ENGLAND PROFESSIONAL RUGBY INJURY SURVEILLANCE PROJECT

2017 – 2018 Season Report

Authored by the England Professional Rugby Injury Surveillance Project Steering Group

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The content of the report is based on data collected and analysed by Stephen West (University of Bath)

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EXECUTIVE SUMMARY

The key findings from the 2017-18 season:

- The Professional Rugby Injury Surveillance Project (PRISP) is the most comprehensive and longest running injury surveillance project in professional rugby union. First commissioned by the RFU and Premiership Rugby in 2002, PRISP monitors injury incidence (how often), injury severity (days absence) and injury burden (incidence x severity) in English Premiership Clubs and the England Senior team.

- The main objectives of PRISP are to accurately report the risk of injury in the professional game and to highlight any patterns or trends over time, allowing for the targeted investigation of specific areas of injury risk and the development of evidence based strategies to reduce injury risk.

- In the 2017-18 season, the overall incidence of match injury in the Premiership was 92 per 1000 hours (1000 hours = 25 matches). This equates to 1.8 injuries per match and 60 injuries per team per season. This figure is slightly higher than the mean for the whole of the surveillance period of 85 per 1000 hours, but remains within the limits of expected season to season variation.

- The average severity of match injuries (the time taken to return to play) for the 2017-18 season was 37 days. This is the second consecutive season that this figure has risen above the expected upper limit of season to season variation. This is largely driven by an increase in injuries in the three highest severity groupings (8-28 days, 28-84 days and >84 days absence) and a reduction in the 2-7 day injuries.

- The type of injuries seen in the 28-84 days category have remained largely similar since 2012, but the >84 day category has seen more variation. Radial fractures (a mix of first injuries and recurrences) were the most common injuries in the >84 day severity category in 2017-18.

- Due to the rise in severity of match injuries, the burden of match injury (a combination of both incidence and severity) increased to 3401 days absence per 1000 hours for Premiership injuries which is the highest seen since 2002 and considerably above the upper limit of expected season to season variation.

- For the seventh consecutive season, the most commonly reported match injury was concussion (17.9 per 1000 hours), contributing 20% of all match injuries. While encouragingly, there was a small reduction in concussion incidence when compared with 2016-17, this only equates to one fewer concussion every eight games.

- The mean severity of medically diagnosed match concussions in 2017-18 was 19 days. This rise in mean severity, first seen last year, is largely due to a relatively small number of concussions (6 in total) where the time to return was more than 84 days, compared with previous seasons. Compliance with the mandatory return to play protocols for concussion was again excellent, with no players returning to play in less than six days.

- 52% of all match injuries are associated with the tackle, with 28% of all injuries associated with tackling and 24% associated with being tackled. 2017-18 is the first season that the incidence of injuries was greater for the tackler than the ball carrier. Concussion accounted for 18% of all injuries to the ball carrier and 37% of all injuries to the tackler, highlighting the tackle as the key game event to consider when developing concussion and all injury reduction strategies.

- The season by season profile of the five most common match injuries and highest burden match injuries has remained constant throughout the surveillance period with the exception of concussion. For the third consecutive year concussion is both the most common and highest burden match injury, followed by hamstring muscle injuries.

- The incidence of training injuries remained stable during the 2017-18 season. However, the average severity rose to its highest ever recorded level at 37 days and above the expected limits of variation. As a result of the increase in severity of training injury the burden of training injury in 2017-18 again rose substantially and above the upper limit of expected variation. In total, 38% of all injuries were sustained during training.

- There was a significant increase in the incidence of injuries sustained in rugby skills contact training and non-weights conditioning sessions. Concussion was the most common injury in full contact training sessions with concussion and hamstring injuries being the most common injuries in semi-contact sessions.

- During the 2017-18 season, games at three Premiership venues were played on artificial turf

(Allianz Park, Kingston Park & Sixways Stadium). Artificial turf was also played on at two other venues in the European and Anglo-Welsh competitions. There was no significant difference in the incidence, severity or burden of match injuries between artificial turf and grass for the 2017-18 season.

- When the data collected over the past five seasons is combined, the incidence of match injuries on natural grass and artificial turf is not different. However, the severity of match injuries on artificial turf is greater than that on natural grass, with an injury sustained on artificial turf lasting, on average, nine days more than one sustained on natural grass (natural grass, 30 days; artificial turf, 39 days). Consequently, the burden of injuries on artificial turf pitches is higher than those on natural grass (natural grass, 2433 days absence per 1000 hours; artificial turf 3015 days absence per 1000 hours).

- When considering injury risk by body location, both severity and burden were greater for lower limb match injuries sustained on artificial turf with this being most marked for hamstring and foot and toe injuries.

- When combining three seasons of training injury data to compare injuries on artificial turf versus natural grass, a similar trend to match injuries is apparent with similar incidence on both turf types while severity and burden are significantly higher on artificial turf. Mean severity on injury on artificial turf is eight days greater than on natural grass, while the burden for training injuries is 155 days per 1000 hours compared with 123 per 1000 hours.

- The incidence of match injuries for the England Senior side for the 2017-18 season remained stable at 105 per 1000 hours. The average severity of 30 days was a substantial increase on the mean of the study period as a whole (19 days).

- During the 17-18 season, the mean incidence of England training injuries sustained during Rugby Skills was double that of the study period average. As a consequence the burden of England training injuries during Rugby Skills (579 days absence per 1000 hrs) rose to more than five times the study mean (96 days absence per 1000 hrs).

- In 2017-18, 10 players retired as a result of injury.

Error in 2016-17 Report

In the 2016-17 season report, an error was made regarding the incidence on artificial grass pitches (AGPs). The figures presented reported an incidence of 129.1 per 1000 hours for match play on AGPs. On completion of data collection for the 2017-18 season, it became apparent that the exposure on AGPs during the 2016-17 season was miscalculated, with less exposure recorded than was correct. As exposure is the denominator in the calculation of incidence, the incidence was therefore presented as being higher than the correct value. The correct value (and that which is reported for the 2016-17 season in this report) was 93 per 1000 hours. As a consequence of the miscalculation of incidence, the burden of injury on AGPs was also incorrect (as this value is the product of incidence and severity). The reported value of 4780 days per 1000 hours exposure should have been reported as 4091 days per 1000 hours. This was an isolated error as exposure data differentiating between matches played on artificial surfaces versus natural grass is calculated manually. All other data in the report is exported directly from the relevant database.

As part of the re-analysis completed for this review, injuries from previous seasons were examined to check return dates from injuries. This revealed several players who had sustained injuries that subsequently encountered complications during recovery meaning the true severity of the injuries was greater than initially estimated. This has also been amended in the current report and shows that the severity of injury on AGPs is significantly greater than that of natural grass pitches (outlined later in the report).

The error in the calculation of exposure has also led to a review of data checking systems and a new policy for data review has been put in place to ensure such an error does not happen again. While this error misrepresented the risk on AGP pitches, it has allowed for a more in-depth analysis of the risk between pitch types to be completed which is outlined in the turf type section of this report. This more in-depth analysis is important work to ensure the welfare of all players involved in the sport at all levels of the game.

CONTENTS

INTRODUCTION

The Rugby Football Union (RFU) and Premiership Rugby Ltd (PRL) first commissioned an injury surveillance study across the Premiership and England teams in 2002 that remains driven and directed towards the improvement of player welfare in professional rugby union. This report presents the Premiership-wide key findings from the 2017-18 season and compares them longitudinally with the results from 14 previous seasons. The Professional Rugby Injury Surveillance Project (PRISP) is pivotal in both providing the baseline data needed to assess trends in injury and in guiding further investigation into injuries that are common, severe or increasing in incidence.

RESEARCH UPDATES: 2017-18

An evaluation of the King-Devick concussion screening tool in professional rugby union

This study, undertaken in the 2016-17 season, was published by the British Journal of Sports Medicine in March 2018. It concluded that the King-Devick test demonstrated limited accuracy as a stand-alone remove-from-play sideline screening test for concussion in the English professional rugby union landscape.

Investigating strategies used in professional rugby to manage athletes on artificial turf.

This study, conducted by the University of Bath, aimed to determine whether professional rugby clubs approach player management differently when playing on artificial turf compared to natural grass, and investigated various management strategies currently being used for this purpose. The study is currently under peer review and the findings from this study will be included in the 2018-19 PRISP report.

Micro RNA Study

This study, led by the University of Birmingham, aims to establish a panel of biomarkers in urine and saliva for the rapid diagnosis of concussion. Samples were collected during the 2017-18 Premiership and Championship seasons and are currently being analysed. The study will be submitted for peer-review publication in early 2019.

PROJECT DEFINITIONS

Time-loss injury

A time-loss injury was defined as 'any injury that prevents a player from taking a full part in all training activities typically planned for that day and/or match play for more than 24 hours from midnight at the end of the day the injury was sustained'. For example, if a player was injured during a match on Saturday and he was able to take a full part in training on Monday, the incident would not be classed as an injury. If the player's training was restricted on Monday due to the injury received on Saturday, the incident would be classed as a time-loss injury and reported.

Injury severity

Injury severity was measured as time (days) lost from competition and practice and defined as the number of days from the date of the injury to the date that the player was deemed to have regained full fitness not including the day of injury or the day of return. A player was deemed to have regained full fitness when he was 'able to take a part in training activities (typically planned for that day) and was available for match selection.'

Recurrent injury

An injury of the same type and at the same site as an index (original) injury and which occurs after a player's return to full participation from the index (original) injury. Manual calculation of within season injury recurrence was completed using player registration codes and OSICS codes (to two digits).

Injury incidence and days absence

The likelihood of sustaining an injury during match play or training is reported as the injury incidence. The injury incidence is the number of injuries expressed per 1,000 player-hours of match exposure (or training exposure).

Burden

The burden of injury is a measure that combines the frequency and severity of injuries. Burden is measured as the days absence per 1,000 player-hours of exposure.

Illness

Any illness (classified using the Orchard sports injury classification system – OSICS 10.1) for which the player sought consultation at his club that prevented the player from participating in training or match play for a period greater than 24 hours after the onset of symptoms.

Statistical significance

A result is considered to be statistically significant if the probability that it has arisen by chance is less than 5% or 1 in 20. In this report, statistical analysis has been performed for the match and training injury incidence and days absence.

Median severity

The median severity is the middle value when all of the severity values are lined up in order numerically.

KEY FINDINGS

MATCH INJURY INCIDENCE, SEVERITY & BURDEN

Likelihood or incidence of match injury

The incidence of match injury during the 2017-18 remained stable compared with the study period as a whole (Figure 1a). Seven hundred and seventeen match injuries that prevented an athlete from participating in training or match play were recorded, compared with an average of 664 per season for the surveillance period as a whole. The match injury incidence in the 2017-18 season was 92 per 1000 hours, or approximately 60 injuries per club. This incidence is higher than the mean incidence of 85 per 1000 hours for the period of 2002-2017, but remains within the expected limits of season-to-season variation.

Three hundred and ninety-one games were included for analysis during the 2017-18 season, which is similar to that of the 2016-17 season (406 games) (NB: 1 game= 2 team matches, if both clubs are involved in the injury surveillance project.) On average, each club experienced 1.8 injuries per match during the 2017-18 season, compared with the 1.9 injuries per club per match in the 2016-17 season.

Severity of match injuries

The average severity of match injury for the 2017-18 season was 37 days lost per injury (Figure 1b). This figure represents the second consecutive season that the severity has risen above the expected upper limit of season to season variation and is 13 days greater than the mean for the study period as a whole (24 days).

Table 1 shows the incidence of injuries associated with each of the four severity groupings. During the 2016-17 season, a rise in the three highest severity groupings was responsible for the overall increase in the mean severity of injuries. During the 2017-18 season, the rise in mean severity of injury is due to both the sustained rates of injury in these three severity groupings as well as a reduction in the number of 2-7 day injuries. The incidence of 2-7 day injuries fell to 28 per 1000 hours from a mean of 38 per 1000 hours for the study period as a whole. The number of injuries in the highest two injury categories were also substantially higher than the mean since 2002 with 29-84 day injuries occurring at a rate of 19 per 1000 hours compared with 13 per 1000 hours and greater than 84 day injuries occurring over twice as frequently in the 2017-18 season (12 per 1000 hours compared with the study period mean 5 per 1000 hours). These figures indicate that, over the last two seasons, the reason behind the rise in average severity is a genuine increase in the severity of injuries rather than a more conservative approach to management.

While mean days absence provides a useful measure to assess the changing severity of injuries over time, the mean can be skewed by a small number of significant long-term injuries and therefore it is also useful to look at the median value. The median severity of injury for the period 2002 to 2017 was nine days with the 2017-18 season being the first season the median has gone above the expected limits of variation at 14 days (Figure 1c).

