: Pakistan, India, Sri-Lanka, Scotland, West-Indies, Zimbabwe, Bangladesh, Ireland, and Afghanistan. Research from these countries may provide insight to multiple factors in cricket including training methodologies, scheduling of domestic seasons, and injury patterns. The socioeconomic impact of playing cricket in developing countries could also be explored. This may ultimately allow for a better understanding of the global landscape of cricket and for the development of country specific interventions.

- Research on cricketers should also be promoted and conducted in the other ICC associate member countries. Where this is not possible, cross-country publications should be promoted. By pooling resources, expertise, and injury data from various countries, cross-country publications may enable a broader understanding of cricket-related issues while maximising efficiency and reducing duplication of efforts.
- Future studies should attempt to verify the source of diagnosis in the amateur cricketing population, where there is limited access to medical personnel to improve the reliability of injury data. These studies should also look to incorporate more standardised injury surveillance strategies that align with the injury surveillance consensus statements.
- The JBI checklist for cohort studies could be a better tool to assess the quality of included publications, future researchers can consider the tool as an option.

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APPENDICES

Appendix A: Final Search Terms per Database

SEARCH TERM	DATABASE
Strateg* AND cricket AND injur*	SportsDiscus via EBSCO host
Injur* AND cricket AND surveillance	SportsDiscus via EBSCO host
Amateur AND cricket AND injur*	SportsDiscus via EBSCO host
Professional AND cricket AND injur*	SportsDiscus via EBSCO host
Strateg* AND cricket AND injur*	PubMed
Injur* AND cricket AND surveillance	PubMed
Amateur AND cricket AND injur*	PubMed
Professional AND cricket AND injur*	PubMed
Strateg* AND cricket AND injur*	CINAHL
Injur* AND cricket AND surveillance	CINAHL
Amateur AND cricket AND injur*	CINAHL
Professional AND cricket AND injur*	CINAHL
Strategy AND cricket AND injury	Science Direct
Injury AND cricket AND surveillance	Science Direct
Amateur AND cricket AND injury	Science Direct
Professional AND cricket AND injury	Science Direct
Injur* AND cricket	Scopus
Cricket AND surveillance	Scopus
Cricket injuries	OATD
Cricket injuries	Google Scholar

Appendix B: Critical Appraisal Skills Programme (CASP) Checklist for Cohort Studies

Major Components **Response options**

Section A: Are the results of the study valid?

1. Did the study address a clearly focused issue? Yes No Can't Tell

2. Was the cohort recruited in an acceptable way? Yes No Can't Tell

Is it worth continuing?

3. Was the exposure accurately measured to minimise bias? Yes No Can't Tell

4. Was the outcome accurately measured to minimise bias? Yes No Can't Tell

5. (a) Have the authors identified all important confounding factors? Yes No Can't Tell

5. (b) Have they taken account of the confounding factors in the design and/or analysis?

Yes No Can't Tell

6. (a) Was the follow up of subjects complete enough? Yes No Can't Tell

(Not used in retrospective studies) - removed from checklist for retrospective studies.

6. (b) Was the follow up of subjects long enough? Yes No Can't Tell

(Not used in retrospective studies) - removed from checklist for retrospective studies.

Section B: What are the results?

7. What are the results of this study?

8. How precise are the results?

9. Do you believe the results? Yes No
Can't Tell

Section C: Will the results help locally?

