

Epidemiology of concussion in men's elite Rugby-7s (Sevens World Series) and Rugby-15s (Rugby World Cup, Junior World Championship and Rugby Trophy, Pacific Nations Cup and English Premiership)

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ABSTRACT

Objective To determine the incidence, nature and causes of concussions sustained during men's elite professional Rugby-7s and Rugby-15s.

Design A prospective cohort study recording injuries classified as a time-loss concussion.

Population Players competing in the following tournaments: Rugby 15s—English Premiership (2007/2008 to 2010/2011), Rugby World Cup (2007, 2011), Pacific Nations Cup (2012, 2013), Junior World Championship (2008, 2010–2013), Junior World Rugby Trophy (2008, 2010–2013); Rugby 7s—Sevens World Series (2008/2009, 2010/2011 to 2012/2013).

Method The study was implemented according to the international consensus statement for epidemiological studies in rugby union; the main outcome measures included the number, incidence (number of concussions/1000 player-match-hours), mean and median severity (days absence) and cause of concussion.

Results The incidence of concussion in Rugby-7s was significantly higher than that in Rugby-15s (risk ratio=1.84; $p<0.001$). The severity of concussions were significantly higher in Rugby-7s than Rugby-15s (mean—Rugby-7s: 19.2, Rugby-15s: 10.1; median—Rugby 7s: 20, Rugby-15s: 7; $p<0.001$). The main causes of concussion were tackling (44.1%) in Rugby-7s and collisions (43.6%) in Rugby-15s. Significantly more (risk ratio=1.49; $p=0.004$) concussed players were removed immediately from the game in Rugby-7s (69.7%) compared to Rugby-15s (46.7%).

Conclusions Six actions were identified to improve the management of concussion in rugby: implement a pitch-side concussion assessment protocol; improve compliance with return-to-play protocols; work with referees to review the nature and consequences of collisions; improve players' tackle technique; investigate the forces involved in tackles and collisions; and evaluate reasons for the higher incidence of concussions in Rugby-7s.

return-to-play protocol, but there are different views on other issues, such as how suspected concussion should be evaluated and the exact format of the graduated return-to-play protocol.⁷ There also remains debate about potential links between concussion and long-term sequelae such as chronic traumatic encephalopathy.^{7–10} White *et al*¹¹ discussed the importance of using rigorous methodologies when developing consensus statements for the management of concussion, as documents of this type are often used to develop clinical guidance: the authors also highlighted the link between the strength of evidence available and the quality and utility of resultant clinical guidelines. In order to develop evidence based, sport-specific, management guidelines, detailed information is required about the magnitude, nature and causes of concussion within individual sports.¹²

Concussion is a risk in many sports but it is of particular concern in full-contact and collision team sports. Rugby union, which is the most popular full-contact team sport in the world with over 100 countries affiliated to the International Rugby Board (IRB), is played professionally in 15-a-side and 7-a-side game formats. Although concussion has been reported to account for 5–9% of all match injuries in men's elite Rugby-15s,^{13–16} and 2% of match injuries in Rugby-7s,¹⁷ previous studies involved restricted populations or small sample sizes, which limits their application in a wider context. The aim of the present study was to provide a broader evidence base to describe the risk of concussion in elite Rugby-15s and Rugby-7s by analysing injury data collected from: (1) the English Premiership, (2) IRB Rugby-15s tournaments and (3) IRB Rugby-7s tournaments. A specific objective of the study was to provide benchmark values for potential risk factors associated with concussion that could be used for future evaluations of concussion management strategies in rugby union.