Figures S6 and S7 provide an overview of the three most common injuries in the two highest severity categories, and provides an overview of which of injuries that cause extended periods of recovery from the game are most common. Injuries within the 29-84 day category have remained largely similar since 2012, while the >84 day category has seen greater variation. In 2017-18, MCL injuries were the most common injuries in the 29-84 day category while radial fractures were the most common injuries in the >84 day category. It must, however, be recognised that the rate of recurrence of radial fractures was high, which is the reason that this injury type is the most common 84+ day injury in 2017-18. The 2017-18 season also represents the first time that shoulder dislocations enter into the top three most common injuries with greater than 84 days of severity. While these injury types are the most severe, it must be noted that the number of these injuries is low with six radial fractures and six shoulder dislocations during the 2017-18 season.

Match injury burden

The observed increase in the severity of injuries during the 2017-18 season resulted in a rise in the burden of match injury (a combination of both incidence and severity, figure 1d). During the 2017-18 season, the burden of match injury was 3401 days absence per 1000 hours, which was higher than the 2016-17 season (3074 days absence per 1000 hours). Furthermore, this figure was the highest seen over the surveillance period as a whole and is considerably higher than the upper limit of expected season-to-season variation. This value equates to around 66 days absence per club per match.

Figure 1a

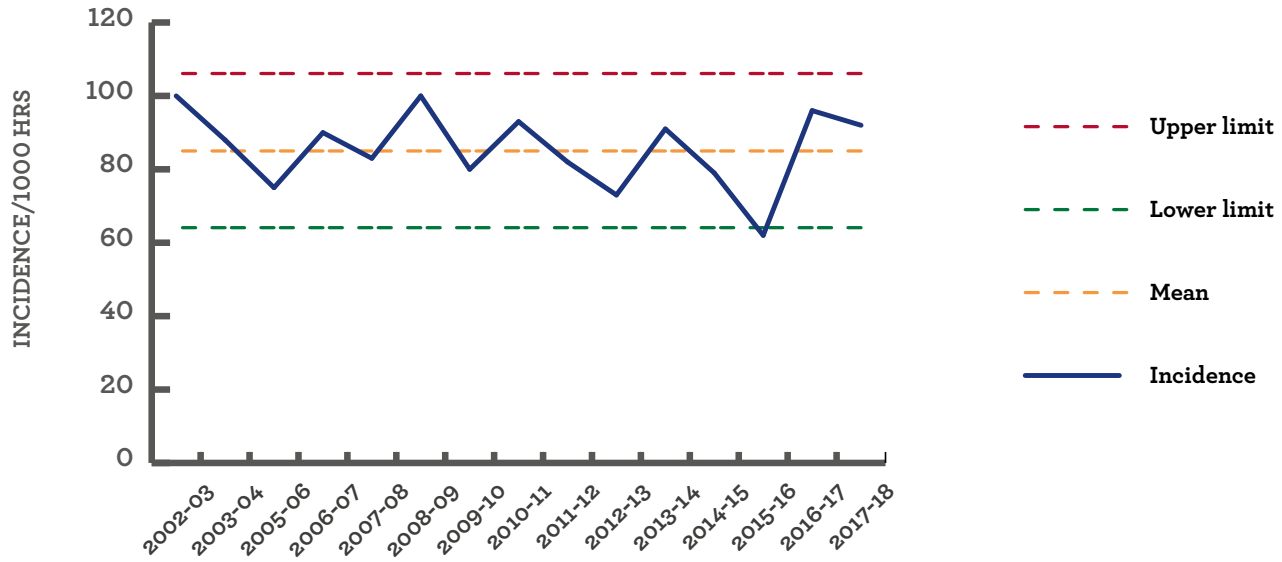

Figure 1a: Incidence rates of match injuries over the surveillance period with mean ± 2 x standard deviation shown.

Note: For a normal distribution, 95% of all data should fall between (Mean - 2 x standard deviation) and (Mean + 2 x standard deviation).

Figure 1b

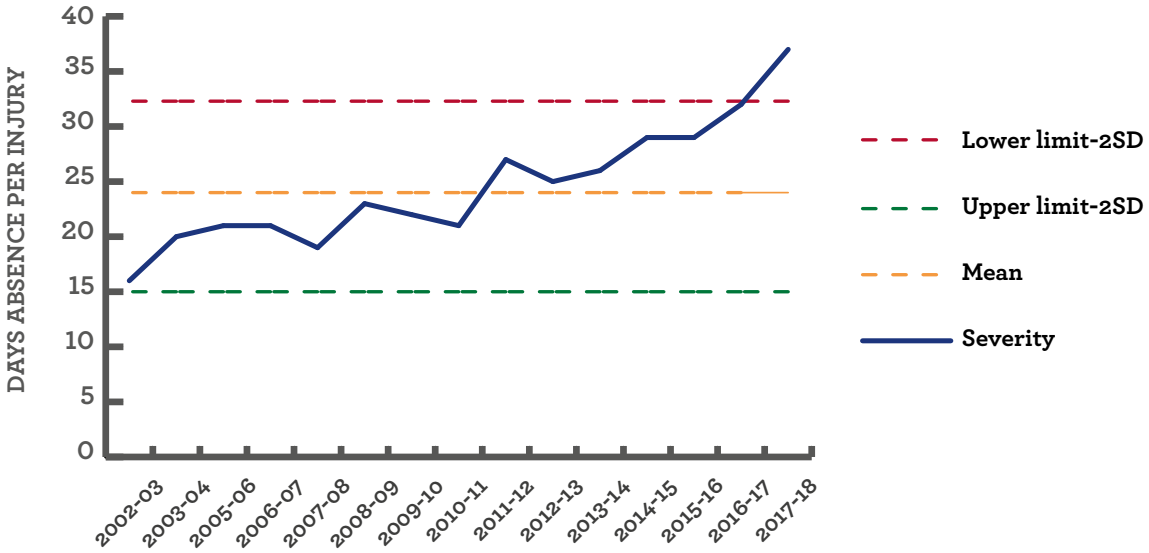

Figure 1b: Mean severity of match injuries over the surveillance period with mean ± 2 x standard deviation shown

Figure 1c

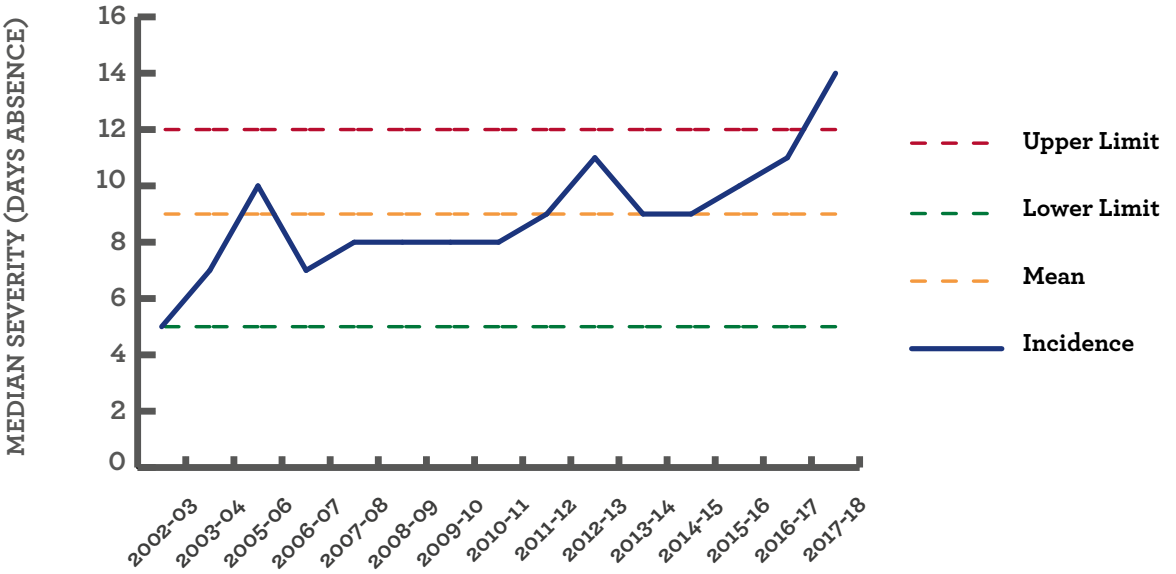

Figure 1c: Median severity of match injuries over the surveillance period with mean ± 2 x standard deviation shown.

Figure 1d

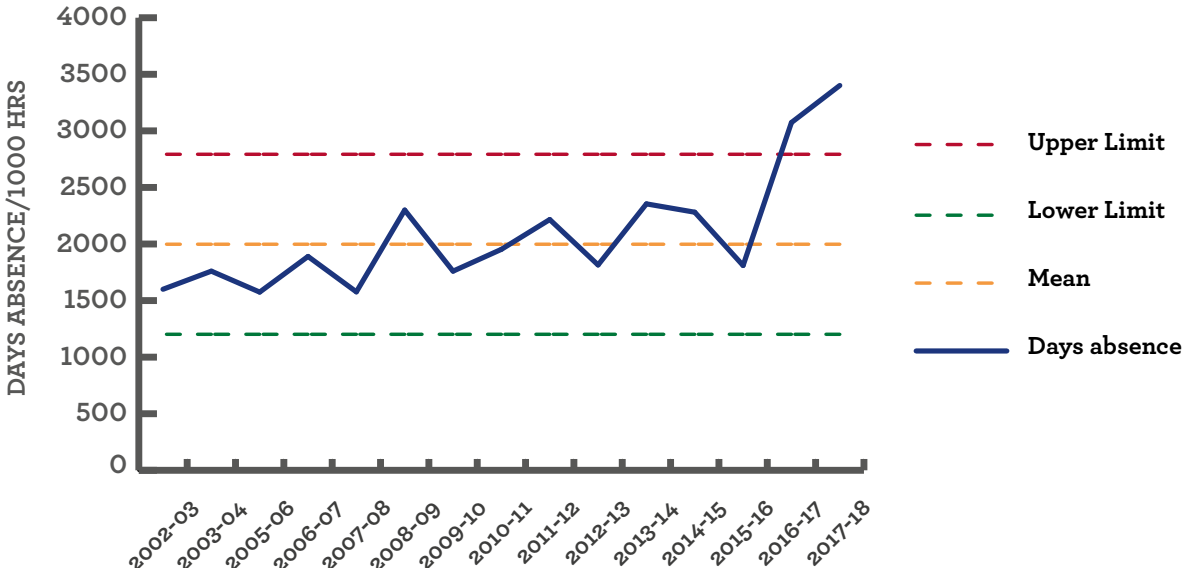

Figure 1d: Days absence per 1000 hours from match injuries over the surveillance period with mean ± 2 x standard deviation shown.

Table 1: Match injury incidence by severity grouping 2002-15 (95% CIs)

SEASON	INCIDENCE/ 1000 HRS				
	2-7 DAYS	8-28 DAYS	29-84DAYS	>84 DAYS	ALL
2002-03	57	30	9	3	100
2003-04	45	26	14	4	88
2005-06	29	29	13	3	75
2006-07	47	28	11	5	90
2007-08	39	30	10	4	83
2008-09	48	31	14	6	100
2009-10	36	29	10	4	80
2010-11	44	32	11	5	93
2011-12	34	28	13	7	82
2012-13	26	30	13	4	73
2013-14	38	33	14	6	91
2014-15	33	25	12	9	79
2015-16	23	24	11	5	62
2016-17	36	33	20	10	96
2017-18	28	32	19	12	92
MEAN (2002-17)	38 (37-39)	29 (28-30)	13 (12-14)	5 (4.6-5.4)	85 (83-87)

Greater than 7-day time-loss match injuries

Since the 2015-16 season, the incidence, severity and burden of greater than 7-day time loss injuries have been reported within the annual report. This not only allows for comparison between different sports but also between different levels of the game, for example, with the RFU Community Rugby Injury Surveillance Project (CRISP), which has a 7-day time-loss injury definition.

The incidence of greater than 7-days match injuries during the 2017-18 season was similar to that reported in 2016-17. This is substantially higher than the mean for the surveillance period as a whole (63 per 1000 hours vs 47 per 1000 hours) (Figure 1e). This rise corresponds with the sustained higher values associated with the three most severe injury categories outlined in Table 1. The severity of greater than 7-day injuries also rose above the expected limits of variation for a second consecutive season, with the figure reaching 51 days absence per injury during the 2017-18 season (Figure 1f). This figure represents 13 days more absence per injury than the mean for the surveillance period as a whole at 38 days. Figure 1g shows the overall burden of > 7-day match injuries, which for the 2017-18 season rose to 3213 days absence per 1000 hours, which is substantially higher than that of the mean for the entire study period (1781 days absence per 1000 hours).

