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## **Epidemiology of injuries in senior male rugby union sevens: a systematic review**

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### **Abstract**

**Objectives:** In 2016 the Rugby Union variant of sevens will enter the official Olympic Programme. Until now, most of injury surveillance studies in Rugby Union focus on elite 15-a-side cohorts, with reported injury incidence rates reaching 96 per 1000 player-

match-hours, and mean severity set at 20 days. Sparse data is available regarding rugby sevens. The aim of this study was to systematically review available data regarding the epidemiology of injuries in senior male rugby sevens.

**Methods:** Electronic databases (Pubmed, Google Scholar, SCOPUS, Scielo and IndexRMP) were searched in September 2015, complemented by manual searches of bibliographies and relevant 'grey literature'.

**Results:** Seven prospective cohort original articles addressing injuries in senior male rugby sevens players were included in this review. Overall injury incidence rates in elite rugby sevens tournaments ranged 101.5 to 119.8 per 1000 player-match-hours. Mean severity was greater than 34.1 days. Lower limb and joint/ligament injuries were the most frequent in elite players. The only study on amateur players revealed a lower injury incidence rate (74.7 per 1000 player-match-hours), and a higher proportion of muscle/tendon (37.5 %) injuries.

**Conclusion:** Injury incidence rates in rugby sevens are higher than those reported for the 15-a-side variant, at the same level of competition. Injuries are also more severe, resulting in longer absence periods. This might result from the fact that rugby sevens is played with greater speed, leading to an increase in energy transfers during tackles, more running and turning manoeuvres, that can possibly cause more severe injuries.

**Keywords:** rugby sevens; football; athletic injuries; epidemiology; preventive medicine

## 1. Introduction

Rugby Union is definitely one of the fastest growing sport in the world, especially after the introduction of professionalism in 1995. In 2009, Rugby Union has been accepted as

one of the new summer Olympic sports,[1] making its return to the Olympic family in the 7-a-side variant. Recent numbers released by the Rugby Union governing body (World Rugby) claim that the sport is played in 120 countries by more than 7 million players, with 102 member unions and 18 associated unions being responsible for developing the sport and organizing competitions within their borders.[2]

Although most rugby players in the world play 15-a-side Rugby Union, it is also undeniable that rugby sevens has become an increasingly popular format.[3–5] It is played in the same field, and with almost the same rules, but over two 7-minute halves (finals with 10-minute halves) by teams of seven players, three designated as forwards and four as backs, although their roles are not as clear as in rugby 15-a-side.[3–6] Currently, World Rugby holds a Rugby Sevens World Series played in a multi-stage tournament throughout 7 months, from December to May, in cities from five continents. Tournaments are scheduled as rounds of 2 tournaments with each round separated by 6 to 8 weeks.[5] Each tournament takes place in 2 days (sometimes 3 days), with teams playing up to three matches each day.[5,6]

In the same way as the original 15-a-side variant, rugby sevens is also a dynamic, high intensity, intermittent full-contact sport,[7] requiring a combination of physical, psychological, technical and tactical skills for success at national and international levels.[3,8,9] As no differences in the dimensions of the field are found in Rugby sevens, and fewer players are engaged in each phase of the game, a tendency towards a higher number of sprints[10] and contacts with the opponents[6] during competitive matches is expected.

Although it is known that rugby union has had a good sports medicine service over the years, and that player welfare is a main concern for World Rugby,[1] injury surveillance studies in rugby union are essentially focused on the 15-a-side variant, with a significant

body of evidence being published in recent years.[11–18] At elite or professional level, injury incidence rates in rugby union 15-a-side reaches 89.1 to 96 injuries per 1000 player match hours, with an average severity of 20 days of absence from competition and training.[11,17,19] The most frequent location of injuries is the lower limb, while muscle/tendon is the most common type of injury.[11,17,19] The aim of our study was to systematically review the available literature regarding the epidemiological aspects of injuries in senior male rugby sevens, especially those regarding the incidence, type, location, period of match and severity of injuries. We chose to include data from all levels of play and playing positions.

## **2. Methods**

The present study was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[20] No ethical approval was requested, since this was just a review of already published studies.