INTRODUCTION

Following publication in 1997 of the American Academy of Neurology statement on the management of concussion in sport,¹ further statements have been presented by a range of national and international stakeholder groups.^{2–6} There is consensus on some issues, such as the need to remove players with actual or suspected concussions from the field of play and to use a graduated

METHOD

The study followed a prospective cohort design and included data collected over the period August 2007 to July 2013. All players taking part in the following competitions were included in the study: Rugby-15s—English Premiership (seasons: 2007/2008 to 2010/2011), Rugby World Cup (years: 2007, 2011), Pacific Nations Cup (years: 2012, 2013),



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Junior World Championship (years: 2008, 2010–2013), Junior World Rugby Trophy (years: 2008, 2010–2013); Rugby-7s—Sevens World Series (series: 2008/2009, 2010/2011 to 2012/2013). The Sevens World Series is an annual competition consisting of eight or nine 2/3-day tournaments involving 16 teams; tournaments played on five continents over a 7–8-month period (October/November to May). The Series' tournaments are normally grouped in pairs with the two grouped tournaments played in consecutive weeks and with the grouped tournaments played 1–2 months apart (2008/2009: four paired tournaments; 2010/2011: three paired tournaments and one triple group of tournaments; 2012/2013: four paired tournaments and one single tournament). All definitions and procedures used in the studies were compliant with the international consensus statement on injury surveillance studies for rugby¹⁸; full implementation details for data collection in these studies have been published previously.^{14 15 17} Injury surveillance manuals, which included definitions, procedures and all necessary report forms required to implement the study, were provided to the medical staff supporting each of the teams taking part in each competition.

The injury definition used in the study was: "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."¹⁸ Cases of concussion referred to injuries that the team physician/physiotherapist allocated the HN1 (concussion) Orchard Code as the diagnosis.¹⁹ Injury severity was defined by the number of days an injured player was unavailable for training and match play; injured players were followed up postinjury to obtain return-to-play/training dates. Team physicians/physiotherapists were responsible for recording and reporting concussion details (date of injury, date of return to play) and risk factors (anthropometric data (age, stature, body mass); playing position (back, forward); starter/replacement player; period of game concussed (first half, second half); activity at time of injury (collision, maul, ruck, scrum, tackled, tackling, other); removal from play (immediate removal from game, returned to game). A full description of the various types of contact activity in rugby is provided in the Laws of the Game.²⁰ While diagnostic tests such as MRI and CT are not suitable for identifying concussion in players, they are of use for ruling out more severe head injuries and therefore the use and type of all diagnostic tests were recorded.

Team medical personnel reported players' anthropometric data (age, stature, body mass) at the start of each competition. Match exposures were calculated for each team based on: Rugby-7s: 7 players (forwards: 3; backs: 4) being exposed for 14 min per game (20 min for each Tournament Final); Rugby-15s: 15 players (forwards: 8; backs: 7) being exposed for 80 min per game. No allowances were made in either match format for players temporarily (medical treatment, yellow card) or permanently (red card) removed from a match.

Incidence of injury is reported as concussions/1000 player-match-hours (95% CI); severities as mean and median days (95% CI); and proportions as percentages (95% CI). Differences in anthropometric data were assessed using t tests, in numbers of injuries using χ^2 tests, in incidences and mean severities using Z tests, and in median severities using Mann-Whitney U tests.²¹ Where appropriate, a risk ratio (RR) and 95% CI were calculated for risk factors.²¹ Statistical significance is reported as a p value.