10. Can the results be applied to the local population? Yes No Can't Tell

11. Do the results of this study fit with other available evidence? Yes No
Can't Tell

12. What are the implications of this study for practice? Yes No
Can't Tell

Appendix C: Data Extraction Tool for Cricket Injury Surveillance Publications Published Between 2006-2015 (Based on the International Consensus Statement by Orchard et al., 2005)

CRITERIA	COMMENTS (DATA)
Author:	
Article Name:	
Article Number:	
Year of Publication:	
Type of Study:	
Level of Cricketers:	
Format(s) of Cricket Surveyed:	
Injury Definitions:	
Definition of Durations (Seasons, teams, and match):	
Definition of Surveillance Cohorts:	
Manner of Representing Injury Rates, Prevalence, and Incidence:	
Type of Surveillance System Used:	
Details for Player Exposure:	
Population and Sample:	
Participants Mean Age and Gender:	
Method of Surveillance:	
Details for Injury Recorded:	

Are these items included on an injury surveillance form (paper, spreadsheet, or database)

Details for each injury recorded:

(1) Player name

(2) Player details—for example, date of birth, bowling type

(3) Injury diagnosis (including code and body region)

(4) Injury side (left/right/bilateral/not applicable)

(5) New injury/recurrence

(6) Time of onset (match/training/other/gradual) including match details

(7) Activity of onset (batting/bowling/fielding/gradual), including fielding position

(8) Date of onset

(9) Mechanism description (if available)

(10) Qualification as a significant injury

(11) Details of any surgery required or any other major treatment (if relevant)

Details for player exposure:

(1) Player participation in each major match

(2) Reasons for not participating for all squad members not playing—that is, playing at another

level, injured, not available for another reason, not selected

(3) Number of overs bowled in each innings (for all players who bowled)

(4) Number of deliveries faced in each innings (for all players who batted)

(5) Eventual length of the match (in days actually played)

Comments on Overall compliance to consensus statement:

Appendix D: Data Extraction Tool for Injury Surveillance Publications Published After 2016 (Adapted from the Summary of 2016 Key Definitions from Orchard et al., 2016)

Criteria	Comments (Data)
Author:	
Article Name:	
Article Number:	
Year of publication:	
Country of publication	
Type of study:	
Level of cricketers:	
Format(s) of cricket surveyed:	
Injury definitions: Match-time loss General time loss Medical attention: Player reported: Imaging abnormality:	
Mode of onset 1. Sudden onset non-contact 2. Impact/traumatic 3. Gradual onset: 4. Insidious 5. Medical illness Has the mechanism of injury been described?	
Definitions of injury recovery and recurrence	
Definition of durations/time frames (Seasons, teams, and match): Annual vs seasonal injury rate Tournament vs match injury rate	
Definition of surveillance cohorts: Has the changes to the squad(s) been noted?	
Injury incidence measures Calculation of injury incidence Match injury incidence Training injury incidence Annual injury incidence	
Injury prevalence measures: Match injury prevalence: Annual and general injury incidence:	
Characteristics of player positions:	

Type of surveillance system used:	
Details for player exposure:	
Population & sample:	
Participants mean age & Gender:	
Method of surveillance:	
Details for injury recorded:	
Preferred injury location categories:	

Appendix E: HSSREC Approval Letter

UNIVERSITY *of the* WESTERN CAPE

60 YEARS *of hope, action & knowledge*

09 December 2021

Mr U Jacob
Physiotherapy
Faculty of Community and Health Sciences

HSSREC Reference Number:	HS21/10/6
Project Title:	Surveillance strategies used to monitor injuries in amateur and professional cricket players: an integrative review.
Approval Period:	**25 November 2021 – 25 November 2024**

I hereby certify that the Humanities and Social Science Research Ethics Committee of the University of the Western Cape approved the methodology, and amendments to the ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report by 30 November each year for the duration of the project.

For permission to conduct research using student and/or staff data or to distribute research surveys/questionnaires please apply via:
https://sites.google.com/uwc.ac.za/permissionresearch/home

The permission letter must then be submitted to HSSREC for record keeping purposes.