### **Search Strategy**

We have conducted a search on Pubmed databases from 1995 to September 2015, using the following search strategy: (“Football”[Mesh]) AND (“Athletic Injuries”[Mesh]) OR “Rugby Sevens”. The same strategy was then adapted to perform a similar search on Google Scholar, SCOPUS, Scielo and IndexRMP. We also searched the reference lists of included studies and ‘grey literature’ to identify other potentially relevant studies. Inclusion criteria for retrieved studies were: (i) Original articles (prospective or retrospective cohort and randomized controlled design), review articles and meta-analyses; (ii) study population comprising 7-a-side senior male rugby teams; (iii) studies clearly defining athletic injuries; (iv) studies providing relevant epidemiological data,

such as: injury incidence for match or tournament, incidence of new and recurrent injuries, incidence of injuries by playing position, type and site of injury, severity of injury or injury mechanism. Studies with all types of design including longitudinal (prospective and retrospective), cross-sectional, observational and ecological, were included. Studies were excluded from our analysis if: they were focused on under-18 or female players only; focused on 15-a-side Rugby Union only; concerned other football codes (Rugby League, Australian Football, American Football, Gaelic sports or similar); did not report Rugby Sevens injury surveillance studies or data.

### **Study Selection and Quality Assessment**

Following the literature search, two reviewers (ACF and ECF) conducted a screening of the title and abstract of the retrieved articles. Whenever necessary, full texts were also analyzed. The relevant studies, according to the eligibility criteria, were selected and underwent a qualitative analysis of the data included, using the 22-item checklist provided by the 'Strengthening the reporting of Observational Studies in Epidemiology' statement for cohort, case-control, and cross-sectional studies (combined),[21] aiming to make the evaluation and interpretation of results more objective. Using a previously accepted methodology,[11,22] studies were categorized as of poor, moderate or good reporting quality.

### **Data collection**

From all the selected articles, relevant data was extracted and compiled (see Table 1), which included: level of the competition; number of athletes; length of the competition; relevant epidemiological data as considered before. Our aim was to determine the level of play, playing position, type and site of injury, injury incident and severity of injuries

reported in the relevant studies selected. When available, data was collected using the items of the international consensus statement on injury definitions and data collection procedures in studies of injuries in rugby union,[23] to ease further analysis and interpretation. Determination of time at risk for injuries is reported as player match-hours; incidence rate is reported as number of injuries per 1000 player match-hours; injury severity is given in days of absence from competition and training.

It is also important to define the variable not contemplated in the consensus statement: level of competition. For the present study, we opted to use the traditional division in tiers according to playing strength and potential usually used by World Rugby and authors engaged in injury surveillances studies in rugby union.[11] Thus, taking into consideration the World Rugby ranking of Rugby Unions (male),[24] competitions were considered of 'level one' if disputed by top-clubs or national teams of at least one tier-1 nation (including England, France, Ireland, Wales, Scotland, Italy, New Zealand, Australia, South Africa and Argentina); 'level two' if disputed by teams of the second division of tier-1 nations or by top-clubs or national teams of at least one tier-2 nation (other Rugby Unions ranked until the 20<sup>th</sup> position of World Rugby rankings); 'level three' if disputed only by teams or nations in none of the previous circumstances.

### **3. Results**

A summary of the study process can be seen in Figure 1, which shows a flow diagram of the article selection process. The initial electronic database search returned a total of 1372 articles, and an additional manual search returned 5 more relevant articles. By removing the duplicated, the non-relevant articles and those related to different football codes, to women or youth rugby only, 209 potentially relevant papers were assessed for inclusion in the review, based on the previously determined inclusion criteria. As

expected, most of the studies involved 15-a-side rugby union, and those were explicitly presented separately from other reasons for non-inclusion. Seven cohort prospective studies were included in this review (See Table 1). The quality of the studies ranged from poor to moderate. Of the seven articles included, five collected data prospectively from the injury incidence from the men's World Rugby Sevens World Series tournaments over the course of one or several seasons.[25–29] These studies were conducted by the World Rugby Medical and Research Staff.[27] One study reported data prospectively collected from injury incidence in a series of amateur rugby tournaments in the United States of America (USA),[30] while one last study prospectively reported data regarding the incidence of concussion in three World Rugby Sevens World Series tournaments (2008/9, 2010/11 and 2012/13).[31] Regarding the study of Lopez et al,[30] included in this systematic review, only data on male players was considered.