RESULTS

The match exposure (player-match-hours) and number of concussions recorded in the various competitions are presented in [table 1](#). The overall incidence of concussion in Rugby-7s was 8.3 concussions/1000 player-match-hours (backs: 9.0; forwards: 7.4; $p=0.582$); for Rugby-15s the overall incidence was 4.5 concussions/1000 player-match-hours (backs: 4.5; forwards: 4.5; $p=1.000$). The overall incidence of concussion in Rugby-7s was significantly higher than the overall incidence in Rugby-15s (RR=1.84; 95% CI 1.28 to 2.65; $p<0.001$). There was no significant difference in the period of the match when concussions were sustained for Rugby-7s (first period: 52.9%; 95% CI 36.2% to 69.7%; second period: 47.1%; 95% CI 30.3% to 63.8%; $p=0.632$) or Rugby-15s (first period: 48%; 95% CI 41.0% to 55.0%; second period: 52%; 95% CI 45.0% to 59.0%; $p=0.418$). There was also no significant difference between Rugby-7s and Rugby-15s when comparing the proportions of concussions sustained in each period of the game (RR: 1.10; 95% CI 0.78 to 1.56; $p=0.576$). The majority of concussions were sustained by players starting games (Rugby-7s: 91.2%; 95% CI 81.6% to 100%; Rugby-15s: 92.5%; 95% CI 88.8% to 96.1%; $p=0.0795$). The proportion of players who were immediately removed from the game when sustaining a concussion was significantly higher (RR: 1.49; 95% CI 1.14 to 1.95; $p=0.004$) in Rugby-7s (69.7%; 95% CI 54.0% to 85.4%) than in Rugby-15s (46.7%; 95% CI 39.8% to 53.7%).

Table 1 Exposures (player-match-hours) and numbers and incidences of concussion for Rugby-7s and Rugby-15s competitions

Competition	Exposure* Player-hours	Concussions			Incidence* Concussions/1000 player-hours (95% CI)
		Backs	Forwards	All players	
Rugby-7s					
Sevens World Series	4086	21	13	34	8.3 (5.9 to 11.6)
Tournaments with a further tournament played in the following week	2022	8	2	10	4.9 (2.6 to 9.1)
Tournaments with no tournament played in the following week	2064	13	11	24	11.6 (7.8 to 17.3)
Rugby-15s					
English Premiership	31 745	68	78	146	4.6 (3.9 to 5.4)
Rugby World Cup	3840	9	11	20	5.2 (3.4 to 8.1)
Junior World Championship	6100	7	13	20	3.3 (2.1 to 5.1)
Junior World Rugby Trophy	2080	6	4	10	4.8 (2.6 to 8.9)
Pacific Nations Cup	560	3	0	3	5.4 (1.7 to 16.7)

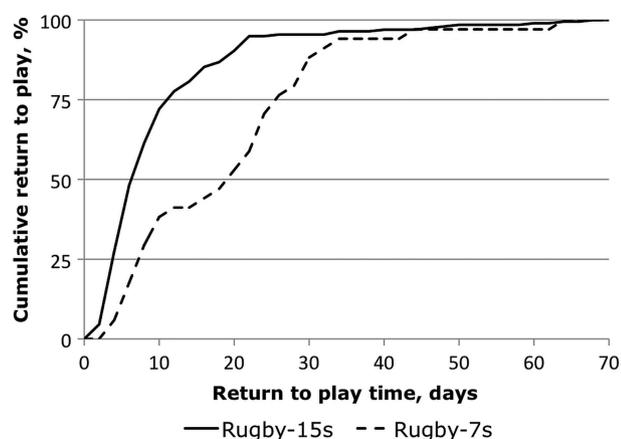
*Exposure and incidence values relate to 'All players'.

Table 2 Severity of concussions sustained in the first and second halves of matches as a function of match format (Rugby-7s, Rugby-15s) and playing position (backs, forwards, all players)

Game format; playing position	Severity; days (95%CI)	
	Mean	Median
Rugby-7s		
Backs (n=21)	17.6 (13.0 to 22.2)	20 (8 to 28)
Forwards (n=13)	21.8 (12.9 to 30.7)	22 (8 to 26)
All players (n=34)	19.3 (14.8 to 23.6)	20 (9 to 24)
Rugby-15s		
Backs (n=93)	9.2 (7.6 to 10.8)	7 (5 to 8)
Forwards (n=104)	11.0 (8.7 to 13.3)	7 (6 to 8)
All players (n=197)	10.1 (8.7 to 11.5)	7 (6 to 8)

Table 2 summarises the mean and median severities of concussion sustained by backs, forwards and all players in Rugby-7s and Rugby-15s: there were no significant differences between backs and forwards for the mean or median values in either Rugby-7s or Rugby-15s. However, mean and median severity values were both significantly ($p < 0.001$) higher in Rugby-7s than Rugby-15s. Figure 1 shows the players' cumulative percentage return-to-play after concussion in terms of days absence for Rugby-7s and Rugby-15s: 72% of Rugby-15s players returned to play within 10 days but only 38% of Rugby-7s players returned within this time period.