The Committee must be informed of any serious adverse events and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

Director: Research Development
University of the Western Cape
Private Bag X 17
Bellville 7535
Republic of South Africa
Tel: +27 21 959 4111
Email: research-ethics@uwc.ac.za

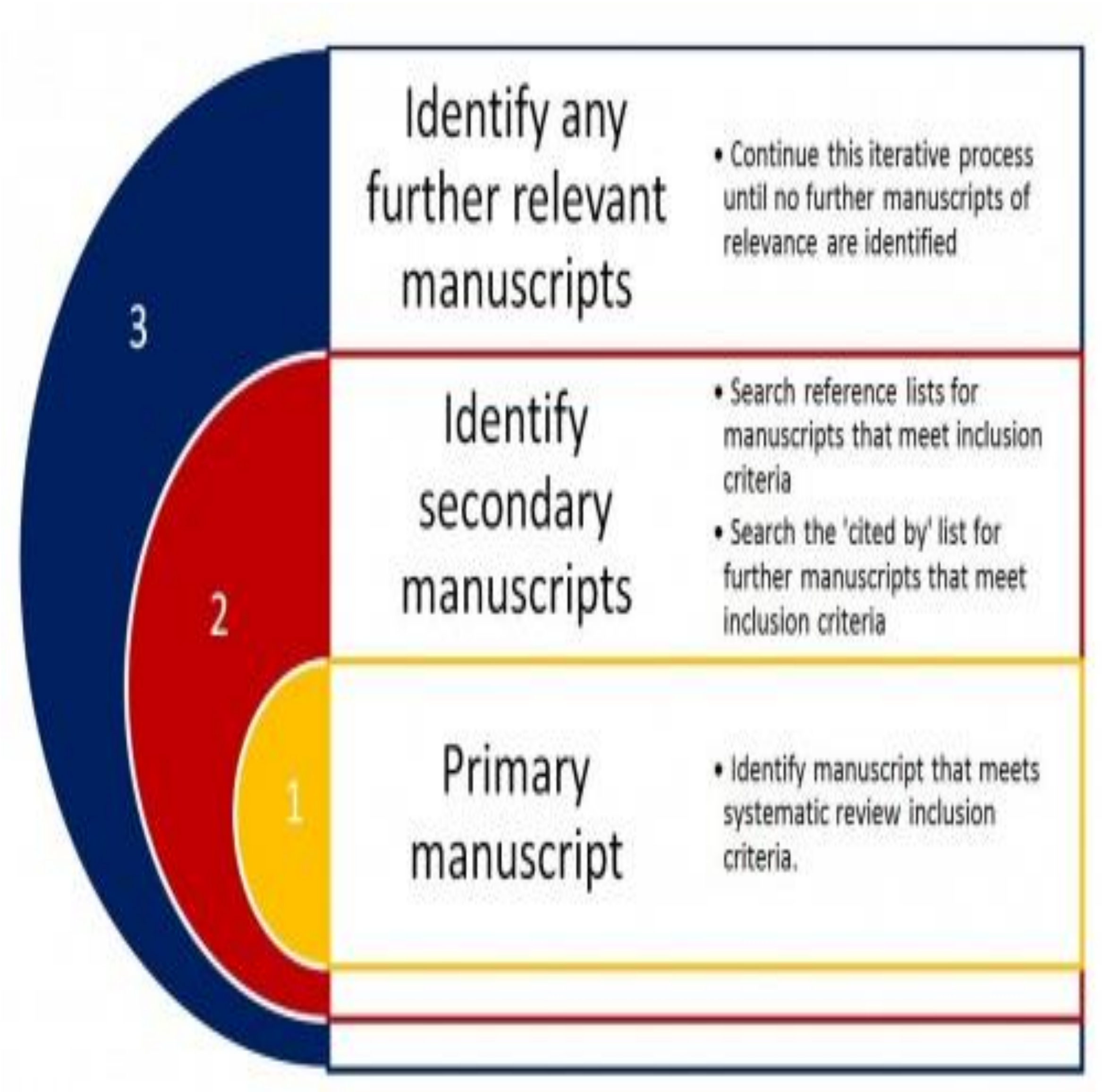
NHREC Registration Number: HSSREC-130416-049

FROM HOPE TO ACTION THROUGH KNOWLEDGE.