### **Level of play**

Most(six) of the studies selected for this review [25–29,31] were conducted by the Rugby Union Governing Body's (World Rugby) Medical and Research Staff[32] in World Rugby Sevens World Series or World Cup, focusing upon a population of level one (elite) rugby players, while only one study[30] was conducted at a non-professional level, in 4 amateur 1-day tournaments in a USA local Rugby Union (level three). All of the studies were conducted between 2008 and 2015.

### **Total match exposure**



The reported total exposure for players ranged between 866.3 player match hours for the amateur tournament series reported and 6480.6 player match hours for the largest collection of data of the injury surveillance studies of the Sevens World Series and World Cup compiled by Fuller and Taylor[29] between 2008 and 2015. When taking into consideration each annual World Rugby Sevens Series, we can identify a growth in the total match exposure between the initial series considered (2008/9) with a total of 979.1 player match hours and the last one (2014/15) with 1253.9 player match hours.

### **Injury definition**

All articles selected for this systematic review provided clear definitions of injuries, essentially in line with the international consensus statement on injury definitions and data collection procedures in studies of injuries in Rugby Union[17], but with slight differences. Injury was defined by Fuller et al[25] as *“any physical complaint sustained by a player during a Rugby Sevens match that prevented the player from taking a full part in training and/or match play for more than one day following the day of injury”*, while the same author in the World Rugby Sevens World Series (Men) Surveillance studies[26–29] defined injury as *“any injury sustained during Sevens World Series Tournament match or training activity that prevents a player from taking a full part in normal training activities and/or match play for more than one day following the day of injury”*. Lopez et al[30] chose to define injury as *“any physical complaint caused by transfer of energy that exceeded the body’s ability to maintain its structural and/or functional integrity, sustained by a player during a rugby match”*. The other study included in our review[31], that only reported the incidence of concussions in World Rugby Sevens World Series, defined injury as *“any concussion sustained by a player during a match that prevented the player from taking a full part in all training activities*

*or match play for more than 1 day following the day of injury, irrespective of whether match or training sessions were actually scheduled”.*

### **Overall injury incidence rate**

Five studies provided overall match injury incidence for level one rugby sevens tournaments,[25–29] one only provided the match injury incidence of concussion in level one rugby sevens tournaments,[31] and one the overall match injury incidence of an Amateur (level three) tournament.[30] The overall injury incidence rate amongst level one players ranged from 101.5 per 1000 player match hours[26] to 119.8 per 1000 player match hours (95% CI, 101.5-141.4),[27] respectively in the Rugby Sevens World Series of 2010/11 and 2012/13. For all seasons between 2008/9 and 2014/15, the overall match injury incidence reported was 108.3 per 1000 player match hours (95% CI, 100.6-116.6)[29]. For amateur players (level three) the reported injury incidence of the only study available was 55.4 per 1000 player match hours (95% CI, 42.3-68.5), including both male and female athletes. For male athletes only, the reported injury incidence of the same study was 74.7 per 1000 player match hours.[30]

### **Severity of injuries**

All studies with level one players provided injury severity data.[25–29] The mean severity of injuries ranged between 34.1 days in 2010/11[26] and 51.5 days (95% CI, 40.3-62.7) in 2013/14, while the overall mean severity for injuries sustained at the level one tournaments considered in this analysis was 44.2 (95% CI, 40.6-48.1).[29] No data was available for the mean severity of injuries in amateur players.[30] Using the international consensus statement on injury definitions and data collection procedures in studies of injuries in Rugby Union[23] definition of injury severity, most of injuries

reported at international level were considered severe (28 days or more),[25] while at amateur level most were moderate (8 to 28 days).[30]

### **Type of injuries**

All studies with level one players provided information on the type of injuries.[25–29] The most frequent type of injuries sustained by elite players, taking into consideration the definition of the international consensus statement on injury definitions and data collection procedures in studies of injuries in Rugby Union,[23] was joint/ligament injuries, ranging from 34.3% (95% CI, 26.4-42.1) in 2012/13 to 51.5% (95% CI, 41.8-61.1) in 2008/9,[25] and an overall 44.5% (95% CI, 40.8-48.2) for all tournaments between 2008/9 and 2014/15.[29] Muscle/tendon was the second most frequent site of injury, being responsible for 32.4 % of all injuries (95% CI, 28.9-35.8), followed by central nervous system/peripheral nervous system in 11.6 % (95% CI, 9.2-13.9) and bone injuries in 8.4 % (95% CI, 6.4-10.5) of cases.[29] Both skin and other injuries accounted for less than 2% of cases each.[29] At amateur level, muscle/tendon accounted for 37.5% (23.0-54.0) of all injuries, followed by joint/ligament in 22.9 % (95% CI, 12.0-37.0), central nervous system/peripheral nervous system in 16.7% (95% CI, 7.0-29.0) and skin in 14.6% (95% CI, 5.0-26.0) of cases.