Table 3 shows the activities associated with concussions as a function of match format (Rugby-7s, Rugby-15s) and playing position (backs, forwards, all players). Tackling was the main cause of concussion in Rugby-7s (backs: 47.6%; forwards: 38.5%; all players: 44.1%); for Rugby-15s, although tackling was again the main cause of concussion for backs (backs: 33.3%; forwards: 29.7%; all players: 31.4%), collisions were responsible for more concussions sustained by forwards (backs: 31.1%; forwards: 43.6%; all players: 37.7%). When comparing the causes of concussions for backs against forwards, being-tackled was twice as likely to be the cause of concussion for backs in both Rugby-7s and Rugby-15s, although the difference was only statistically significant in Rugby-15s. There were no significant differences in the proportions of concussions caused by the various match activities when comparing Rugby-7s with Rugby-15s for backs, forwards and all players.

**Figure 1** Players' cumulative return to play (%) following concussion for Rugby-7s and Rugby-15s.

Significantly more Rugby-7s players sustaining a concussion were subjected to diagnostic testing than Rugby-15s players; overall, however, less than 60% of players were tested (Rugby-7s: 58.8%; Rugby-15s: 39.2%; $p = 0.032$). Neuropsychological testing was by far the most common procedure used (Rugby-7s: 44.1%; Rugby-15s: 24.1%) followed by CT (Rugby-7s: 5.9%; Rugby-15s: 11.1%) and MRI (Rugby-7s: 5.9%; Rugby-15s: 5.5%), which were used to rule out more severe head injuries.

Table 4 presents the mean and SD for the age, stature and body mass of backs and forwards in the Rugby-7s and Rugby-15s sample populations and compares these with the values for backs and forwards sustaining a concussion. Although there was a trend in both Rugby-7s and Rugby-15s for backs and forwards sustaining concussions to be older and lighter, the only statistically significant difference related to the age of concussed Rugby-15s backs and forwards ($p \leq 0.001$).

For the Sevens World Series, table 1 shows that there was a significantly higher incidence of concussion reported in the second of the paired tournaments compared to the first tournament (RR=2.37, 95% CI 1.13 to 4.95; $p = 0.022$). There was no significant difference ($p = 0.711$) in concussions sustained on each of the tournament days when comparing the first of the paired tournaments (day 1: 60%, 95% CI 29.6% to 90.4%; day 2/3: 40%, 95% CI 9.6% to 70.4%) with the second of the paired tournaments (day 1: 66.7%, 95% CI 47.8% to 85.5%; day 2/3: 33.3%, 95% CI 14.5% to 52.2%). The mean and median severities of concussions reported in the second of the paired tournaments (mean: 21.7 days, 95% CI 16.2 to 27.2; median: 23 days, 95% CI 10 to 28) were higher than those reported in the first of the paired tournaments (mean: 13.5 days, 95% CI 7.2 to 21.7; median: 8 days, 95% CI 6 to 25), although the differences did not reach statistical significance (mean: $p = 0.055$; median: $p = 0.056$). Additionally, significantly ($p = 0.003$) more players sustaining concussions in the first of the paired tournaments (50.0%, 95% CI 19.0% to 81.0%) returned to match play within 7 days, compared to players sustaining concussions in the second of the paired tournaments (8.3%, 95% CI 0% to 19.4%).