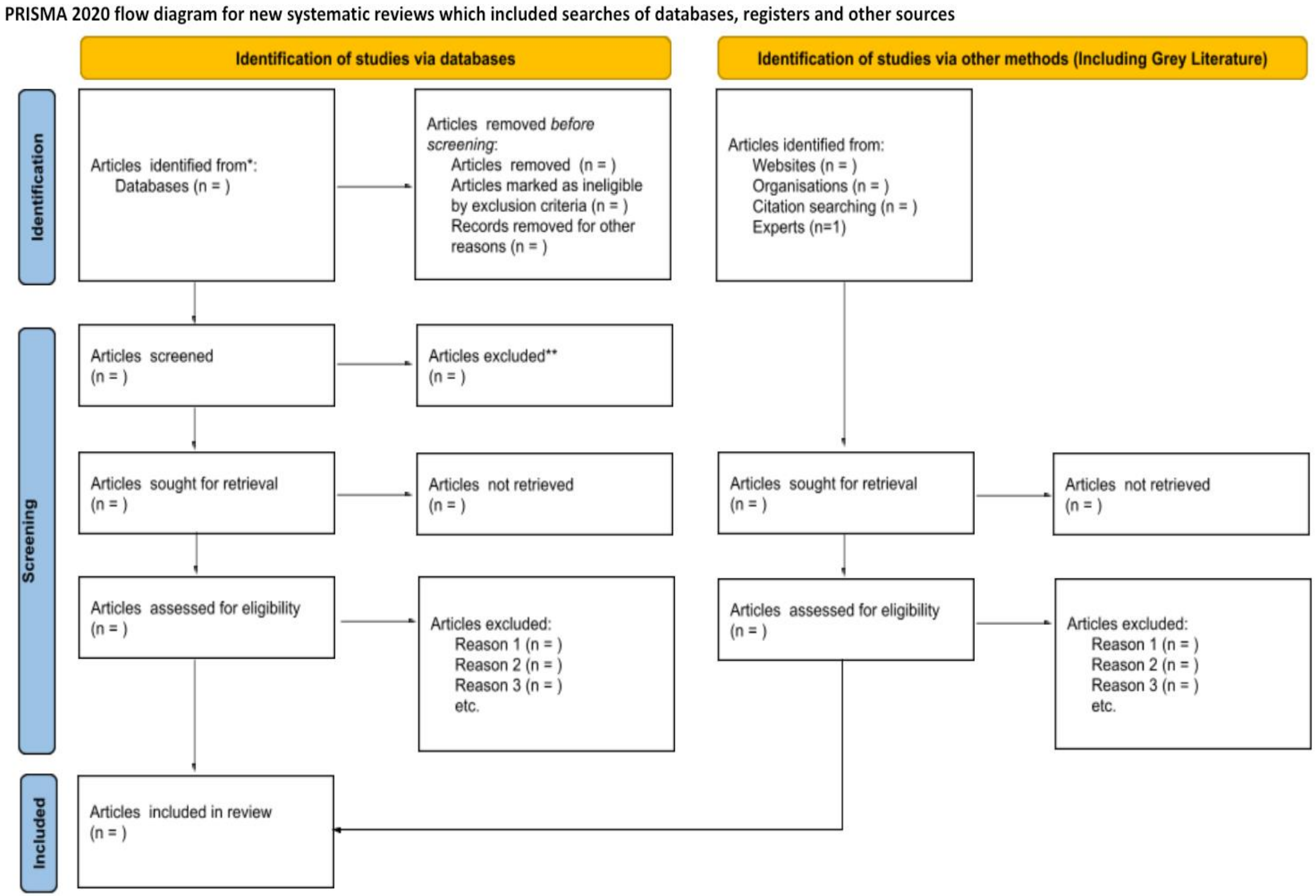
Appendix F: Evaluation Table (Title and Abstract Reading)