Figure 1e

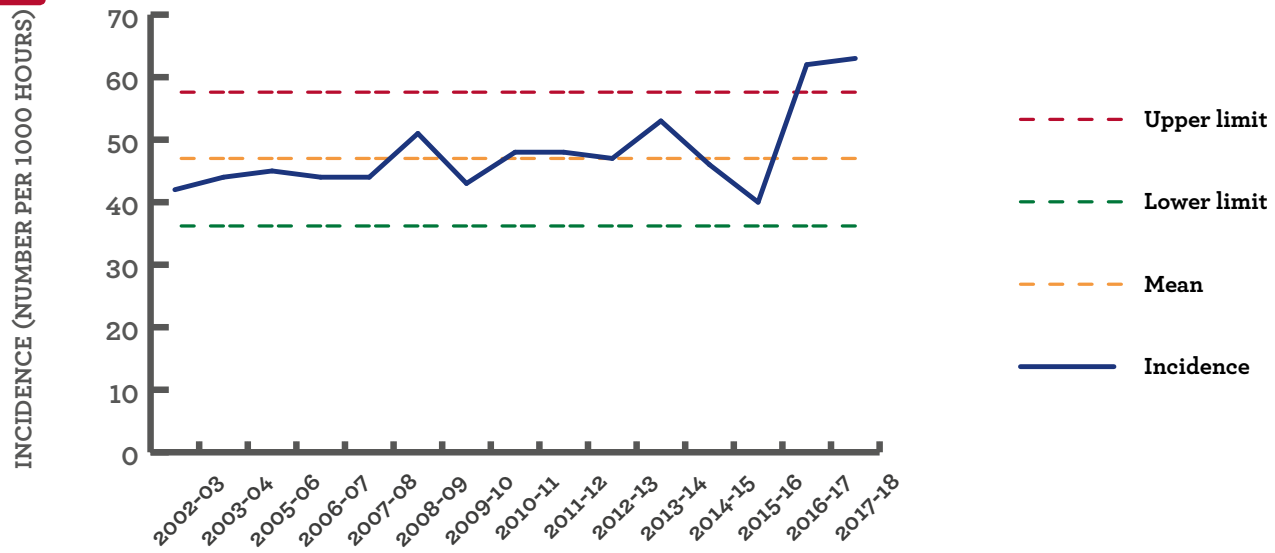

Figure 1e: Incidence rates of >7 day match injuries over the surveillance period with mean ± 2 x standard deviation shown.

Figure 1f

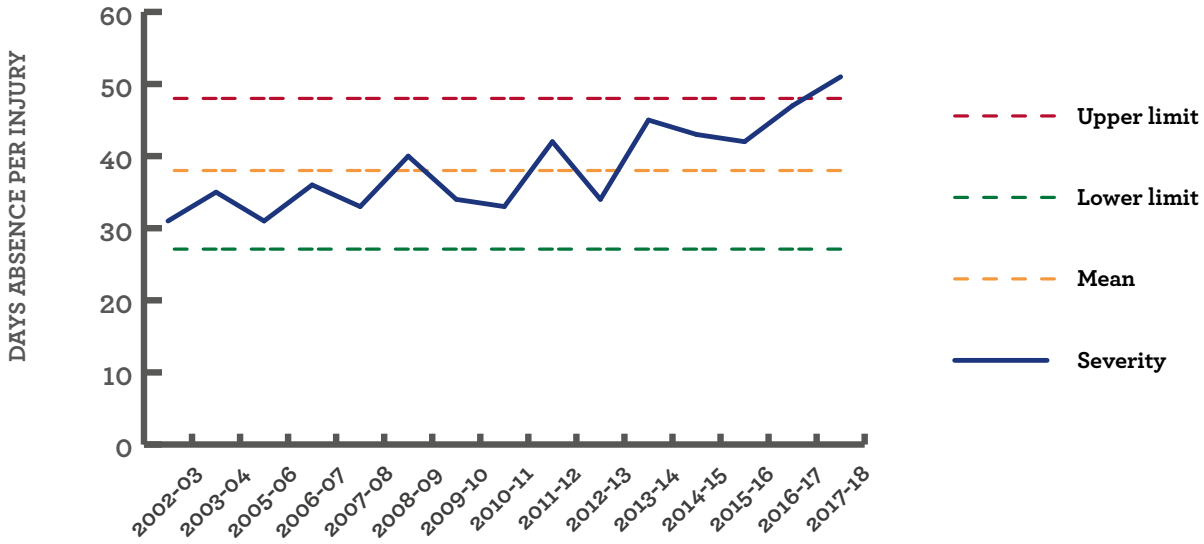

Figure 1f: Severity of >7 day match injuries over the surveillance period with mean ± 2 x standard deviation shown.

Figure 1g

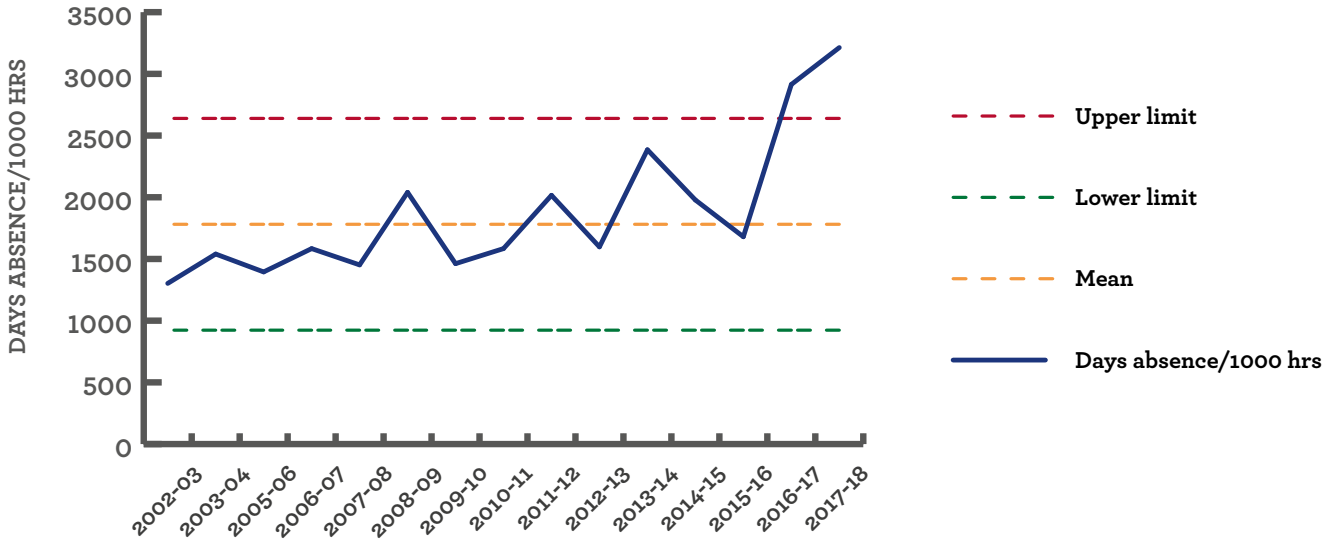

Figure 1g: Days absence per 1000 hours from >7 day match injuries over the surveillance period with mean ± 2 x standard deviation shown.

Training Injury Incidence, Severity & Burden

Summary of the training injury risk

A total of 438 training injuries (38% of the total injury count for 2017-18) that led to time lost from training and/or match play were reported for the 2017-18 season. This equated to a training injury incidence rate of 2.9 per 1000 hours or approximately 37 injuries per club per season (a season-by-season breakdown can be seen in Table S2). In practical terms, this means that a Premiership squad of 50 players could expect to sustain approximately three injuries every 20 hours of squad training. The incidence of training injuries remained stable and falls within the expected limits of variation (Figure 2a).

The severity of training injuries during the 2017-18 season was 37 days absence per injury (Figure 2b). This figure represents the highest reported severity recorded over the study period and is above the expected limits of variation. This is the third year whereby the severity of training injuries has exceeded the upper limit of variation and the fourth consecutive season where the value has exceeded the previous season. Further examination of the training injuries by severity grouping (Table 2) indicates that increasing values in the two most severe injury categories are responsible for this rise, with a figure of 0.66 per 1000 hours in the 29-84 day category (compared with an average of 0.39 per 1000 hours for the surveillance period) as well as a value of 0.35 per 1000 hours for the >84 day category (compared with an average of 0.14 per 1000 hours for the surveillance period). Unlike match injuries, the incidence of 2-7 day injuries remained stable during the 2017-18 season.

The burden of training injuries (Figure 2c) rose for the second consecutive season as a consequence of the rising severity and stable incidence value for the 2017-18 season. The rise to 106 days absence per 1000 hours during the 2017-18 season is substantially higher than the mean for the surveillance period (57 days absence per 1000 hours) and is above the upper limit of expected variation.

Figure 2a

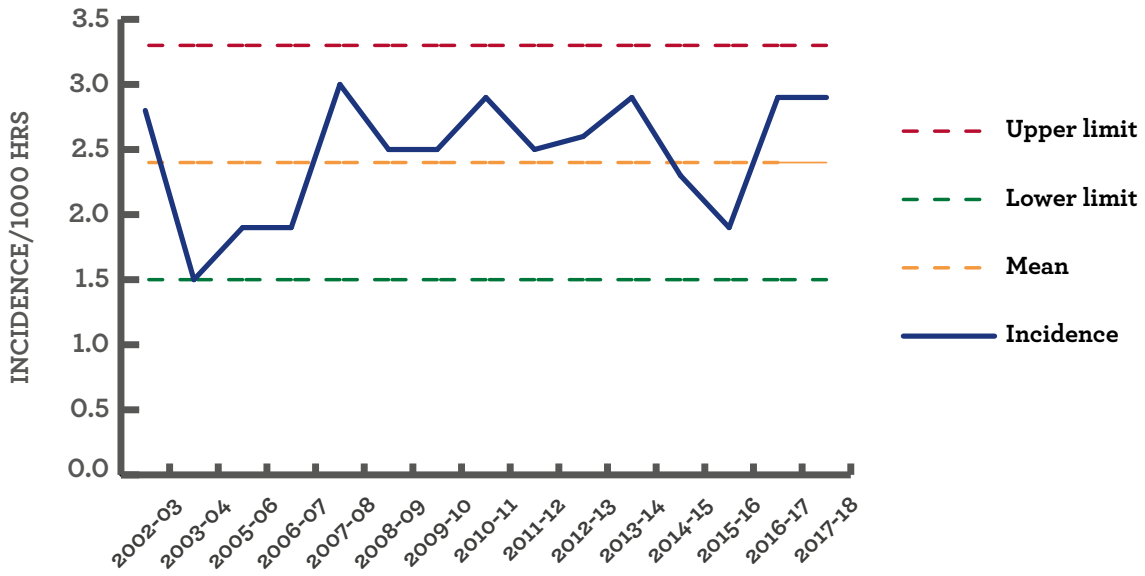

Figure 2a: Incidence rates of training injuries over the surveillance period with the mean ± 2 x standard deviation shown.

Figure 2b

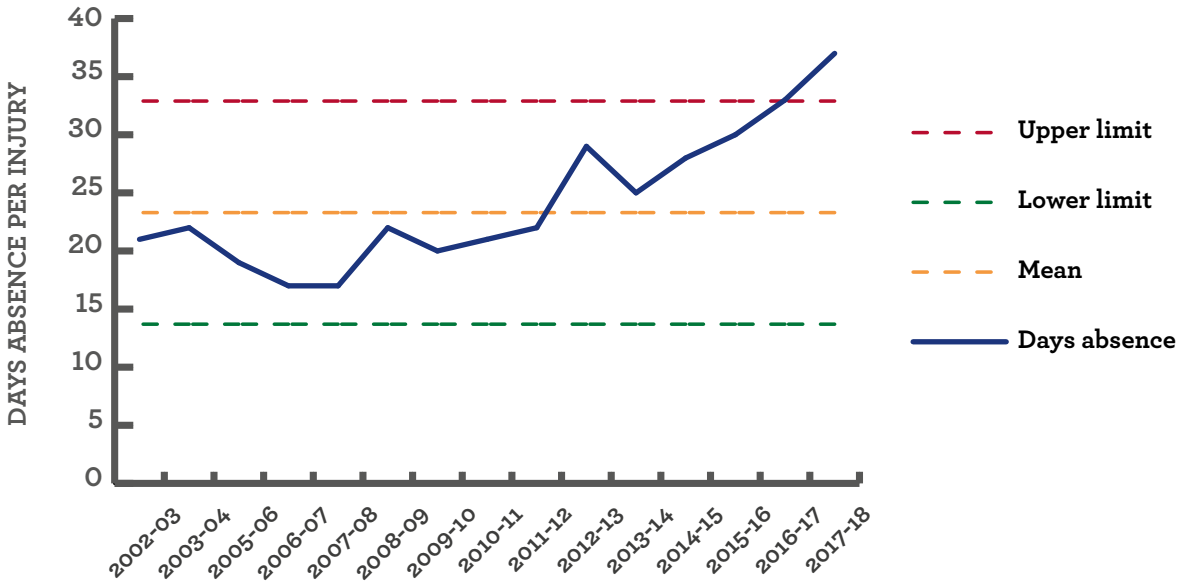

Figure 2b: Severity of training injuries over the surveillance period with mean ± 2 x standard deviation shown.