DISCUSSION

The range and number of Rugby-7s and Rugby-15s tournaments included in this study should mean that the results are representative of elite rugby, which allows the conclusions from the study to be generalised. The incidences of concussion recorded in the Rugby-15s competitions (3.3–5.4) were similar to those reported in previous studies (2.6–7.8)^{12–16}; however, the incidence of concussion recorded in the Rugby-7s tournaments was four times higher than that reported previously.¹⁷ The higher incidence of concussion recorded in the present Rugby-7s study may reflect a real increase in the period since the previous study or may merely provide a better estimate of the true value as only two concussions were recorded in the earlier study. The incidence of concussion in Rugby-15s was lower than the incidence reported for American football (18.2),²² and rugby league (9.8),²³ but higher than that reported in ice hockey (1.8)²⁴; for Rugby-7s, the incidence was lower than that for American football, similar to rugby league and higher than ice hockey.

The overall incidence of concussion in Rugby-7s was higher than that observed in Rugby-15s; however, the incidence of concussion in the first of the paired Rugby-7s tournaments was similar to that observed in Rugby-15s: the overall difference therefore resulted from the higher incidence in the second of the paired tournaments. The higher incidence in the second

Table 3 Match activities responsible for concussion injuries as a function of match format (Rugby-7s, Rugby-15s) and playing position (backs, forwards, all players)

Match activity	Proportion of concussion injuries, % (95% CI)						Risk ratio (95% CI)			
	Rugby-7s (n=21)		Rugby-15s (n=90)		All players (n=191)		Rugby-7s		Rugby-15s	
	Backs (n=13)	Forwards (n=8)	Backs (n=50)	Forwards (n=40)	All players (n=191)	Backs (n=191)	Forwards (n=101)	All players (n=191)	Backs vs forwards	Rugby-15s
Collision	19.0 (2.3 to 35.8)	30.8 (5.7 to 55.9)	31.1 (21.5 to 40.7)	43.6 (33.9 to 53.2)	37.7 (30.8 to 44.6)	0.62 (0.19 to 2.06)	0.71 (0.49 to 1.04)			
Maul	0.0 (-)	0.0 (-)	0.0 (-)	1.0 (0 to 2.9)	0.5 (0 to 1.5)	-	0.00 (-)			
Ruck	0.0 (-)	7.7 (0 to 22.2)	6.7 (1.5 to 11.8)	9.9 (4.1 to 15.7)	8.4 (4.4 to 12.3)	0.00 (-)	0.67 (0.25 to 1.78)			
Scrum	0.0 (-)	0.0 (-)	0.0 (-)	1.0 (0 to 2.9)	0.5 (0 to 1.5)	-	0.00 (-)			
Tackled	33.3 (13.2 to 53.5)	15.4 (0 to 35.0)	25.6 (16.5 to 34.6)	10.9 (4.8 to 17.0)	17.8 (12.4 to 23.2)	2.17 (0.53 to 8.88)	2.35* (1.21 to 4.54)			
Tackling	47.6 (26.3 to 69.0)	38.5 (12.0 to 64.9)	33.3 (23.6 to 43.1)	29.7 (20.8 to 38.6)	31.4 (24.8 to 38.0)	1.24 (0.54 to 2.81)	1.12 (0.74 to 1.71)			
Other	0.0 (-)	7.7 (0 to 22.2)	3.3 (0 to 7.0)	4.0 (0.2 to 7.8)	3.7 (0.1 to 6.3)	0.00 (-)	0.84 (0.19 to 3.66)			

*p<0.005.

tournaments may result from cumulative player fatigue resulting from playing two tournaments within 10 days; however, there was no indication that fatigue was a risk factor within individual games, as the proportions of concussions sustained in the first and second halves of games were similar,²⁵ or within tournaments, as fewer concussions were sustained on day 2/3 than on day 1. It is possible that the difference could be linked to the logistical arrangements for the paired tournaments in the Sevens World Series. Most Rugby-7s teams travel with a squad of 12 players; hence, because of the short time period (5–7 days) between the last match in the first tournament and the first match in the second tournament, it may sometimes be difficult for teams to replace injured players in time for the start of the second tournament. Additionally, any player declared with a concussion injury at the end of the first tournament of a back-to-back pair of tournaments would most likely have to miss the second tournament because the medical team would not be able to predict whether a concussed player would recover within the minimum 6 days required. It is possible therefore that mild concussions sustained in the first of the paired tournaments were undeclared by some players and/or medical teams. Players sustaining a concussion in the second of the paired tournaments would not be affected in the same way, as pairs of tournaments take place every 1–2 months, which provides sufficient time for most players to recover from concussions sustained in a second tournament.