ARTICLE TITLE	YEAR	AUTHOR	JOURNAL	EXCLUDE OR INCLUDE (TITLE READING)	EXCLUDE OR INCLUDE (ABSTRACT READING)

Appendix G: Pearl Growing Process (Hadfield, 2020)



Appendix H: 2020 PRISMA Flow Diagram



Appendix I: Table of Excluded Publications After Full-Text Review

AUTHOR	TITLE	REASON FOR EXCLUSION
Akodu et al. (2016)	Prevalence of generalized joint hypermobility and its association with sports injuries at recreational cricket players.	Made use of a soccer-based questionnaire.
Bayne et al. (2016)	Lumbar load in adolescent fast bowlers: A prospective injury study	Under 18 years old participants only.
Das et al. (2014)	Nature and Pattern of Cricket Injuries: The Asian Cricket Council Under-19, Elite Cup, 2013	Only under 18 years old participants
Dennis et al. (2008)	Use of field-based tests to identify risk factors for injury to fast bowlers in cricket	Only under 18 years old participants.
Deshmukh et al. (2022)	Epidemiology of Hand Fractures and Dislocations in England and Wales Professional Cricketers	Unable to access full text.
Forrester (2021)	Cricket related injuries in United states emergency departments	Hospital study.
Gamage et al., 2019)	Match injuries in Sri Lankan junior cricket: a prospective, longitudinal study	Under 18 years old only participants.
Hulin et al. (2014)	Spikes in acute workload are associated with increased injury risk in elite cricket fast bowlers	Pertains more to workloads.
Mahapatra et al. (2018)	A 3-year prospective study on ocular injuries with tennis or cricket ball while playing cricket: A case series	Under 18 years old participants only
McLeod et al. (2020)	Injury surveillance in community cricket and the exploration of insurance claims systems (Thesis)	Insurance claims.
Nealon & Cook (2018)	Trunk Side Strain Has a High Incidence in First-Class Cricket Fast Bowlers in Australia and England.	No mention of injury.
Orchard et al. (2009)	Coding sports injury surveillance data: has version 10 of the Orchard Sports Injury Classification System improved the classification of sports medicine diagnoses?	Discusses the limitations of OSICS. Does not look at injury.
Orchard et al. (2010)	Revision, uptake and coding issues related to the open access Orchard Sports Injury Classification System (OSICS) versions 8, 9 and 10.1.	Discusses OSICS classification system.

Appendix H continued

AUTHOR	TITLE	REASON FOR EXCLUSION
Panagodage Perera et al., 2019)	Epidemiology of hospital-treated cricket injuries sustained by woman from 2002-2003 to 2013-2014 in Victoria Australia	Hospital study.
Peckitt & McCraig., 2019)	In-season variation in shoulder strength, movement and pain in elite cricketers: A cohort study.	Inadequate duration of monitoring
Peens (2005)	A longitudinal study on the effectiveness of injury prevention strategies on injury epidemiology of the elite cricket player (Thesis)	Published before inclusion criteria
Rahman et al., 2019)	Common Sports Injuries among Male Cricket Players in Bangladesh	Under 18 years old participants.
Ranawat et al. (2012)	Variations of lumbar spine stress fractures in fast bowlers.	Unable to access full text.
Sadiq et al. (2017)	Bowled over by cricket: Impact of tape-ball injuries on the eyes	Under 18 years old participants only.
Sathya & Parekh (2017)	Prevalence of Musculoskeletal Problems in Cricket Players	Modified Nordic questionnaire.
Saw et al. (2022)	Upper Lumbar Bone Stress Injuries in Elite Cricketers.	Unable to access full text.
Soomro et al. (2015)	Design, Development, & Evaluation of an Injury Surveillance App for Cricket: Protocol and Qualitative Study	Discusses injury surveillance app.
Soomro et al., 2019)	Design, development, and evaluation of an injury surveillance app for cricket: Protocol and qualitative study	Discusses injury surveillance application development.
Walker et al. (2010)	Injury to recreational and professional cricket players: Circumstances, type, and potential for intervention	Only under 18 years old participants.
Warren et al., 2018)	High acute: chronic workloads are associated with injury in England & Wales Cricket Board Development Programme fast bowlers	Under 18 years old participants only