### **Location of Injuries**

All studies included in our review provided clear information on the location of injuries reported. [25–31] Lower limb injuries occurred more often than injuries to all other body regions together, as reported in all level one tournaments, with its proportion ranging from 56.3 % (95% CI, 47.9-64.7) in 2014/15[29] to 70.4 % in 2010/11[26].

Upper limb and head/neck were the locations, respectively, in 17.0 % (95% CI, 14.2-19.8) and 15.8 % (95% 13.1-18.5) of all injuries reported between 2008/9 and 2015/16 at World Rugby sevens World Series and Rugby sevens World Cup[29], and Trunk was the site for only 6.1 % (95% 4.4-7.9) of cases. However, at amateur level, lower limb injuries were the least frequent site for reported injuries (14.6%) and head/neck the first (33.3%), followed by the upper limb (31.3%) and trunk (18.8%).[30]

### **Injury incident**

All studies reported that the ratio between contact and non-contact events leading to injuries was 3:1, with overall percentages ranging from 72.8 % to 83.7 % (95% CI, 77.4-90.1).[25–31] The tackle is the event of the game where more injuries occur at both amateur (74.5%; 95% CI 60.0-85.0)[30] and international rugby (51.9%)[29]. Being tackled however, at level one rugby tournaments, is usually more frequently associated with injuries (33.6%; 95% CI, 30.1-37.2) than tackling (21.3 %; 95% CI, 18.2-24.4)[29]. While running and collision with the opponent respectively accounted for 19.3% (95% CI, 16.3-22.2) and 12.0 % (95% CI, 9.5-14.5) of the all injuries at elite level.[29]

### **Period of match**

Six of the seven articles reported the period of match when injury occurred. [25,27–31] Injuries were more frequent in the second half of the games for both backs and forwards. Data regarding all elite tournaments from 2008/9 to 2014/15 shows an incidence, in the first half, of 37.7 (95% CI: 33.1-42.3) to 40.5 (95% CI: 34.4-46.5) injuries per 1000 player match hours, respectively for backs and forwards. During the second half, backs sustained an average of 62.3 (95% CI: 57.7-66.9) injuries per 1000

player match hours, while forwards suffered 59.5 (95% CI: 53.5-65.6) injuries per 1000 player match hours. According to Fuller and Taylor,[29] a significant statistical difference is reached ( $p<0.001$ ) in terms of injury incidence between halves at elite rugby. No data was available for amateur players.

### **Playing position**

Six studies included in our systematic review provided information on the incidence of injuries according to playing position in male rugby sevens.[25–29,31] At elite level tournaments, injury incidence for backs ranged from 101.5 to 129.1 (95% CI: 105.0-158.8) injuries per 1000 player match hours[26,28]. For the same level of competition, injury incidence amongst forwards ranged between 81.9 (95% CI: 60.9-110.0) to 119.8 (95% CI: 93.0-154.3) injuries per 1000 player match hours. Data regarding all World Rugby Sevens World Series from 2008/9 to 2014/15[29] confirmed an overall incidence rate of 91.5 (95% CI: 80.9-103.4) injuries per 1000 player match hours for forwards and 121.0 (95% CI: 110.3-132.7) injuries per 1000 player match hours for backs, revealing a significant difference between them ( $p<0.001$ ). [29] For amateur players, it is reported that backs also sustained more injuries, with no significant differences regarding mean severity, type, location or cause of injuries between players of different positional groups; however no data regarding male players only is reported.[30]

## **4. Discussion**

The present study reports the first systematic review of injury incidence rate in elite and amateur rugby sevens. We collected a relevant amount of epidemiological data related

to injury incidence, type, location, period of match and severity in senior male rugby sevens players from all levels of play and playing positions.