Although there were no significant differences between the severities of concussion sustained by backs and forwards in either Rugby-7s or Rugby-15s, the overall mean and median severities of concussions sustained by players in Rugby-7s were significantly greater than those sustained in Rugby-15s. However, the severity of injuries sustained in the first of the paired Rugby-7s tournaments were similar to those sustained in Rugby-15s; the difference therefore results from the severity of Rugby-7s concussions sustained in the second of the paired tournaments. It is not apparent whether this difference is a real effect or whether it simply reflects the extended time available between each set of paired tournaments, which enables physicians and physiotherapists to adopt a more conservative rehabilitation process for concussed players.

The proportion of players returning to training/match play within 10 days (Rugby-7s: 38%; Rugby-15s: 72%) was lower than the 80–90% value quoted in the fourth International Conference on Concussion in Sport statement⁶; this may indicate that more conservative return-to-play practices are adopted in rugby compared to other sports. It is also apparent from [figure 1](#) that the proportion of players (Rugby-7s: 18%; Rugby-15s: 48%) returning to match play in less than the current IRB guideline minimum concussion recovery time of 6 days (when under the supervision of a medical practitioner) is significant and this warrants further investigation. The median severities of concussion observed in this study of rugby union were similar to values reported previously for professional ice hockey (median severity: 6 days),²⁴ but very much higher than values reported for American football (mean: 2–5 days; median: 0–1 days),²² although these values seem surprisingly low.

Players sustaining a concussion in Rugby-7s were more likely to be removed immediately from the pitch than they were in Rugby-15s. However, this trend is most likely a reflection of the format of the game and the relative impact on team performance of physicians taking match-time to assess a player for concussion in a team of 7 players during a 14 min Rugby-7s game compared to the impact in a team of 15 players during an 80 min Rugby-15s game. The proportions of players sustaining a concussion who were not removed immediately from play are

Table 4 Anthropometric data for Rugby-7s and Rugby-15s backs and forwards sustaining concussion compared to the sample population

Parameter	Mean value (SD)							
	Players sustaining concussion injuries				Sample population			
	Rugby-7s		Rugby-15s		Rugby-7s		Rugby-15s	
	Backs (n=21)	Forwards (n=13)	Backs (n=93)	Forwards (n=106)	Backs (n=689)	Forwards (n=439)	Backs (n=1624)	Forwards (n=1667)
Age (years)	24.0 (3.1)	24.8 (3.3)	25.0 (4.3)*	26.3 (4.4)*	22.9 (3.2)	24.1 (3.4)	23.0 (4.6)	23.7 (5.0)
Stature (cm)	179.2 (7.1)	185.4 (4.9)	181.8 (4.9)	188.3 (7.4)	180.3 (6.3)	187.3 (5.7)	181.8 (6.0)	188.2 (7.2)
Body mass (kg)	84.6 (8.2)	96.7 (6.4)	89.8 (6.1)	107.7 (8.3)	86.2 (7.5)	97.3 (8.3)	90.0 (8.4)	108.2 (9.3)

*p<0.001.

high in both game formats and until questions about possible links between concussion and potential long-term sequelae have been answered,²⁻⁶ this proportion should be reduced.