Appendix J: Table Representing Methodological Quality of Included Publications per CASP Questionnaire

Green: Yes; Yellow: Unsure; Red: No

Article reference In-text)	Clearly focused issue	Recruited in acceptable manner	Exposure accurately measured/ bias	Outcome measured/ bias	Identify confounding factors	Design confounding factors	Complete follow up	Long enough follow up	Believability of results	Application to local population	Fit with other available	Clearly focused issue
Ahumen et al. (2019)	Green	Green	Green	Yellow	Yellow	Yellow	Green	Green	Green	Green	Yellow	Yellow
Alway et al. (2019)	Green	Green	Green	Green	Yellow	Yellow	Green	Green	Green	Green	Green	Yellow
Brooks et al. (2020)	Green	Green	Green	Yellow	Green	Yellow			Green	Green	Green	Green
Bullock et al. (2020)	Green	Green	Yellow	Green	Green	Yellow			Green	Green	Green	Yellow
Cowan (2006)	Green	Green	Yellow	Green	Yellow	Green	Green	Green	Green	Yellow	Yellow	Yellow
Dhillon et al. (2012)	Green	Green	Green	Green	Green	Green	Yellow	Yellow	Green	Green	Green	Yellow
Dovbysch et al. (2021)	Green	Green	Green	Green	Green	Yellow			Green	Green	Green	Yellow
Dutton et al. (2019)	Green	Green	Green	Green	Yellow	Yellow	Green	Green	Green	Green	Green	Green
Frost & Chalmers (2014)	Green	Green	Green	Green	Yellow	Green	Yellow	Yellow	Green	Green	Green	Green
Goggins (2021a)	Green	Green	Yellow	Green	Yellow	Yellow	Green	Green	Green	Green	Yellow	Yellow
Goggins et al. (2020a)	Green	Green	Green	Green	Green	Yellow	Green	Green	Green	Yellow	Yellow	Yellow
Goggins et al. (2020b)	Green	Green	Green	Green	Green	Yellow	Yellow	Yellow	Green	Green	Yellow	Green
Goggins et al. (2021b)	Green	Green	Green	Green	Green	Green	Green	Green	Green	Yellow	Green	Green
He Cai et al. (2019)	Green	Green	Green	Green	Green	Yellow	Green	Green	Green	Green	Yellow	Yellow
Hill et al. (2018)	Green	Green	Green	Green	Green	Yellow	Green	Green	Green	Green	Yellow	Yellow
Kountouris (2013)	Green	Green	Yellow	Yellow	Yellow	Green	Green	Green	Green	Yellow	Green	Red
Mansingh et al. (2006)	Green	Green	Green	Green	Yellow	Yellow	Green	Green	Green	Green	Green	Green
Olivier & Gray (2018)	Green	Green	Green	Yellow	Green	Yellow	Yellow	Green	Green	Green	Yellow	Green
Olivier et al. (2014)	Green	Green	Yellow	Green	Yellow	Yellow	Green	Green	Green	Green	Yellow	Green
Olivier et al. (2015)	Green	Green	Green	Yellow	Green	Yellow	Yellow	Green	Green	Green	Yellow	Green
Orchard et al. (2006)	Green	Green	Green	Green	Green	Yellow	Green	Green	Green	Yellow	Yellow	Green
Orchard et al. (2010)	Green	Green	Green	Green	Yellow	Yellow	Green	Green	Green	Green	Green	Yellow
Orchard et al. (2014)	Green	Green	Green	Green	Yellow	Green	Green	Green	Green	Green	Yellow	Yellow
Orchard et al. (2015)	Green	Green	Green	Green	Yellow	Yellow	Green	Green	Green	Green	Yellow	Green
Orchard et al. (2016)	Green	Green	Green	Green	Green	Yellow	Green	Green	Green	Green	Green	Green
Orchard et al. (2017)	Green	Green	Green	Green	Green	Green			Green	Green	Green	Green
Panagodage Perera et al. (2019)	Green	Green	Green	Green	Green	Yellow	Green	Green	Green	Green	Yellow	Yellow
Ranson & Gregory (2007)	Green	Green	Green	Green	Green	Green	Yellow	Green	Green	Yellow	Green	Green
Ranson et al. (2013)	Green	Green	Green	Green	Green	Green	Yellow	Green	Green	Yellow	Green	Green
Rao et al. (2020)	Green	Green	Green	Green	Green	Green			Green	Yellow	Green	Yellow
Soni et al. (2015)	Green	Green	Green	Green	Green	Green	Yellow	Green	Green	Green	Green	Yellow
Soomro et al. (2018)	Green	Green	Green	Green	Yellow	Yellow	Green	Green	Green	Green	Yellow	Yellow
Stretch & Raffin (2011)	Green	Green	Green	Green	Yellow	Yellow	Green	Green	Green	Green	Yellow	Yellow
Tallent et al. (2020)	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Yellow	Yellow
Tysoe et al. (2020)	Green	Green	Yellow	Yellow	Green	Green	Yellow	Yellow	Green	Green	Green	Green
Walter (2020)	Green	Green	Yellow	Green	Yellow	Yellow			Green	Green	Yellow	Green
Warren et al. (2019)	Green	Green	Green	Green	Green	Yellow	Yellow	Yellow	Green	Green	Green	Green