It is clear that injury surveillance studies in rugby sevens, when compared to the 15-a-side variant, are scarce and that most of the available data relies on grey literature and the work of the World Rugby Medical and Research Staff.[32] We chose to discuss the results of the present review while simultaneously comparing them with the available literature on injury surveillance and epidemiology of injuries in the 15-a-side variant of rugby union. Both types of rugby formats involve players of the same football code, the same field dimensions, basic rules, match events and moments of the game, as well as the definitions and methodologies recommended by the international rugby consensus statement.[23]

The largest collection of data, as mentioned before, relates to the World Rugby Sevens World Series,[25–29] and shows some interesting aspects. Firstly, a constant growth in the number of games (player match hours) that athletes are exposed to is clear: from 979.1 player match hours in 2008/9[25] to 1253.9 player match hours in 2014/15,[29] showing an increase of almost 30% in match exposure over a period of 6 years. Despite this relevant increase in the number of hours that athletes had to be on the field, the overall injury incidence rate at level one tournaments remained stable, with 106.2 injuries per 1000 player match hours in 2008/9 and 107.7 in 2014/15. In fact, between each annual Series, not much difference is seen in the injury incidence rate at the World Rugby Sevens World Series tournaments, with numbers ranging from 101.5[26] to 119.8[27] injuries per 1000 player match hours, with an average of 108.3 per 1000 player match hours for all tournaments held between 2008 and 2015.[29] At amateur level, the only available study revealed an injury incidence rate of 74.7 per 1000 player match hours in an American local seven series of tournaments.[30] At both levels, the

injury incidence rates reported are higher than those reported for 15-a-side rugby union, where injury incidence rates were 89.1 to 96 per 1000 player match hours, at professional/elite level[11,17] 21.7 to 25 per 1000 player match hours, at amateur level.[14,15]

One other aspect that becomes clear after the analysis of the collected data is that injuries in rugby sevens are more severe than in the 15-a-side variant. From our review, we concluded that injuries lead, on average, to 34.1 to 51.5 days of absence in rugby sevens level one players whereas in the 15-a-side variant, at the same level of competition, the mean severity of match injuries was 20 days of absence from competition and training.[11] However, the underreporting of minor injuries in rugby sevens might influence the average severities recorded.[31] Rugby sevens is played with greater speed, thereby leading to an increase in energy transfers during tackles and other contact events. In addition, it also involves more running,[33] cutting and turning manoeuvres possibly causing more severe knee and ankle ligament injuries associated with longer absences from practice.[25] It is also important to remember that rugby sevens tournaments consist of several matches played during the same day, or two days. Recent data seems to confirm that match demands remain consistent across tournament rounds, and that players are involved in up to 40% more contact events in a rugby sevens tournament than in a 15-a-side match, which could lead to higher fatigue.[6,33,34]

In 15-a-side rugby, the most frequent site of injury at level one competitions are muscle/tendon[12] and, at amateur level, joint/ligament.[29] The opposite was seen in rugby sevens. At level one sevens tournaments, joint/ligament injuries were more frequent, while muscle/tendon were of higher frequency in the only level three tournament considered. This might also be used to advocate that at elite level rugby

sevens is played with greater speed and with more open field running and turning movements that can lead to this type of injuries. However, larger and more detailed studies should be taken in order to make such statements.

Despite these differences, both at rugby sevens or 15-a-side and amateur or elite level, joint/ligament and muscle/tendon are responsible for over two-thirds[12,24] of all injuries and should be the main focus of future interventions designed to reduce injury incidence rates in rugby union. Nevertheless, due to the risk associated with severe/catastrophic injuries, head/neck injuries should remain an important field of intervention by World Rugby Medical Research Group, as it currently happens.[26]

Regarding the location of injuries, no differences were found between rugby sevens and 15-a-side. Lower limb injuries were more frequent at level one competitions, and accounted for about half of the reported injuries.[11] At amateur level, the largest meta-analysis of injury surveillance studies in rugby 15-a-side, reported that injuries at this level were also most frequent in the lower limbs. However, in our review, the only study available with non-elite players does not support that conclusion. It is important to notice, in any case, that in order to draw any significant conclusions, more data would have to be available. Injuries sustained on the head/neck and upper limb were less frequent, with the former ranging from 4.9 to 21.5 % and the latter from 9.2 to 17.8 %, at international level. However, at level three competitions, a significant number of head and neck injuries were reported, being the single most frequent site of injuries. This data is ambiguous and is not in agreement with the available literature for amateur rugby 15-a-side, in which head/neck injuries are supposed to be of a lesser frequency.[14] For this fact, health professionals providing medical care at rugby sevens tournaments should be familiar with the guidelines and protocols on the management of head and neck injuries in rugby union.[31]



In agreement with all literature,[11,14,29,30] at level one and level three competitions, most injuries result from contact events, particularly tackle (tackling and especially being tackled),[11,29] but also with collision resulting from high speed running. This highlights the nature and demands of rugby union, and might account for the high injury incidence rate of the sport. The rugby sevens variant, due to its specificities, might be associated with even greater incidence rates.