The only significant differences in the anthropometric data of concussed players compared to the sample population were that concussed players were older; this may be related to the fact that older players are more likely to have sustained a previous concussion, which it is claimed is a risk factor for further concussions.²⁻⁶ In general, Rugby-7s and Rugby-15s players were most likely to sustain concussions when tackling or in collisions although, for Rugby-7s backs, the second most common cause was being-tackled. This shows similarities and differences to the causes of concussion in other full-contact sports, which supports the argument for obtaining sport-specific information about the nature and causes of concussion. In American football,²² tackling (29%), being tackled (27.5%), being blocked (16.2%) and blocking (16%) were the most common activities leading to concussion; whereas, in rugby league head-high tackles (39.5%) and head contact with the ground (34.9%) were identified as the major causes.²³ The results from the present study indicate that the major causes of concussion in rugby union are controllable, which provides scope for developing and communicating effective injury prevention strategies. The IRB Rugby Ready training programme teaches players the correct tackling technique, which includes ensuring that players have their head in the correct position to minimise the risk of sustaining a concussion. Second, deliberate collisions are not allowed within the Laws of the Game²⁶; Law 10.4(g) states that charging or knocking down a player without trying to grasp the player constitutes dangerous play. It has been reported previously that 97% of collision events in Rugby-15s go unpunished²⁶; the potential for reducing the role of collisions in concussion injuries is therefore large but match referees must play a major part by rigorously enforcing the Laws of the Game and by imposing the appropriate penalties on players, as this should act as a strong deterrent.

The data, conclusions and generalisations reported in this study relate specifically to the men's elite, professional game of rugby union (Rugby-7s and Rugby-15s). It is recognised that the overall incidence of injury and the incidence of concussion are significantly lower at the men's and women's community level of play than the values reported in this study. Additionally, the recommended pitch-side and postgame protocols for the management of concussion at the community level are quite different from those at the professional level of the game. For these reasons, the conclusions reached from this study cannot and should not be generalised to the community level of play in rugby union.

This study has confirmed the level of concussion in elite/professional Rugby-15s across a range of competitions and established for the first time the level of concussion in elite/professional Rugby-7s. The results presented highlight a number of areas of the game where there is the potential for reducing the risk of concussion in rugby.

First, implement a pitch-side concussion assessment protocol (consisting of appropriate assessment tools together with guidance on their application and time for their implementation) to aid the decision-making of physicians in order to increase the proportion of concussed players being removed immediately from the pitch. Second, determine the reasons why a high proportion of players return to play, following a concussion, in less than the IRB recommended 6-day recovery period. Third, work with referees to minimise the consequences of collisions. Fourth, improve players' tackle technique and increase players' awareness of the connection between poor tackle technique and concussion. Fifth, examine the forces involved in tackles and collisions to identify the biomechanics of the concussion mechanism and to identify potential mitigation strategies. Sixth, establish the reasons for the higher incidence of concussion during the Rugby-7s Rugby World Series and, if necessary, examine the logistics associated with paired tournaments in the Series.

What are the new findings?

- ▶ Provides benchmark values for the incidence, severity and risk factors associated with concussion in elite, professional 7-a-side and 15-a-side rugby union.
- ▶ Identifies a higher risk of concussion in 7-a-side compared to 15-a-side rugby union.
- ▶ Identifies six issues associated with rugby union where further more detailed investigations could lead to a reduced risk of concussion.

How might it impact on clinical practice in the near future?

- ▶ Match-day physicians should be more vigilant in immediately removing players with confirmed concussion from the pitch.
- ▶ Team physicians should be made more aware of concussion recovery recommendations in order to increase compliance with minimum return-to-play timescales.
- ▶ Match-day physicians should be made aware of the higher incidence of concussion in 7-a-side Rugby compared to 15-a-side Rugby.

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Contributors CWF designed the study, developed the implementation strategy, analysed the results, prepared the draft paper, edited and approved the final

submission. Responsible for the overall content and guarantor, AT reviewed the implementation strategy, implemented the data collection studies, reviewed the draft paper and approved the final submission. MR reviewed the study design, reviewed the implementation strategy; reviewed the draft paper and approved the final submission.

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Competing interests None.

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