Appendix K: Table of Included Publications

Purple: Female cricketers only Green: Male and female cricketers

ARTICLE REFERENCE (IN-TEXT)	TITLE	PUBLICATION TYPE
Ahumen et al. (2019)	Association of Daily Workload, Wellness, Injury and Illness during Tours in International Cricketers	JA
Alway et al. (2019)	Incidence and prevalence of lumbar stress fracture in English County Cricket fast bowlers, association with bowling workload and seasonal variation	JA
Brooks et al. (2020)	Hand fractures and return to play in elite Australian cricketers	JA
Bullock et al. (2020) Amateur and Pro	Playing sport injured is associated with osteoarthritis, joint pain and worse health-related quality of life: a cross-sectionalstudy	JA
Cowan (2006)	The prevalence of injuries in women's cricket and its relationship to training practices and physical-conditioning	Thesis
Dhillon et al., 2012)	Nature and incidence of upper limb injuries in professional cricket players a prospective observation	JA
Dovbysch et al. (2021)	Injury incidence within male elite New Zealand cricket from the early T20 era: 2009–2015	JA
Dutton et al. (2019)	The cricketer's shoulder: Not a classic throwing shoulder	JA
Frost & Chalmers (2014)	Injury in elite New Zealand cricketers 2002–2008: descriptive epidemiology	JA
Goggins (2021a) Thesis	Injury Epidemiology and Injury Prevention in Elite English and Welsh Cricket	T
Goggins et al. (2020b)	Negative association between injuries and team success in professional cricket: a 9-year prospective cohort analysis	JA
Goggins et al. (2021b)	Hamstring injuries in England and Wales elite men's domestic cricket from 2010 to 2019	JA
Goggins et al., 2020a)	Injury and Player Availability in Women's International Pathway Cricket from 2015 to 2019	JA
He Cai et al. (2019) Amateur and Pro	Joint pain and osteoarthritis in former recreational and elite cricketers	JA
Hill et al. (2018)	Incidence of Concussion and Head Impacts in Australian Elite-Level Male and Female Cricketers After Head Impact Protocol Modifications	JA
Kountouris (2013)	Injuries in cricket: epidemiology and factors associated with lumbar spine injury in cricket fast bowlers	Thesis