With this paper we aimed to contribute to establish the extent of the problem, which had yet not been done, but also to highlight some reasons that could explain the relevant numbers of injuries found. The high number of matches played in the same day and in subsequent days by Sevens' players, possibly leading to higher levels of fatigue, as suggested by recent studies,[6] should be taken in consideration by all agents. Changing the competition models, aiming to reduce the number of matches played in a day and increasing the time between each game in order to reduce the number of injuries, seems a reasonable hypothesis to test in future studies.

In order to allow an effective intervention, further research at all levels of competition and capable of providing consistent evidence is needed. The authors believe that future focus of research in rugby sevens should include larger, high-quality injury surveillance studies in level two and level three competitions held at national and international level.

At international level, Sevens Series are played throughout the year, with tournaments taking place in two consecutive weeks, with players involved in 3 games per day for two consecutive days.[20] At amateur level, competitions take place with three 1-day tournaments played in consecutive weeks during one month, at the end of the season.[25,34] A question that should be raised in future research is whether the competition format in rugby sevens is appropriate or if it might be responsible for the high level of injuries and severity reported. Changes in the tournament formats must be

considered and tested, aiming to assess strategies to reduce injury incidence rates and severity.

Rugby sevens has the same basic set of rules as rugby union 15-a-side, which allows players to move from one to other variant during the same season.[20] Whether lack of specific training and player's mobility between variants is or not a cause for the high injury rates and severity, should also be a question raised in future investigations.

### **Limitations**

It is important to report that, despite being of the knowledge of the authors, our systematic review did not include a search in EMBASE and SPORTDISCUS databases due to their inaccessibility at the authors' institutions.

Regarding the selected articles, although a significant homogeneity in the methodology was found, since the consensus statement on injury definitions and data collection procedures in studies of injuries in Rugby Union,[23] was followed by all authors in their study design, and injury definitions were very similar, there are some limitations to report.

Firstly, most of data available has not yet been published and it is available only at World Rugby website. [26–29] Secondly, it represents the effort of the same group of investigators, who are also members of the World Rugby Medical and Research Staff.[32] And thirdly, even from the published data, only one article is not from the same main author. Therefore, we have to consider that there could be a bias in the data reported.

Data regarding non-elite players reported in our systematic review is naturally biased, since only one study[30] reported data for non-elite players and included mixed data from male and female athletes, while data from elite players was reported by six of the selected articles. [25–29]

## **5. Conclusion.**

Rugby sevens, being a high-speed, high-intensity variant of rugby union, holds a significantly high injury risk for players. Injuries sustained by rugby sevens players are severe, leading to higher average absences from training and playing, when compared to the 15-a-side variant. Joint or ligament injuries on the lower limb, and injuries following contact events are the most common among elite athletes.

Taking into consideration the recent growth of rugby sevens, and the acceptance of this sport among the Olympic Family, a growing interest of the medical and scientific community in the topic of injury surveillance and injury prevention is expected, as occurred after the introduction of professionalism in the most popular variant of Rugby Union (15-a-side).

The relevant numbers identified for injury incidence and its severity in rugby sevens should drive all Rugby agents to consider the discussion of rules changes or tournaments organizational changes in this variant of the sport, as has previously happened with rugby 15-a-side.[35]

