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Epidemiological studies of injuries in rugby league: Suggestions for definitions, data collection and reporting methods

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Summary Studies on rugby league injuries use a variety of definitions and methodologies. Consequently, comparisons of published studies are difficult. Researchers with an interest in understanding the epidemiology of rugby league injury participated in a majority agreement process. This paper provides suggestions for the definitions, data collection and reporting methods for future studies of rugby league injuries. The proposed methods and definitions were developed through the use of a majority agreement process on draft versions by all authors. Recommended definitions for injury incidence, recurrence, severity and match exposure are provided as well as injury site, type, diagnosis and causation. Suggestions for match and training injury incidence calculations are also provided for the purposes of comparison. This paper provides standard definitions that, if utilised, will enable meaningful comparison of future rugby league injury surveillance data from different countries and playing levels.

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Introduction

Studies on the incidence of sporting injuries have varied in two main areas. These variations are (1) the definitions utilised and (2) the methodologies undertaken.^{1–5} As a consequence of these

variations between studies, the results and conclusions obtained often have some important differences.^{1,3–9} A fundamental process, and typically the first step behind the injury prevention process, is ongoing injury surveillance.^{1,4,10,11} However, inter-study comparisons may prove to be difficult due to the inconsistencies in the injury definitions utilised.

Studies on the incidence of injuries in rugby league have suffered from inconsistencies in the

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injury definitions utilised. As a result of these inconsistencies, comparison and determination of the injury incidence may be difficult to undertake.^{5,12} Variations reported in injury incidence are often the result of data obtained from a relatively small number of players and teams^{13,14} and, often over a limited time frame.¹²

Undertaking long term studies and incorporating data collection from several teams increases the sample size and may assist in reducing any random error that may occur.¹⁵ In addition, the use of a similar injury definition aids in inter-study comparisons. In a similar fashion to other professional sporting codes,^{10,16} the purpose of this paper was to address this problem by establishing definitions, methodology and reporting standards that may be adopted for the reporting of injuries in rugby league enabling comparison between future studies.

Methods

Researchers from Australia, United Kingdom and New Zealand who have an interest in rugby league injury epidemiology participated in this project. All researchers communicated by email and contributed to all discussions. Two Australian authors subsequently withdrew from the paper as not all authors could agree on the injury definition or its use in their future research.^{17,18} The resulting suggested methods and definitions paper was developed through the use of email communication and draft reviews by the remaining authors. A majority agreement was adopted for producing the suggestions for the definitions and methodological issues related to the conducting of studies on rugby league injuries. A working document was then produced and distributed to all authors for review and discussion. Minor amendments were completed before the document was produced and submitted for publication.

Definitions

Rugby league injuries

In the study of sports injuries, definitions are typically provided as operational criteria for the recording and reporting of injuries rather than as a theoretical definition.¹⁹ These definitions usually are broadly based around the concept that “*bodily damage caused by a transfer or absence of energy*” is the reason injuries occur.¹⁹ This concept is useful in the clarification of whether an incident in

rugby league should be recorded as an injury. Historically, the main focus of rugby league injuries has been the recording and reporting of match related injuries.^{5,6,8,9,12–14} To enable standardization between future studies it is recommended that the following definitions be utilised. This definition is similar to other consensus definitions^{16,19} and is designed to enable comparisons to occur between studies.

Injury definition

It is recommended that a rugby league injury be defined as:

“Any pain or disability that occurs during participation in rugby league match or training activities that is sustained by a player, irrespective of the need for match or training time loss or for first aid or medical attention. An injury that results in a player requiring first aid or medical attention is referred to as a ‘medical attention injury’ and an injury that results in the player being unable to partake in full part of future training and/or match activities is referred to a ‘time loss’ injury.”

The definition is designed to capture all injuries, including those that do, and do not result in missed matches. A match or training time loss injury is “*any injury that causes a player to be unable to participate in a rugby league training activity or to be selected in a competitive match*”. The match or training time loss definition has been popular in rugby league injury research and is often used to compare between studies. However, it avoids documenting injuries that fall below this threshold,²⁰ which may account for as much as 70% of all treatments.^{21–23} This definition is designed to be limited in a way so that all researchers of rugby league injuries can apply it equally. Given that all injuries may be associated with direct and/or indirect costs, data recorders that wish to record more injury details than just missed match injuries are encouraged to do so.