Appendix K continued

ARTICLE REFERENCE (IN-TEXT)	TITLE	PUBLICATION TYPE
Mansingh et al. (2006)	Injuries in West Indies cricket 2003–2004	JA
Olivier & Gray (2018)	Musculoskeletal predictors of non-contact injury in cricketers e Few and far between? A longitudinal cohort study	JA
Olivier et al. (2014) Amateur	Injury and lumbar reposition sense in cricket pace bowlers in neutral and pace bowling specific body positions	JA
Olivier et al. (2015)	Static and dynamic balance ability, lumbo-pelvic movement control and injury incidence in cricket pace bowlers	JA
Orchard et al. (2006)	Injuries to elite male cricketers in Australia over a 10-year period	JA
Orchard et al. (2010)	Changes to injury profile (and recommended cricket injury definitions) based on the increased frequency of Twenty20 cricket matches	JA
Orchard et al. (2014)	Fast bowling match workloads over 5–26 days and risk of injury in the following month	JA
Orchard et al. (2015)	Cricket fast bowling workload patterns as risk factors for tendon, muscle, bone and joint injuries.	JA
Orchard et al. (2016)	Incidence and prevalence of elite male cricket injuries using updated consensus definitions	JA
Orchard et al. (2017)	Risk factors for hamstring injuries in Australian male professional cricket players	JA
Panagodage Perera et al. (2019)	The incidence, prevalence, nature, severity and mechanisms of injury in elite female cricketers: A prospective cohort study	JA
Ranson & Gregory (2007)	Shoulder injury in professional cricketers	JA
Ranson et al. (2013)	International cricket injury surveillance: a report of five teams competing in the ICC Cricket World Cup 2011	JA
Rao et al. (2020)	Epidemiology of annual musculoskeletal injuries among male cricket players in India	JA
Soni et al. (2015)	Epidemiology of Orthopedic Injuries in Indian Cricket: A Prospective One Year Observational Study	JA
Soomro et al. (2018) Amateur	Injury rate and patterns of Sydney grade cricketers: A prospective study of injuries in 408 cricketers.	JA
Stretch & Raffin (2011)	Injury patterns of South African international cricket players over a two-season period	JA
Tallent et al. (2020)	The Impact of All-Rounders and Team Injury Status on Match and Series Success in International Cricket	JA

Appendix K continued

ARTICLE REFERENCE (IN-TEXT)	TITLE	PUBLICATION TYPE
Tysoe et al. (2020)	Bowling loads and injury risk in male first class county cricket: Is 'differential load' an alternative to the acute-to-chronic workload ratio?	JA
Walter (2020) Thesis	Shoulder injuries of cricket fast bowlers in New Zealand	T
Warren et al. (2019)	Injury profiles in elite women's T20 cricket	JA

JA – Journal Article

Appendix L: Confirmation of Academic Editing

21 May 2024

To whom it may concern

RE: CONFIRMATION OF ACADEMIC EDITING SERVICES FOR U-F JACOB

This is to confirm that the dissertation titled: **"SURVEILLANCE STRATEGIES USED TO MONITOR INJURIES IN AMATEUR AND PROFESSIONAL CRICKET PLAYERS: AN INTEGRATIVE REVIEW,"** to be submitted for examination for the qualification of **Master of Science in Physiotherapy** by **Mr. Umar-Farouk Jacob** of the **University of the Western Cape**, has been professionally edited for spelling, punctuation, grammar, sentence structure, phrasing, and formatting. The suggested edits were individually reviewed and approved by Mr Jacob, and the content of the dissertation remains his own work.

Best

Cindy Palm (Editor)

BSocSc *Cape Town*, BA (Hons) Psych *Stellenbosch*, MA Res Psych cum laude *Stellenbosch*, PGDip Risk Mgmt *Unisa*

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