Figure 2c

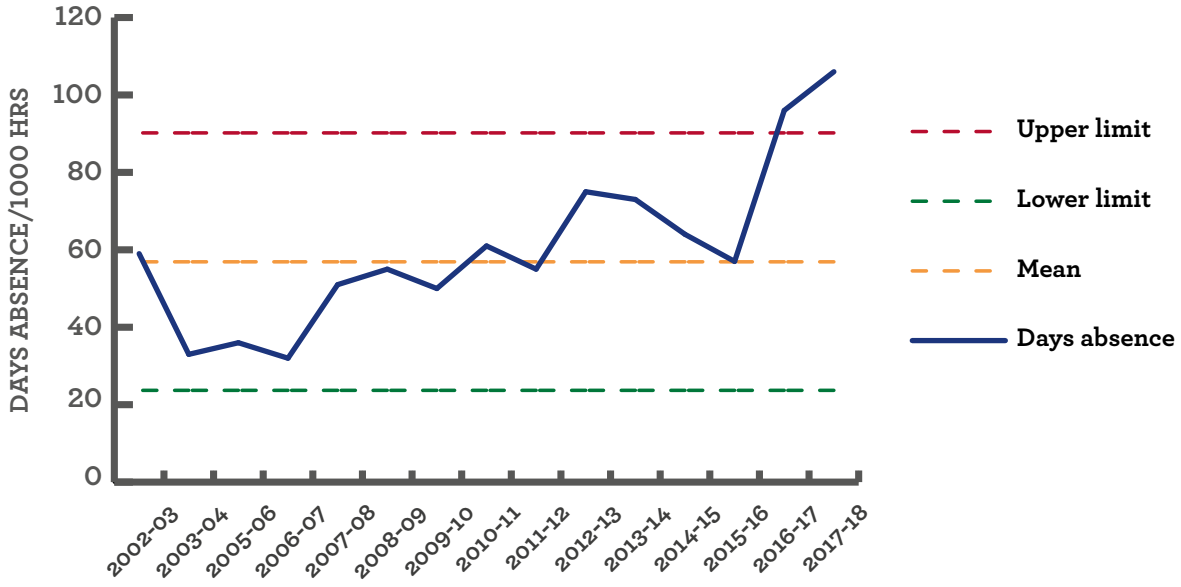

Figure 2c: Days absence per 1000 hours for training injuries over the surveillance period with mean ± 2 x standard deviation shown.

Figures S8 and S9 provide an overview of the three most common training injuries in the two highest severity categories and the associated average severity of those injuries. This data shows that the injuries within these higher severity groupings have remained similar since 2012. Calf and Hamstring injuries remain the two most common injuries in the 29-84 day category for the second consecutive season, with the appearance of meniscus injuries for the first time. In the greater than 84 day category, shoulder dislocations were the most common injuries during 2017-18 season, which was the first time they appeared in the list, while ACL and hamstring injuries made up the other two most common injuries in this category. As shoulder dislocation appears in both the match and training most common injuries in the greater than 84 day category for the first time, it is important to monitor this in the next season and investigate potential mechanisms for this injury, should it remain high.

Table 2: **Training injury incidence by severity grouping 2002-18 (95% CIs)**

SEASON	INCIDENCE/ 1000 HRS				
	2-7 DAYS	8-28 DAYS	29-84	>84	ALL
	DAYS	DAYS	DAYS	DAYS	
2002-03	1.13	1.29	0.42	0.18	3.02
2003-04	0.16	0.63	0.30	0.08	1.17
2005-06	1.04	0.70	0.35	0.10	2.19
2006-07	0.99	0.61	0.20	0.07	1.87
2007-08	1.26	1.08	0.38	0.07	2.79
2008-09	1.00	0.94	0.31	0.10	2.35
2009-10	1.09	0.89	0.34	0.07	2.39
2010-11	1.24	1.12	0.32	0.13	2.81
2011-12	0.87	0.97	0.30	0.14	2.28
2012-13	0.90	0.98	0.49	0.21	2.58
2013-14	0.94	1.25	0.52	0.18	2.89
2014-15	0.87	0.82	0.44	0.19	2.32
2015-16	0.47	0.86	0.43	0.14	1.90
2016-17	0.89	1.06	0.61	0.34	2.90
2017-18	1.00	0.87	0.66	0.35	2.88
MEAN (2002-17)	0.92 (0.87-0.97)	0.94 (0.90-0.99)	0.39 (0.36-0.42)	0.14 (0.12-0.16)	2.39 (2.32-2.46)

The incidence of greater than 7-day training injuries remained stable during the 2017-18 season at 1.9 per 1000 training hours. This figure is within the expected limits of variation, and compares with the mean for the surveillance period of 1.5 per 1000 hours (Figure 2d). The severity of greater than 7-day injuries rose for a second consecutive year during the 2017-18 season, with an average absence of 55 days per injury. This represents a value substantially higher than that of the surveillance mean at 36 days per injury and also exceeds the expected limits of variation (Figure 2e). Figure 2f shows the overall burden of greater than 7-day training injuries. Given the rise in severity above the expected limits of variation for the season and a stable incidence value, it follows that the burden for the 2017-18 has risen to 103 days absence per 1000 hours of training. This represents a value substantially higher than that of the mean for the surveillance period as a whole, which is 54 days absence per 1000 hours.

Figure 2d

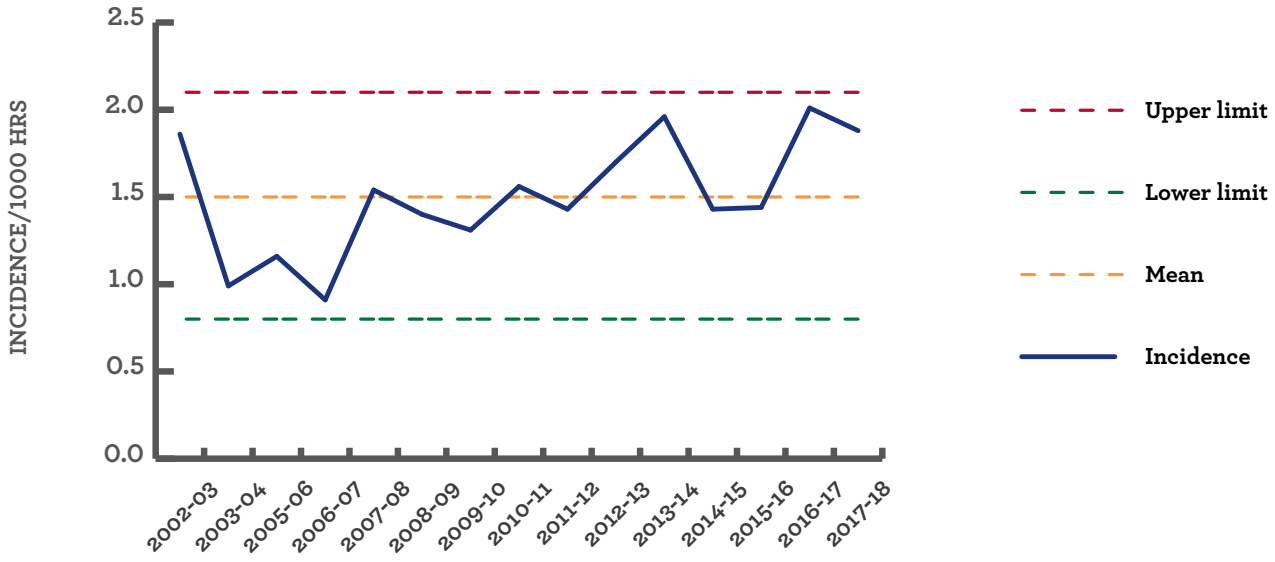

Figure 2d: Incidence rates of >7 day training injuries over the surveillance period with mean ± 2 x standard deviation shown.

Figure 2e

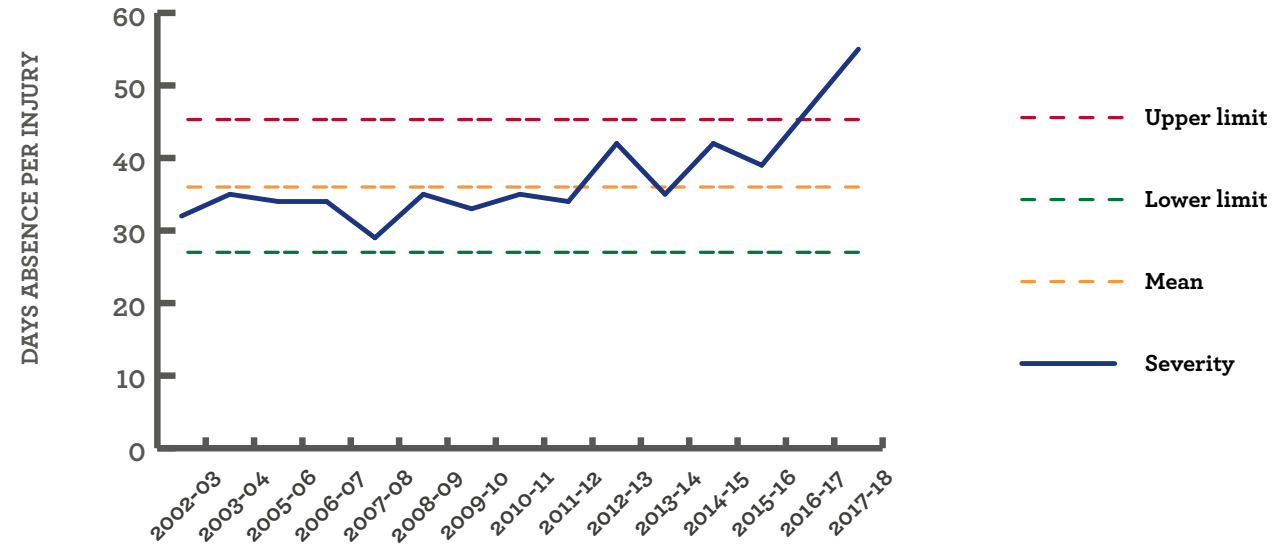

Figure 2e: Severity of >7 day training injuries over the surveillance period with mean ± 2 x standard deviation shown.

Figure 2f

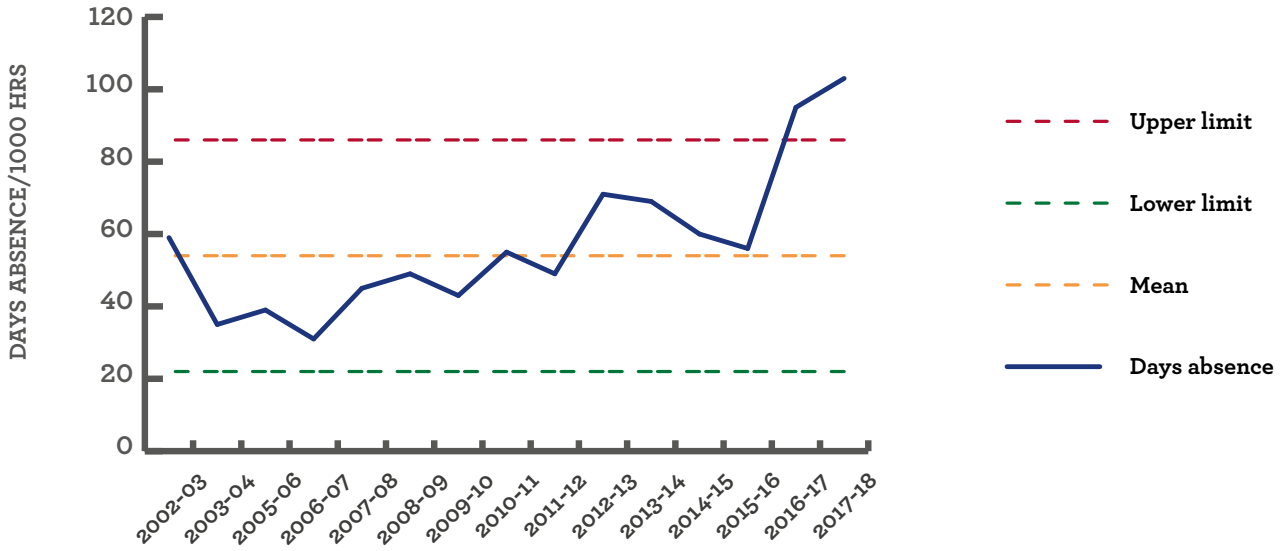

Figure 2f: Days absence per 1000 hours from >7 day training injuries over the surveillance period with mean ± 2 x standard deviation shown.