Match injury

The rugby league match is any game undertaken as part of any official competition. These injuries should be reported utilising the suggested definitions for both an injury and for injury severity.

Training participation loss

Not all studies record or report injuries that occur as a result of players participating in training activ-

ities. Also, not all studies record and report training time loss as a result of injuries from either match or training participation. This is where match or training related injuries result in loss of training time and these can be recorded as part of any study on rugby league injuries. The loss of training time as a result of injuries sustained from match participation needs to be identified separately from training time loss from injuries that occur as a result of participating in a training activity.

Injury recurrence

An injury is considered to have recovered once the player has returned to full participation in a rugby league match or training activity. It is, therefore, recommended that a rugby league recurrent injury be defined as:

“An injury of the same type, site, side and location as the index injury which occurs after a player’s return to full participation in rugby league activities from the index injury. A recurrent injury occurring within 2 months of a player’s return to full participation is referred to as an ‘early recurrence’; one occurring 2–12 months after a player’s return to full participation as a ‘late recurrence’; and one occurring more than 12 months after a player’s return to full participation as a ‘delayed recurrence’.”^{16,19}

The recording of recurrent injuries can be undertaken for both match and training injuries. These could be recorded and reported separately for both match and training injuries to reduce the possibility of confounding the results.² Any injury that is recurrent does not necessarily need to be identical in severity to be considered recurrent.

Injury severity

The definition of injury severity for the purpose of studying rugby league match injuries is the actual number of matches missed per injury. As such, it is recommended that the rugby league injury severity be defined as:

“Transient (no matches/trainings missed), Minor (1 missed match/training week), Moderate (2–4 missed matches/training weeks), or Major (5 or more missed matches/training weeks)”.²⁰

Studies that wish to include injuries that do not result in time loss these should be recorded and reported under the term transient injuries. For the purpose of studies in rugby league, a transient injury is defined as “any injury that causes a player to seek medical or first aid treatment

during or after a rugby league activity but does not lead to loss of further participation or non-selection for matches”. These include injuries that are ongoing but not of sufficient severity to prevent the player from participating in match activities or being selected for match participation.

A transient injury does not imply a quick recovery from an injury, simply that there is no loss of match or training participation. Some injuries can last for long periods but if there are no missed matches or training activities as a result of these injuries, these transient injuries would be missing from the missed match data set.

Training injury severity

If reporting training injuries, these may be reported utilising the same time loss injury severity format. The use of missed training activities enables capture across all levels of participation irrespective of the number of trainings that the squad undertakes. The recording and reporting of training injury severity should be kept separate from match injury severity.²

Match exposure

It is recommended that match exposure be defined as:

“The product of the number of players, the number of matches between two different teams,^{16,19} and the match duration for the period that the study is being conducted. The recommended recording of exposure time is the duration of the matches being studied in hours.”

The recording of match exposure is best performed without adjusting for technical aspects of the match such as golden point period (extra time) or when players are temporarily suspended or dismissed from participation as a result of misconduct or foul play (i.e. sin-bin or sent off). If the match participation time is less than 80 min (1.33 h) then the time should be calculated to reflect the actual match duration (e.g. 70 min = 1.17 h).

Training exposure

Training exposure should be used for those studies including training aspects in studies on rugby league injuries. Training exposure is defined as:

“The product of the number of players, the number of training sessions, and the training duration for the period that the study is being conducted. The recommended recording of exposure time is

Table 1 Participation level classification

	Main grouping	Category	Definition
1.	Junior	Mini modified	Under 9 years of age and played under the mini-modified rules of the game
		Modified	From 9 years of age to 12 years of age and played under modified rules of the game
2.	Amateur	Junior	From 13 years or age and under 18 years of age as played under International competition rules as stipulated by local competitions
		Senior	From 18 years of age and played under international competition rules but not receiving any payment for participation
3.	Sub Elite	Semi-professional	From 16 years of age and played under international rules and receiving moderate remuneration for participation as well as additional employment to generate income
4.	Elite	Professional participants	From 16 years of age and played under international rules and receiving remuneration for participation as their main source of income

the duration of the training sessions being studied in hours.”