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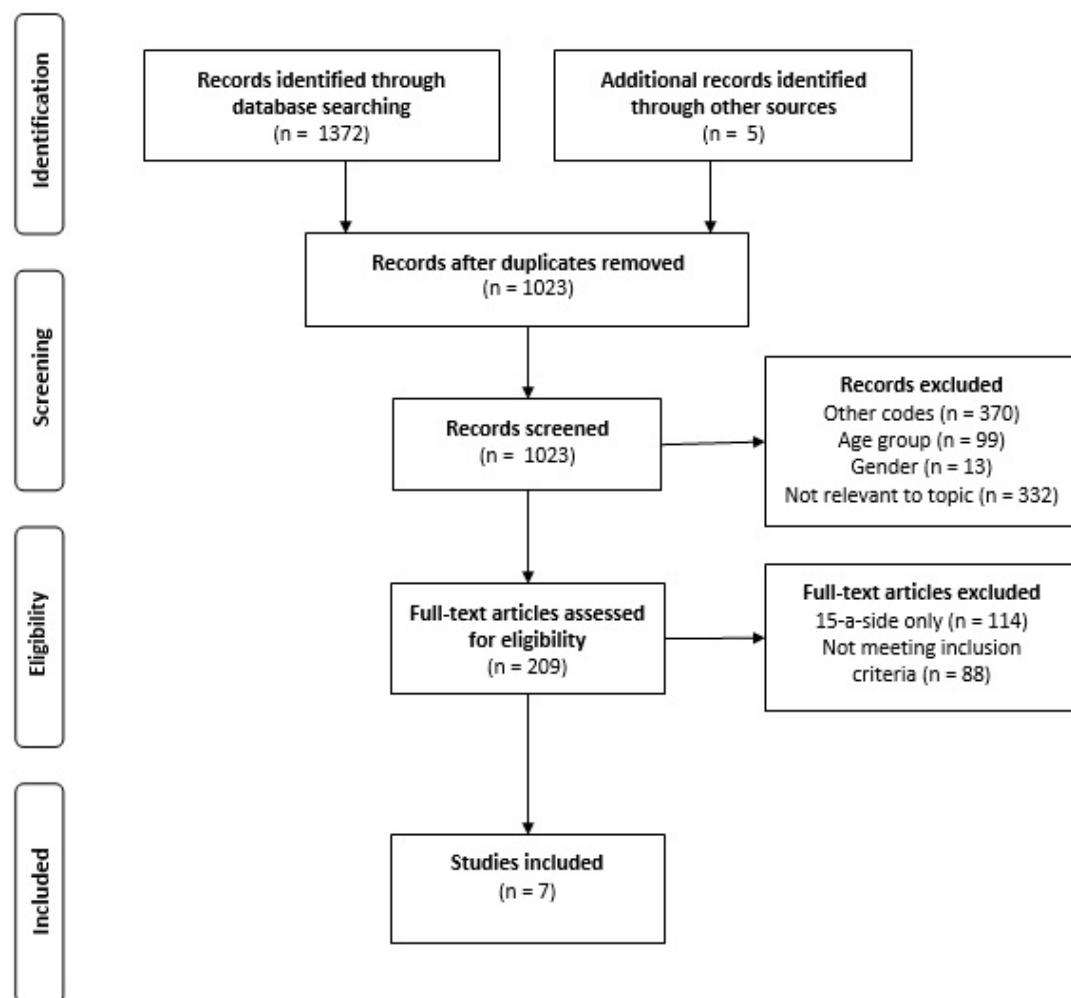
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Figure 1. Search strategy flow diagram



**Table 1.** Data extracted from the studies included in this review

<b>Author</b>	Lopez et al[30]	Fuller et al[25]	Fuller and Taylor[26]	Fuller and Taylor [27]	Fuller and Taylor [28]	Fuller and Taylor [31]	Fuller and Taylor [29]	Fuller and Taylor [29]
<b>Level</b>	Amateur	Elite	Elite	Elite	Elite	Elite	Elite	Elite
<b>Tournament</b>	USA Rugby	RBSWS, RSWC	RBSWS	RBSWS, RSWC	RBSWS	RBSWS	RBSWS	RBSWS
<b>Year</b>	2010	2008-9	2010-11	2012-13	2013-14	2008-13	2014-15	2008-15
<b>Quality</b>	Moderate	Moderate	Poor	Poor	Poor	Moderate	Poor	Poor
<b>Number of players</b>	1536	290	Not given	312	357	Not given	331	1824
<b>Total exposure (player/hours)</b>	866.3	979.1	965.8	1168.3	1219.6	4086	1253.9	6480.6
<b>Incidence rate (per 1000 player/hours, 95% CI)</b>	55.4 (42.3-68.5)*	106.2 (87.8-128.9)	101.5	119.8 (101.5-141.4)	109.9 (92.8-130.1)	8.3 (5.9-11.6)**	107.7 (90.9-127.4)	108.3 (100.6-116.6)
<b>Mean Severity (days absent from sport)</b>	NA	45.0	34.1	42.7 (35.2-50.3)	51.5 (40.3-62.7)	19.3 (14.8-23.6)	41.3 (36.2-48.15)	44.2 (40.6-48.1)
<b>Injury incidence as function of injury severity (per 1000 player/hours, 95% CI)</b>								
Slight (0-1 days)	25.0 (0.0-37.0)	NA	NA	NA	NA	NA	8.1 (3.5-12.8)	8.4 (6.4-10.5)
Minimal (2-3 days)	6.3 (0.0-13.0)	8.2 (4.1-16.4)	NA	NA	NA	NA	17.0 (10.7-23.4)	11.6 (9.2-13.9)
Mild (4-7 days)	22.9 (11.0-35.0)	16.3 (10.0-26.7)	NA	NA	NA	NA	40.0 (31.7-48.3)	44.5 (40.8-48.2)
Moderate (8-28 days)	33.3 (20.0-)	31.7 (22.3-)	NA	NA	NA	NA	31.1 (23.3-)	32.4 (28.9-35.8)