CONCUSSION

Prevalence, incidence, severity and burden

During the 2017-18 season, 140 match concussions were reported. These concussions were sustained in the following competitions: Premiership (98), European competition (18) and Anglo Welsh Cup (24). There were 32 reported training concussions (21 in the 2016-17 season), accounting for 19% of all reported concussions, with the remaining 81% of concussions attributed to match play. During the 2017-18 season, 16% of all consented players sustained at least one match concussion. Of the 16% with medically diagnosed concussions, 94 players suffered one concussion, 20 suffered two concussions and two players sustained three concussions. The RFU and Premiership Rugby currently recommend that a specialist neurological opinion should be sought for players following a second diagnosed concussion during a 12-month period.

For the first time since the 2009-10 season, the incidence of match concussions did not increase from the previous season (Figure 3). In 2017-18, the incidence of match concussion was 17.9 per 1000 hours of match play, compared with the 2016-17 figure of 20.9 per 1000 hours. While there was no rise in concussion, it is important to consider several potentially important reasons for this. Firstly, the small reduction in concussion incidence may be a one season drop in the rate as opposed to a meaningful deviation from the upwards trend; further seasons of data must be collected for this to be established. Secondly, it must be recognised that the small decrease in incidence is equivalent to one fewer concussion every eight games, and therefore the injury remains a top priority for the game as it continues to be the most commonly occurring and highest risk match injury. Finally, the 2017-18 season represented the first season since 2011 whereby the education of staff, players and other stakeholders as well as the operational definitions of concussion remained stable. In recent seasons the drive for education and the changing operational definition of concussion may have contributed to the rise in reported concussions. The 2018-19 season sees a development in this area with the introduction of Hawkeye concussion real-time video provision in the Premiership.

The mean severity of match concussions was 19 days for the 2017-18 season (Figure 4). This figure is seven days higher than the mean for the surveillance period of 12 days absence per concussion and is also marginally above the upper limit of expected season-to-season variation. Table 3 shows the incidence of concussion by severity groupings. From this table, it can be seen that a large amount of the rise in average severity during the 2017-18 season can be attributed to the increase in the incidence of a small number of concussions lasting greater than 84 days, which has also been the case for the past two seasons. Despite this substantial rise in average severity, Figure 5 shows that the median days absence experienced as a result of concussion remained stable for the 2017-18 season (9 days), suggesting that the severity of the majority of concussions has not substantially changed, but that the management of players with multiple concussions is more conservative.

When examining the number of days within which players return from concussion, it was reported that 39% had returned within seven days, 86% had returned by 28 days, 96% had returned by 84 days and 4% (six players) did not return within 84 days. Current graduated return to play guidelines after concussion dictates that players must not return to play in a period shorter than six days from the day of injury. For the 2017-18 season, no player returned to play sooner than six days, showing excellent compliance with the concussion return to play guidelines.

Figure 3

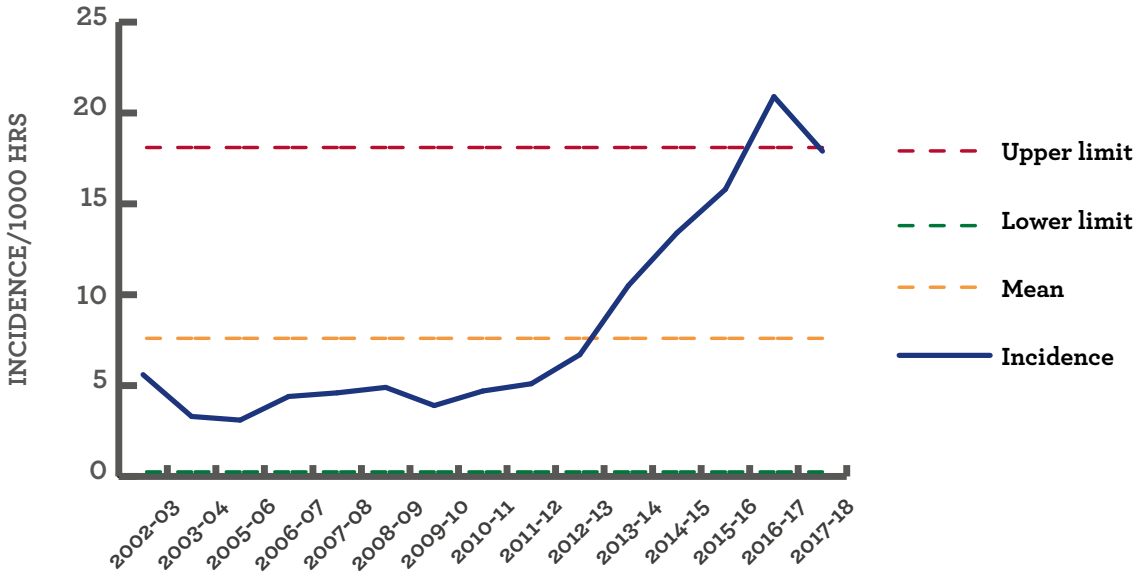

Figure 3: Incidence per 1000 player hours of reported match concussions by season with mean ± 2 standard deviations.

Figure 4

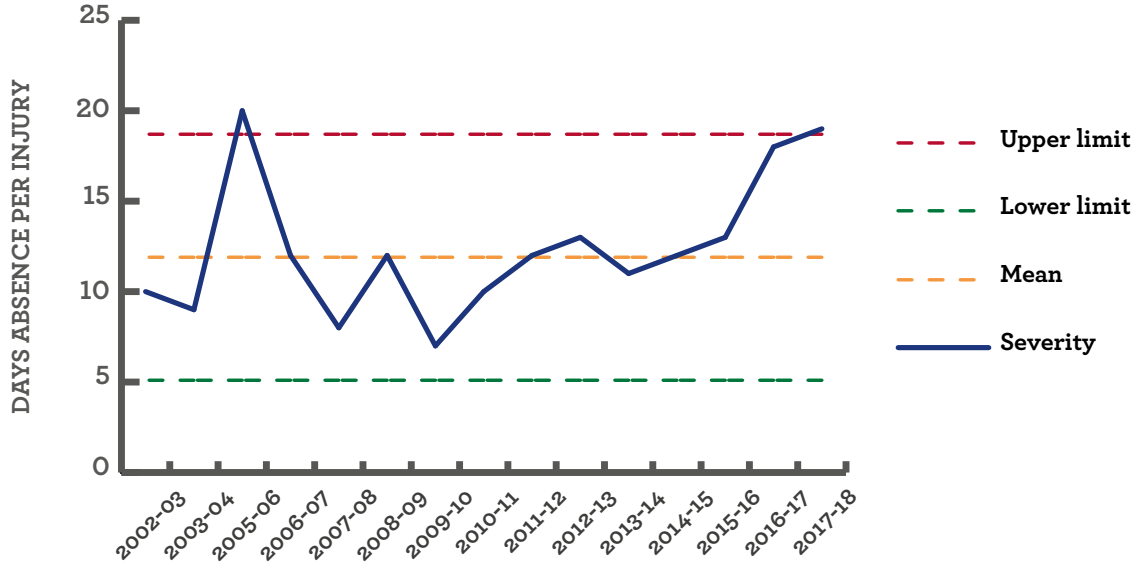

Figure 4: Mean severity (days absence) of reported match concussions by season with mean ± 2 standard deviations.

Table 3: Incidence of match concussion by severity grouping 2011-2017 (95% CIs)

SEASON	INCIDENCE/ 1000 HRS			
	2-7DAYS	8-28 DAYS	29-84 DAYS	>84 DAYS
2010-11	2.6	1.9	0.1	0.0
2011-12	2.5	2.3	0.4	0.0
2012-13	2.7	3.1	0.5	0.1
2013-14	5.0	4.8	0.5	0.0
2014-15	6.2	4.0	0.7	0.4
2015-16	7.3	7.1	1.3	0.1
2016-17	8.3	10.2	1.5	0.9
2017-18	6.9	8.5	1.8	0.8
MEAN 2010-18	4.9 (4.35-5.52)	4.8 (4.25-5.42)	0.7 (0.51-0.96)	0.2 (0.11-0.35)

Figure 5

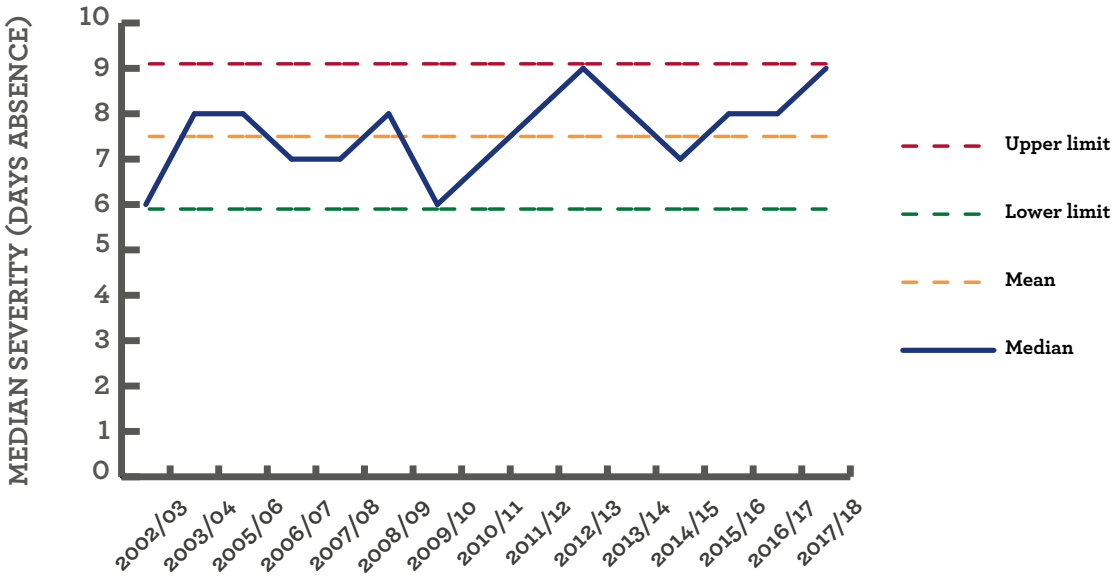

Figure 5: Median days absence per concussion over the surveillance period with mean ± 2 x standard deviation

Figure 6:

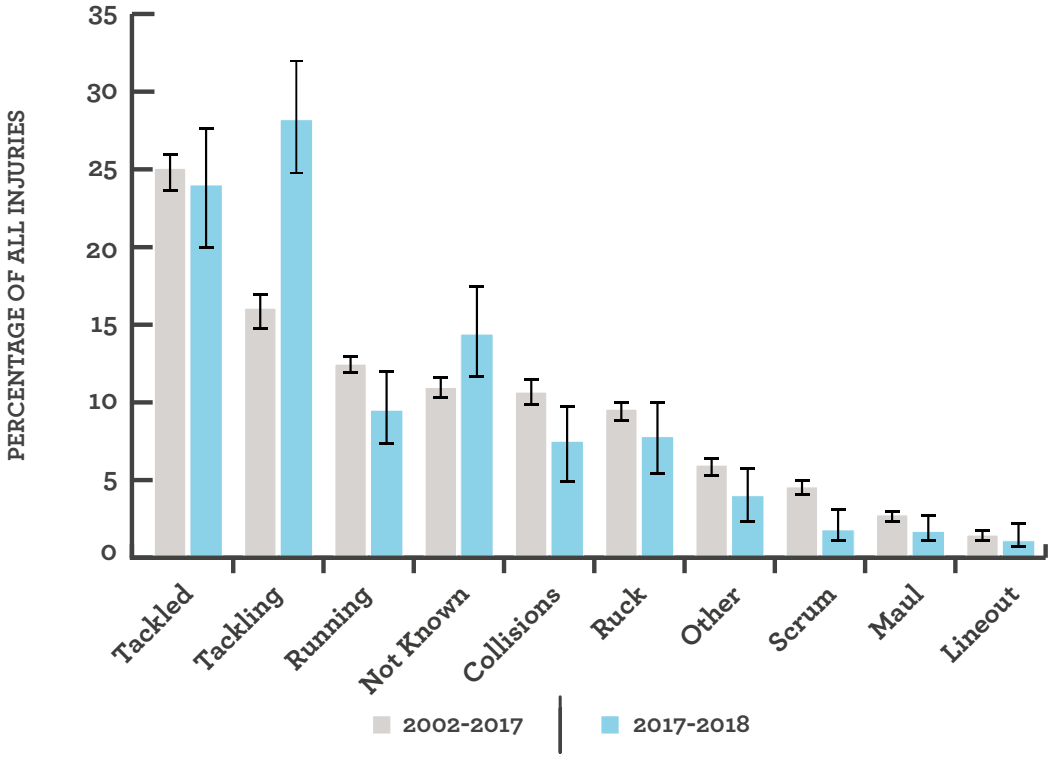

Figure 6: Percentages of match injuries by injury event. Error bars show 95% CIs.