Injury onset

It is suggested that all injuries which satisfy the injury definition be subdivided into: (1) overall injuries (2) match injuries and (3) training injuries. This leads to five fundamental injury rates being calculated: (1) overall injury incidence, (2) total match onset injuries, (3) match onset injuries resulting in match time loss and training time loss, (4) total training onset injuries and (5) training onset injuries leading to training time loss and missed matches.

Study design

We recommend that most epidemiological studies in rugby league be undertaken as prospective cohort studies. This minimises the occurrence of errors associated with recall bias as identified with retrospective study designs.¹⁶ Cohort designs allow the examination of the relationship between exposure and injury risk, and permits the temporal sequence between exposure and injury risk to be established.²⁴ These studies would ideally be used to establish the magnitude of the injury risk and to establish the aetiological risk factors associated with participation in rugby league activities. It has been suggested that they provide the best information and direct measurement of risk for developing an outcome.²⁵ Other studies, such as intervention studies, and controlled trials are encouraged.

Participation level

The level of participation may be categorised utilising the categories listed in [Table 1](#).

Injury incidence

Match injury incidence

More studies are now reporting the injury incidence per 1000 match participation hours. Calculation of the match injury incidence may be undertaken by dividing the number of recorded injuries by the exposure hours, then multiplying this value by 1000 to obtain the injury incidence per 1000 playing hours.^{20,26–29}

Injury incidence

$$= \left(\frac{\text{Number of injuries in the period}}{\text{Players} \times \text{hours} \times \text{matches}} \right) \times 1000$$

Training injury incidence

Training injury incidence may be expressed as the injury incidence per 1000 training hours. Calculation of the training injury incidence may be undertaken by dividing the number of recorded injuries by the exposure hours, then multiplying this value by 1000 to obtain the injury incidence per 1000 training hours.^{20,26–29}

Injury incidence

$$= \left(\frac{\text{Number of Injuries in the period}}{\text{Players} \times \text{hours} \times \text{training sessions}} \right) \times 1000$$

Activity at time of injury

The activity at the time of injury may be recorded utilising the categories listed in [Table 2](#).

Table 2 Activity at the time of injury classification

Timing	Primary activity	Specific activity	Specific activity
Acute	Player contact	Tackling	Tackling
		Other player contact	Being tackled Collision Scrum Other (e.g. fighting)
	Other contact	Fixture contact Ball contact Landing on surface	
Gradual or unknown	Non contact	Acute running Acute kicking Acute passing Acute catching Other	
	Contact	e.g. Tackling	
	Non contact	Gradual running Gradual kicking Gradual weights Unknown Environmental	

Study population

Studies, whether utilising a single squad of players or more, may be best conducted over no less than one season (including the preseason), 12 months or the duration of any tournament being studied.^{16,19,30} Ideally, all injuries reported and exposures experienced would be documented for every player in the cohort throughout the study period to aid in the analysis.

Baseline information

Physiological^{31–36} and anthropometric^{31,33,34,37} studies in rugby league are becoming more established as other researchers become involved in studying all physical aspects of participants. Although, no set guidelines have been established in regards to what anthropometric assessments or physiological tests should be undertaken, basic descriptive information relating to the person (i.e. age, gender, height and body mass) are recommended to be included in the study as these parameters help define the study population and may be used for analysis of potential risk factors in relation to injuries.²⁴

Injury recording form

Preferably all injuries would be recorded on a standardised injury recording form. An example of a standardised injury reporting form that has been developed for all sporting activ-

ities, including rugby league, can be found at <http://sma.org.au/information/ssdownload.asp>.

This injury reporting form may include player details (name, age or player identifier), participation level being studied (Table 1), injury location, injury type, activity at the time of injury (Table 2), injury time, and playing position. Ideally injury reporting forms should be completed as soon as possible after the injury is sustained to avoid inaccuracies associated with recording information retrospectively.^{16,19} In the case of injuries requiring further advanced medical assessment it may be necessary to await the results of the assessment before recording the injury.