	47.0)	45.1)					38.9)	
Severe (>28 days)	12.5 (3.0-22.0)	49.0 (37.0-65.2)	NA	NA	NA	NA	3.0 (0.1-5.8)	1.9 (0.9-2.9)
<b>Type (% , 95% CI)</b>								
Bone	6.3 (0.0-14.0)	8.7 (3.3-14.2)	8.2	10.7 (5.6-15.8)	9.7 (4.7-14.7)	-	8.1 (3.5-12.8)	8.4 (6.4-10.5)
CNS/PNS	16.7 (7.0-29.0)	4.9 (0.7-9.0)	6.1	14.3 (8.5-20.1)	13.4 (7.7-19.2)	100	17.0 (10.7-23.4)	11.6 (9.2-13.9)
Joint/ligament	22.9 (12.0-37.0)	51.5 (41.8-61.1)	49.6	34.3 (26.4-42.1)	49.3 (40.8-57.7)	-	40.0 (31.7-48.3)	44.5 (40.8-48.2)
Muscle/tendon	37.5 (23.0-54.0)	33.0 (23.9-42.1)	35.7	36.4 (28.5-44.4)	24.6 (17.3-31.9)	-	31.1 (23.3-38.9)	32.4 (28.9-35.8)
Skin	14.6 (5.0-26.0)		2.0	2.1 (0.0-4.5)	2.2 (0.0-4.7)	-	3.0 (0.1-5.8)	1.9 (0.9-2.9)
Other injuries	2.1 (0.0-7.0)	1.9 (0-4.6)	1.0	2.1 (0.0-4.5)	0.7 (0.0-2.2)	-	0.7 (0.0-2.2)	1.3 (0.5-2.1)
<b>Location (% , 95% CI)</b>								
Head/neck	33.3	4.9 (0.7-9.0)	12.2	18.6 (12.1-25.0)	19.4 (12.7-26.1)	100	21.5 (14.6-28.4)	15.8 (13.1-18.5)
Upper Limb	31.3	17.5 (10.1-24.8)	9.2	15.0 (9.1-20.9)	17.2 (10.8-23.5)	-	17.8 (11.3-24.2)	17.0 (14.2-19.8)
Trunk	18.8	7.8 (2.6-12.9)	8.2	5.7 (1.9-9.6)	4.5 (1.0-8.0)	-	4.4 (1.0-7.9)	6.1 (4.4-7.9)

Lower Limb	14.6	69.9 (61.0- 78.8)	70.4	60.7 (52.6- 68.8)	59.0 (50.6- 67.3)	-	56.3 (47.9- 64.7)	61.1 (57.4- 64.7)
<b>Cause (% , 95% CI)</b>								
Contact	72.9 (59.0- 83.0)	77.8 (69.7- 85.8)	72.8	76.8 (69.8- 83.9)	83.7 (77.4- 90.1)	100	77.7 (70.5- 84.8)	78.5 (75.4- 81.6)
No-contact	27.1 (15.0- 39.0)	22.2 (14.2- 30.3)	27.2	23.2 (16.1- 30.2)	21.3 (17.8- 24.7)	-	22.3 (15.2- 29.5)	21.5 (18.4- 24.6)

\*Refers to overall rate (males injury incidence was of 74.7); \*\*Injury incidence related to concussion only; CI: confidence interval; CNS/PNS: Central nervous system/ Peripheral nervous system; NA: not available; RBSWS: Rugby Board Sevens World Series; RSWC: Rugby Sevens World Cup.