Table 4: **The most common injuries as a result of tackling or being tackled. (Percentages are percentages of the 24% and 28% presented above, i.e. 18% of the 24% of all match injuries to the ball carrier are concussion)**

BALL CARRIER	TACKLER
CONCUSSION (18%)	CONCUSSION (37%)
QUAD HAEMATOMA (11%)	ACJ INJURY (6%)
MCL (8%)	RADIAL FRACTURE (2%)
ANKLE SYNDESMOSIS (7%)	HAMSTRING (2%)

Long term trends in the tackle.

For the first time during the 2017-18 season, the incidence of injuries to the tackler was greater than that of the ball carrier (Figure 7a). After relative stability in the rate of tackle injuries between 2002 and 2016, 2016-17 and 2017-18 have seen a rise in the rate of tackle injuries. Similarly, the severity of tackle related injuries has risen in the past two season to 38 days per injury for both the tackler and ball carrier, which is the second highest value recorded for tackle related injuries over the study period (Figure 7b). As a consequence of the higher incidence, the burden of injuries to the tackler was greater than that of the ball carrier during the 2017-18 season (989 vs 830 days absence per 1000 hours), however this was not significantly different (Figure 7c).

Figure 7a

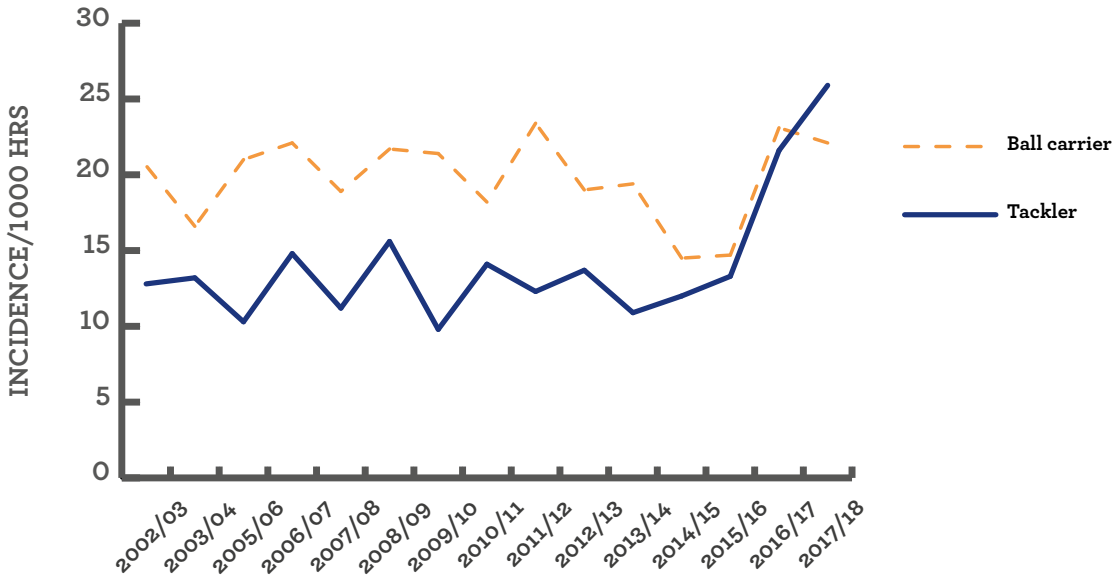

Figure 7a: Incidence of tackle related injuries 2002 to 2018. Solid blue line represents the tackler while the dashed line represents injuries to the ball carrier in the tackle.

Figure 7b

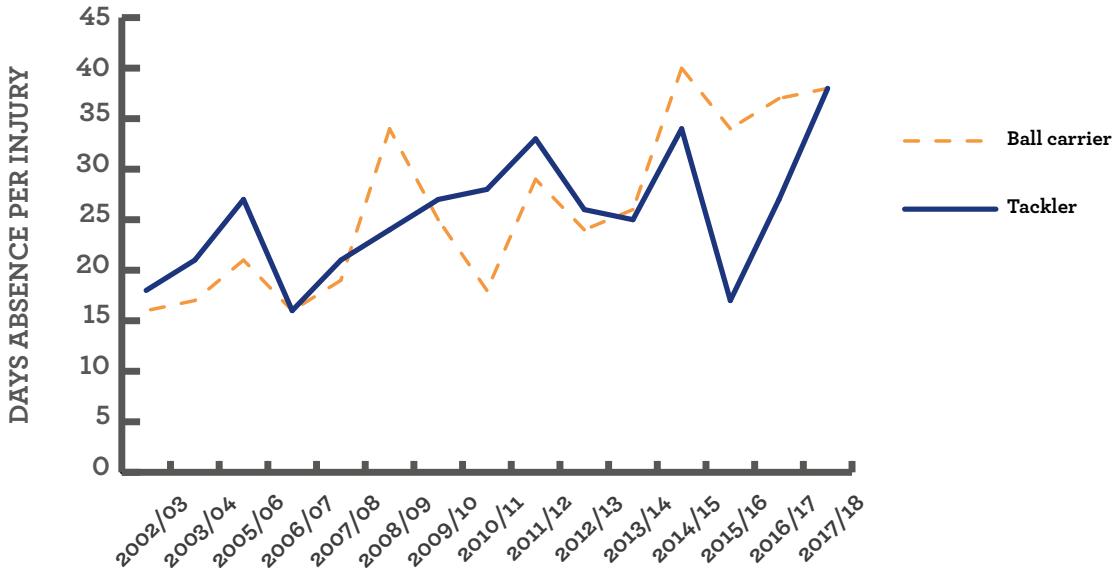

Figure 7b: Severity of tackle related injuries 2002 to 2018. Solid black line represents the tackler while the dashed line represents injuries to the ball carrier in the tackle.

Figure 7c

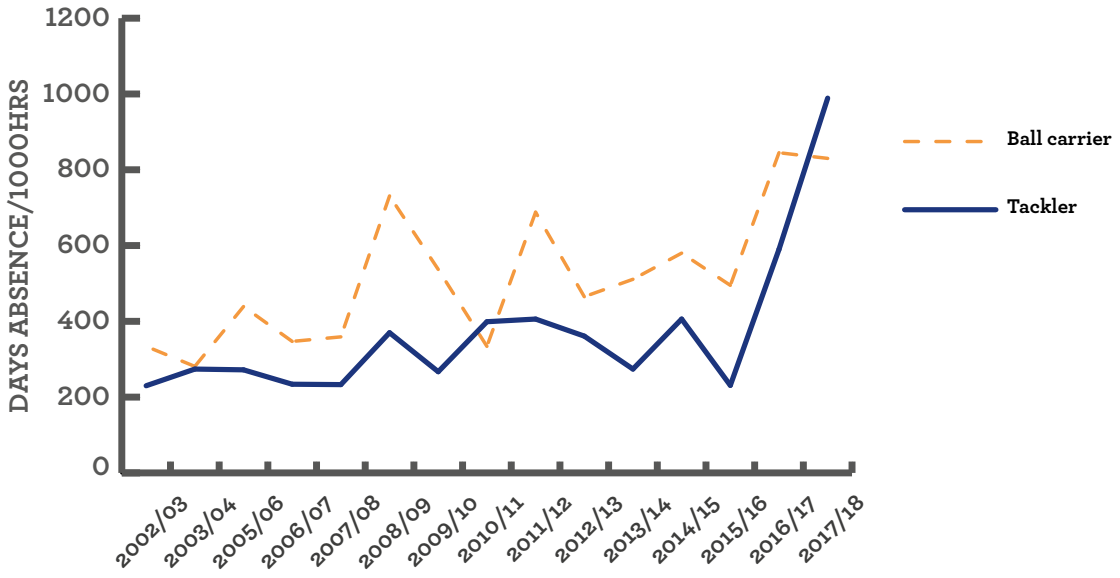

Figure 7c: Burden of tackle related injuries 2002 to 2018. Solid black line represents the tackler while the dashed line represents injuries to the ball carrier in the tackle.

When considering a match event such as the tackle, calculating a rate per 1000 events (propensity for injury) provides additional information over and above incidence. Data from OPTA (https://optaprorugby.com/) indicates that since the 2013-14 season, there has been an incremental increase in the number of tackles in matches, with 9%, 2%, 5% and 18% rises seen each season. Across European, National Cup and Premiership fixtures each team made an average of 102 tackles in 2013-14 compared with 139 tackles in 2017-18 (Figure 7d). Figure 8e reports the propensity of tackle related injuries between 2013 and 2018, with a mean propensity of 5.7 injuries per 1000 tackles. In the 2017-18 season the propensity of tackle injuries was 6.3 injuries per 1000 tackles (Figure 7e). This rate of injury is comparable with that of previous work, which reported the propensity of injuries in the tackle as 6.1 per 1000 tackles (Fuller 2007). By looking at the average tackles per game as well as the propensity for injury, it appears that the rise in risk in the 2016-17 season was due to a rise in the propensity for injury whereas the rise in 2017-18 was due to an increase in the number of tackles per match.

Figure 7d:

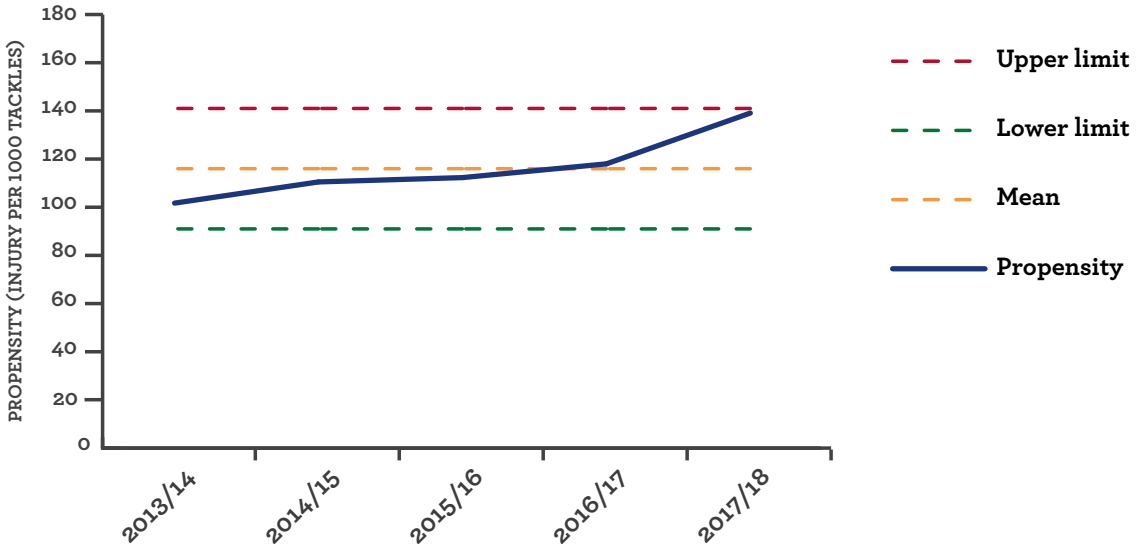

Figure 7d: Average number of tackles per match 2013-4 to 2017-18.

Figure 7e:

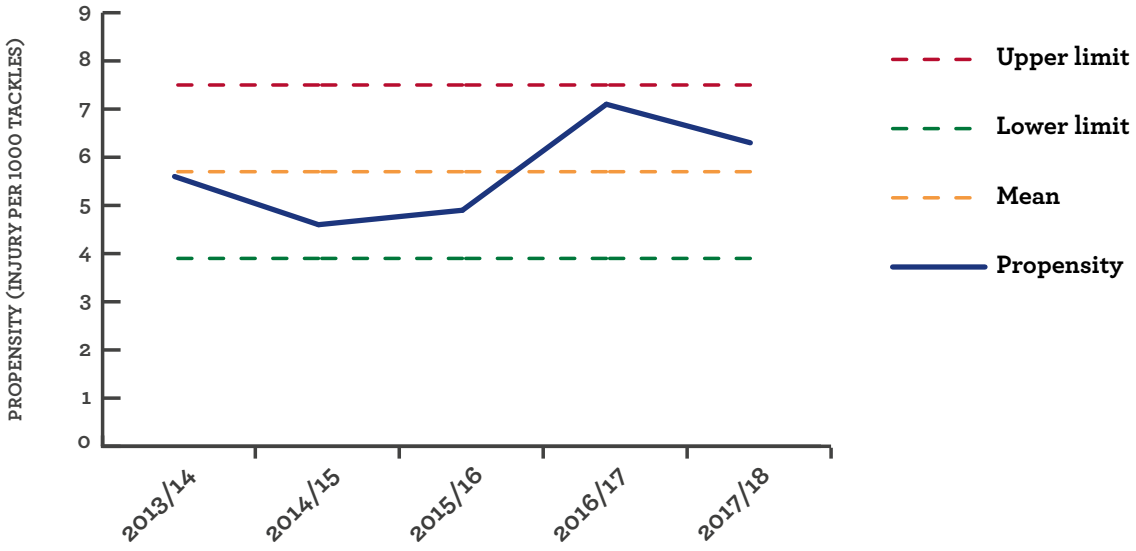

Figure 7e: Propensity of tackle injuries: number of injuries per 1000 tackles. 2013-14 to 2017-18.