Reporting

risks

The epidemiologic incidence proportion (IP) may be included in epidemiological studies.²¹ The IP is used to enable identification of the average risk per player over a specified study period.²¹ The IP ideally would be reported as a percentage of risk for injury from participation in rugby league. It is recommended that when reporting the IP that the time period that the IP defines is identified (i.e. season, tournament, year).²¹ Calculation of the IP may be undertaken by dividing the number of players that have sustained an injury over the study period by the number of players at risk of being injured.²¹

$$\text{Incidence proportion} = \left(\frac{\text{Number of injured players}}{\text{Number of players at risk}} \right)$$

Discussion

The injury definition was the most challenging aspect for all authors to agree upon. Inclusion and exclusion criteria created the greatest debate with the definition focusing on what can be fully complied with now and in the future. For example, having an injury definition with the inclusion of "seeking trainer/medical assistance" or "presenting to medical staff," may expose a study to bias as not all teams under study may have qualified trainers or medical staff present at all sessions.^{2,10} A bias may be introduced because injury rate will vary according to the accessibility of these staff.^{2,10}

The original group contributed to the debate about the preferred definitions. Unfortunately, having several authors meant that it was difficult to make some decisions about some of the fundamentals of the project, including the actual definition of an injury. Two of the authors strongly felt that the fundamental injury definition in rugby league should be based on match injuries and time loss participation only, while the remaining authors felt strongly that the fundamental injury definition should be broader. Many attempts were made to resolve this conflict in opinion by the use of email. The resulting injury definition led to two of the contributors requesting that they not to be named as authors of the paper, on the grounds that they did not support the proposed injury definition. The resulting injury definition is similar to previous consensus definitions for rugby union¹⁹ and football (soccer).¹⁶

Injury severity classification also created considerable discussion. Although time loss is identified as the gold standard in reporting rugby league injuries, transient injuries do create an impact on the financial resources of teams and participation of players.^{14,21} As well, injuries that result in missed training sessions may be recorded as part of the injury severity, although it is acknowledged that not all authors are present at training sessions and may not be able to record data for these activities.

Training injury inclusion also created discussion for the reasons above. Teams with dedicated researchers who, as part of their employment through their role in the team, are present at training sessions, will record a higher training injury incidence than teams where players have to travel to consult medical staff.¹⁰ Additionally, any retrospective review of injuries has been identified to have some associated difficulties.³⁸ Players are often unable to fully recall injury

severity and only have an acceptable to good level of agreement for all details relating to the injury.³⁸

Transient injuries may be included in the study as this enables documentation of all injuries that occur in matches but these should be identified as such. If transient injuries were to be included, it is recommended that future studies on rugby league injury incidence include data for both total (all injuries recorded) and those injuries that resulted in time loss injuries.

Although not all studies include training injuries, there are an increasing number of studies now being published on this area of rugby league.^{29,39} As such, this paper aims to provide a suggested standard injury definition for rugby league studies. The purpose and setting of any study undertaken will determine the inclusion or exclusion of aspects of this paper. Whatever recording regimen is adopted for the study being undertaken, it is recommended that it is consistently used throughout the study. Although the collection of transient injuries is important in economic terms as they require a level of input or treatment,¹⁴ it must be acknowledged that the recording of these injuries may place a higher demand on personnel involved in the study.²

Data collectors for epidemiological studies in rugby league would ideally be a single recorder throughout the duration of the study. It is acknowledged that there will be different levels of expertise between the various participation levels and that this has an impact on the data collected, interpretation of the definitions used and identification of the areas of interest in the study. It is recommended that identification of the data collectors' qualifications be included in the studies manuscript.

Although, these definitions and methods outlined are only suggestions, we recommend the use of these for all levels of rugby league participation. It is acknowledged that the definitions and methods will need to be trialled and evaluated and that further consultations, feedback and amendments to these may be required before a consensus amongst all rugby league researchers can be achieved. The aim of this paper is to promote discussion and to provide a standard that, if followed, will enable comparison of future rugby league injury epidemiological data from different countries, thereby enhancing the body of information already established. As well, trends of and risk factors for injuries in rugby league among countries could be identified after establishing the injury incidence and causes. These standards enable future researchers to inves-

tigate the next stage in the sequence of prevention by establishing the aetiology and mechanism of injury in rugby league.^{11,40}

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