Given that the tackle is associated with a high proportion of injuries in rugby union, there has been a focus on finding ways to reduce the risk of injuries in the tackle, and in particular trying to reduce the risk of concussion. In two studies examining head injury risk in the tackle, active shoulder tackles, front on tackles, and high-speed tackles (Tucker et al, 2017) and accelerating players, high tackler speed, head contact type and tackle type (Cross et al, 2017) were all found to increase the risk of head injury. As a result of this work, changes to the sanctions for high tackles were made, with an increase in the sanctions for reckless and accidental challenges above the line of the shoulders. It is hoped that with consistent application of the laws by officials and behavioural changes by the players that the risk of injury as a result of the tackle may decrease.

Further to this, other law trials are being tested in both the Junior World Trophy as well as the Championship Cup. In the Junior World Trophy a post-game review process of high tackles and a warning system was trialled to try to influence player behaviour and to reduce the occurrence of these dangerous tackles. In the 2018-19 Championship Cup, the legal height of the tackle is being lowered to the armpit line in an effort to reduce the head injuries in both ball carriers and tacklers. The outcome of these trials will be reported when they are complete.

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1. Fuller, C.W., Brooks, J.H., Cancea, R.J., Hall, J. & Kemp, S.P.T. 2007. Contact events in rugby union and their propensity to cause injury. British Journal of Sports Medicine. 41 (12) 862-867.

2. Tucker, R., Raftery, M., Kemp, S.P.T., Brown, J., Fuller, G.W., Hester, B., Cross, M.J. & Quarrie, K. 2017. Risk factors for head injury events in professional rugby union: a video analysis of 464 head injury events to inform proposed injury prevention strategies. British Journal of Sports Medicine. Doi: 10.1136/bjsports-2017-097895. [Epub ahead of print]

3. Cross, M.J., Tucker, R., Raftery, M., Hester, B., Williams, S., Stokes, K., Ranson, C., Mathema, P. & Kemp, S.P.T. 2017. Tackling Concussion in professional rugby union: a case-control study of tackle-based risk factors and recommendations for primary prevention. British Journal of Sports Medicine. Doi: 10.1136/bjsports-2017-097912 [Epub ahead of print]

TIME IN THE SEASON

During the 2017-18 season, most match injuries occurred in September with 115 injuries occurring across the 12 clubs. The month also represented the highest incidence of injury with an incidence of 120 per 1000 hours (Figure 8). Figure 9 presents the training incidence by month across the season and shows June to have the highest incidence at 4.3 per 1000 hours, although this reflects a period with a relatively small amount of exposure and a total of 23 injuries. In comparison, July accounts for the highest number of training injuries, with 71 reported at an incidence of 3.6 per 1000 hours.

Figure 8:

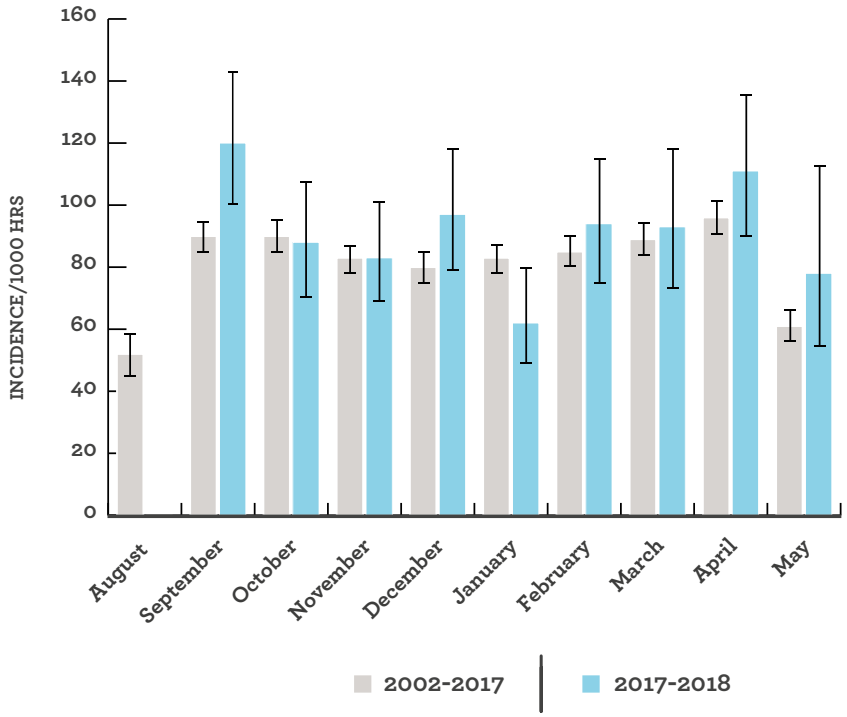

Figure 8: Match injury incidence by month. Error bars show 95% CIs.

Figure 9:

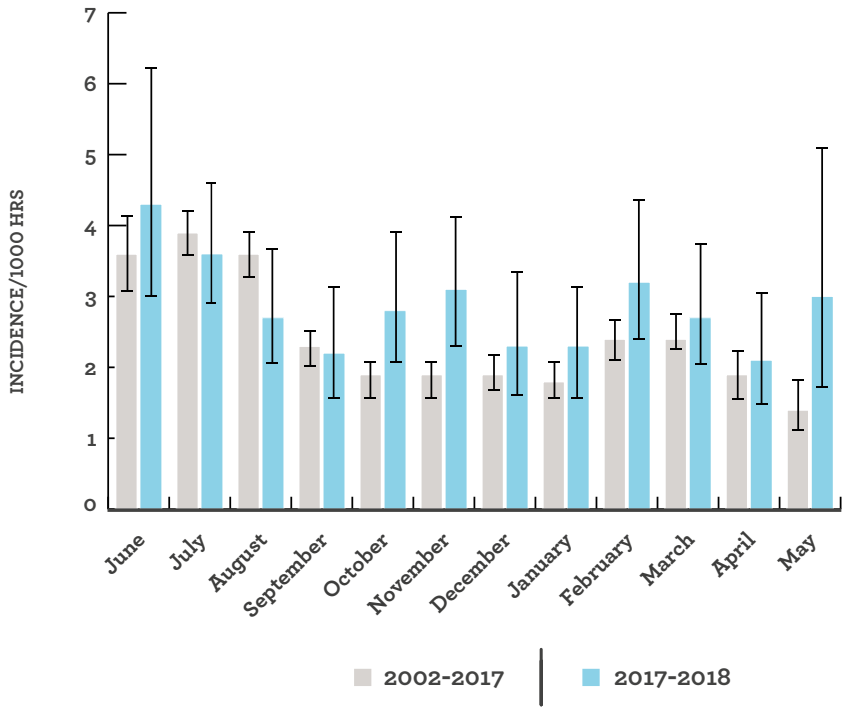

Figure 9: Training injury incidence by month. Error bars show 95% CIs

INJURIES LEADING TO RETIREMENT

The Injury Surveillance Steering Group would like to thank the Rugby Players' Association (RPA) for its assistance with compiling data on players who retired as a result of injury or illness.

Since 2013-14 the injury surveillance report has published the number of players who have retired with injury or illness being cited as the reason for retirement. In 2017-18, 10 players retired as a result of injury (Table 5).

The injuries, which led to players retiring from the sport, were sustained at the following body locations:

LOWER LIMB	3
THORACIC AND LUMBER SPINE	0
TRUNK	0
UPPER LIMB	3
HEAD/NECK	4

Table 5: **Number of retired players through injury and illness, 2013-18.**

SEASON	NUMBER RETIRED THROUGH ILLNESS	NUMBER RETIRED THROUGH INJURY
2013-14	2	23
2014-15	1	11
2015-16	1	10
2016-17	0	19
2017-18	0	10

INJURIES AT THE SCRUM

The 2013-14 season saw the introduction of a new scrum engagement sequence ("crouch, bind, and set"). The 2013-14 annual report presented the first season of data regarding the incidence of injury at the scrum and highlighted the importance of continued monitoring of injury rates in future seasons to understand the impact of this change upon acute injury risk. The new scrum engagement process has been shown in previously published research to reduce the impact force at engagement by approximately 20% and improve the stability of the scrum, thus hopefully leading to a reduction in chronic and catastrophic injuries caused by scrummaging. Further longitudinal research is required to ascertain the full impact of this law variation.

During the 2017-18 season, 13 injuries were attributed to the scrum, resulting in an incidence of 1.7 per 1000 hours. Combining these figures for scrum related injuries with those of previous seasons results in an incidence of 2.6 per 1000 hours (95% CIs: 2.1-3.2) for the period 2013-18 compared to that of the pre-law change incidence of 4.3 per 1000 hours (95% CIs: 3.8-4.9) (Figure 10). These figures highlight the significant reduction in the risk of scrum related injuries since the introduction of the new scrum engagement process. The average severity of injuries for scrum related injuries was 75 days for the 2017-18 season, which was higher than the overall average of match injuries and scrum-related injuries during the 2016-17 season (42 days absence). The most common injury type encountered at the scrum was medial gastrocnemius strains (n=3). The burden of scrum injuries in 2017-18 was 128 days per 1000 hours, which is higher than that of the 2016-17 season at 89 days per 1000 hours.

Figure 10:

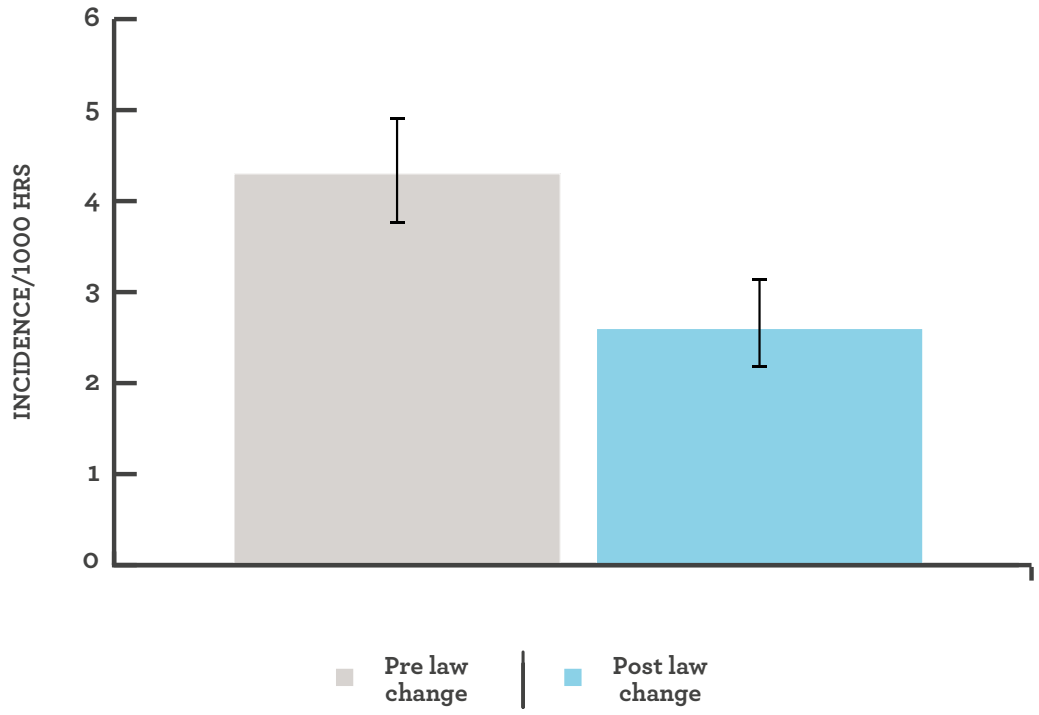

Figure 10: Incidence per 1000 player hours of match injuries associated with the scrum with 95% CIs

ARTIFICAL TURF

The RFU, Premiership Rugby and the RPA first commissioned a study to investigate the impact of artificial playing surfaces in this setting during the 2012/13 season, when the first artificial surface for match play was installed in the English Premiership (three English Premiership teams now play their home fixtures on artificial playing surfaces). The 2014-15 report provided a summary of the key findings from that study, showing no clear differences in the incidence severity or overall injury burden of time loss match injuries. The 2014-15 report also highlighted the need for investigation into the impact of training of artificial turf. The 2015-16 report, outlined the first season of surveillance of training exposure on artificial turf. This report provides an injury update on for the 2017-18 season for both matches and training on both natural grass and artificial turf.

Match Injuries:

During the 2017-18 season, 542 injuries were recorded for match play on grass and 175 injuries for match play on artificial turf. With fewer teams using artificial turf than natural grass at their home venue, the exposure to this surface was also lower than that for grass resulting in match injury incidences of 88 per 1000 hours (95% CIs: 81-96) for grass and 93 per 1000 hours (95% CIs 80-108) for artificial turf (Figure 11). The average severity for match injuries on grass was 35 days, compared with 42 days for artificial turf (Figure 12). The burden of injuries on natural grass was 3079 days per 1000 hours compared with 3881 per 1000 days on artificial turf (Figure 13) during the 2017-18 season. The figures for the 2017-18 season show no significant difference in the incidence, severity or burden of match injuries between surfaces.

Figure 11:

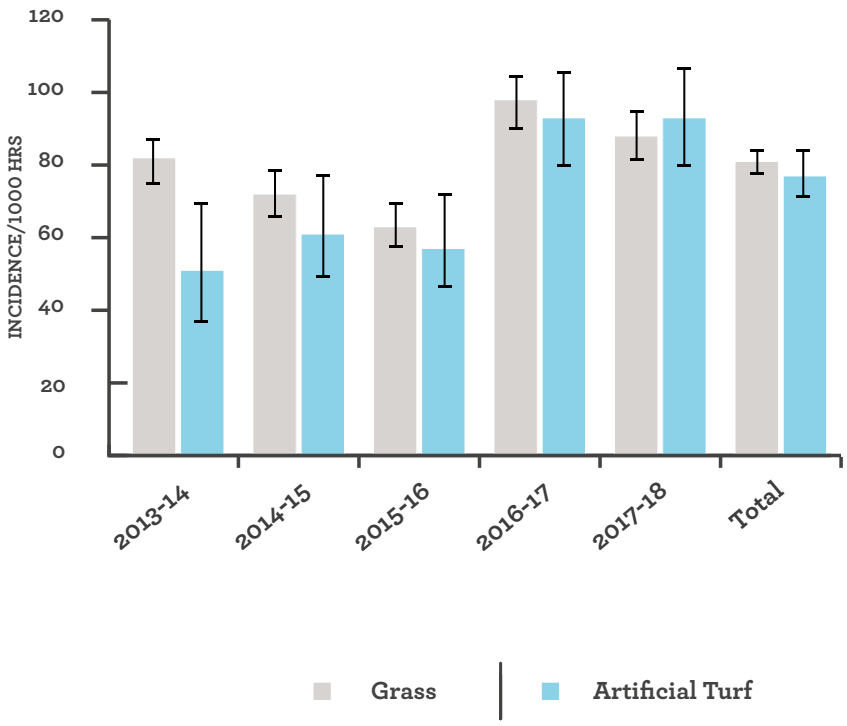

Figure 16: Incidence per 1000 player hours of match injuries on natural grass vs artificial turf with 95% CI's.

Figure 12:

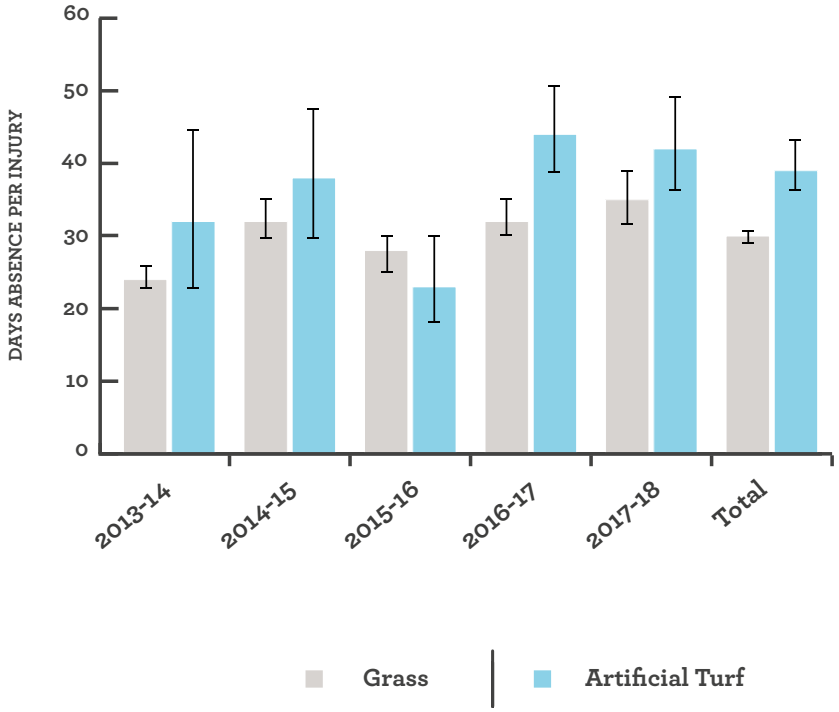

Figure 12: Mean severity (days absence) of match injuries on natural grass vs artificial turf with 95% CIs

Figure 13:

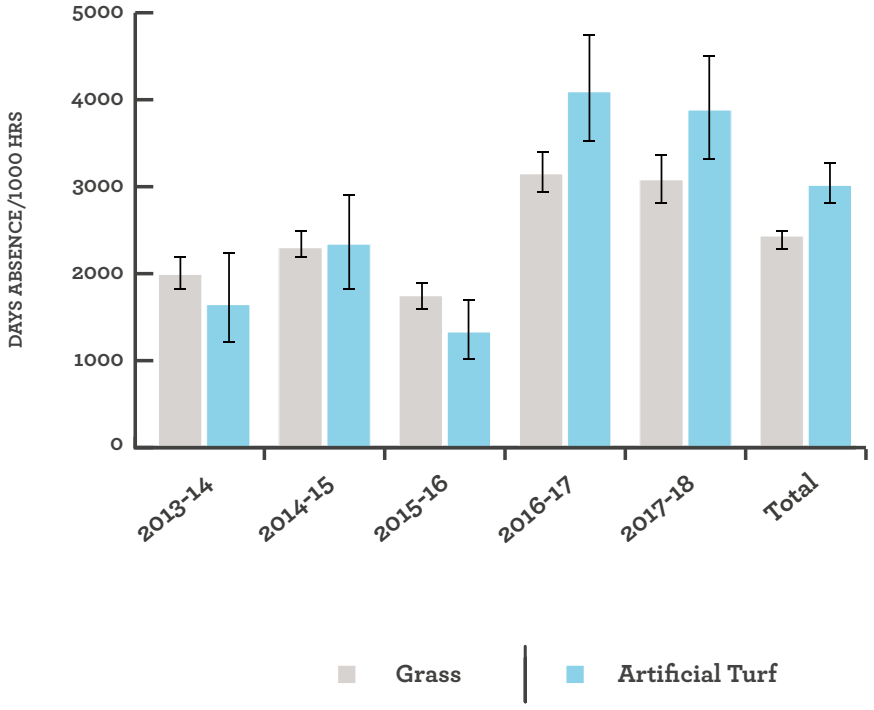

Figure 13: Days absence per 1000 hours of match injuries on natural grass vs artificial turf with 95% CIs

Five seasons of artificial turf data, where are we now?

Combining the data collected for the past five seasons, the incidence of injuries on natural grass and artificial turf are not different (Table 6). However, the severity of injuries on artificial turf is greater than that on natural grass, with an injury sustained on artificial turf lasting, on average, nine days more than one sustained on natural grass (natural grass, 30 days; artificial turf, 39 days). Consequently, the burden of injuries on artificial turf pitches is higher than those on natural grass (natural grass, 2433 days absence per 1000 hours; artificial turf 3015 days absence per 1000 hours).

Table 6: **Summary data for natural grass compared with artificial turf over five seasons (95% CIs)**

	NUMBER OF INJURIES	MATCH EXPOSURE (HOURS)	INCIDENCE (NUMBER PER 1000 HOURS)	SEVERITY (DAYS ABSENCE PER INJURY)	BURDEN (DAYS ABSENCE PER 1000 HOURS)
NATURAL GRASS	2646	32848	81 (78-84)	30 (29-31)	2433 (2342-2527)
ARTIFICIAL TURF	525	6800	77 (81-84)	39 (36-43)	3015 (2768-3285)

After five seasons it is also possible to describe the pattern of injuries on different playing surfaces in more detail. The incidence of injury was not different for any specific body region (Figure 14), but both severity (Figure 15) and burden (Figure 16) were greater for the lower limb on artificial turf compared with natural grass. Average severity for injuries to the lower limb on natural grass was 37 days compared with 50 days for injuries on artificial turf. Given that some lower limb injuries may be influenced by the traction between a player's boots and the pitch surface, with increased traction on artificial turf compared with natural grass under some conditions, this might contribute to the higher severity of lower limb injuries observed.

Figure 14:

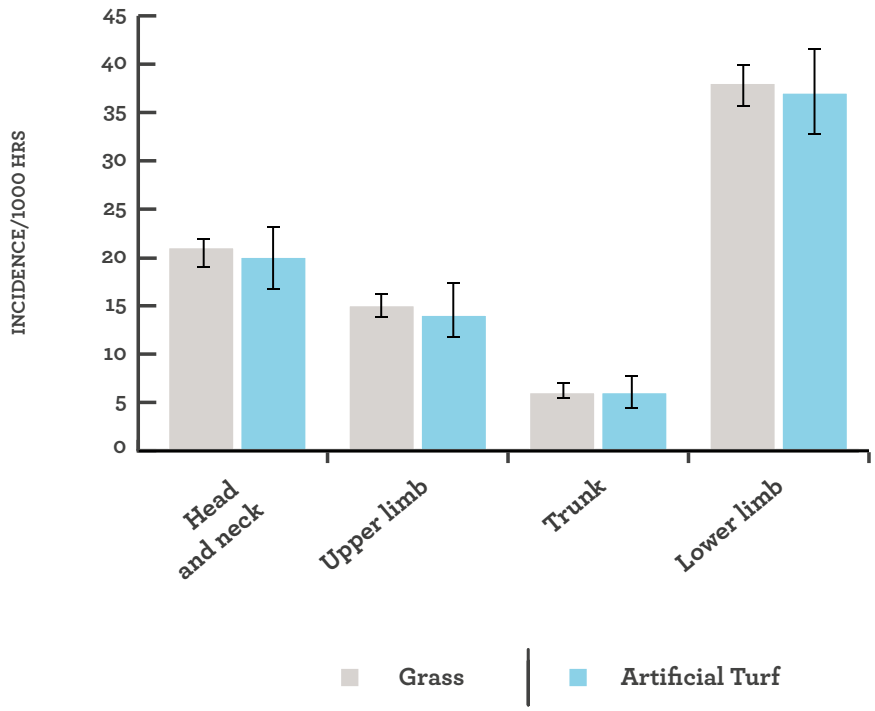

Figure 14: Incidence per 1000 player hours of match injuries by body region on natural grass vs artificial turf with 95% CIs

Figure 15:

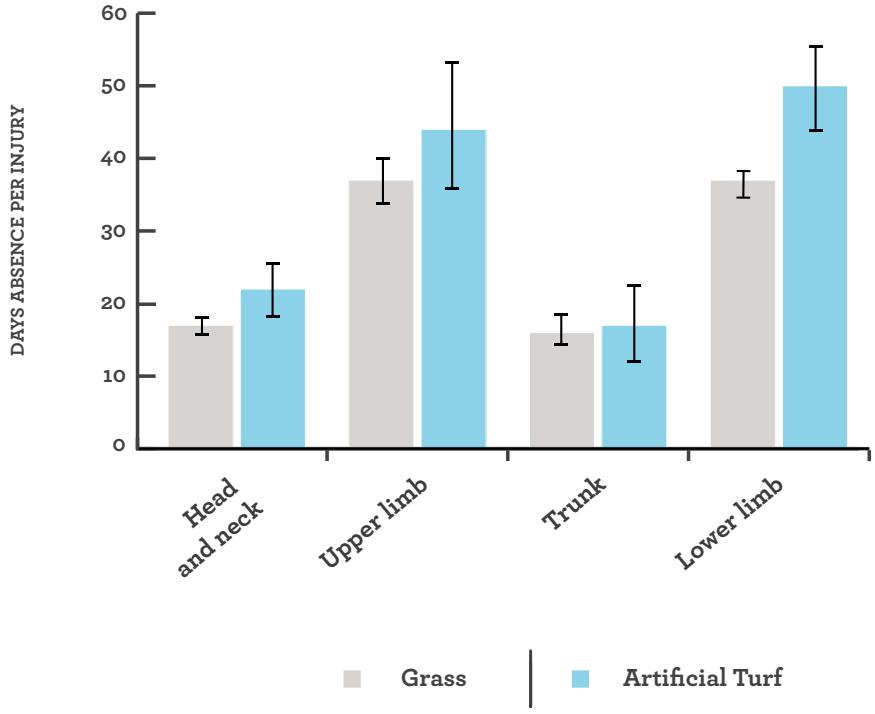

Figure 15: Mean severity (days absence) of match injuries by body region on natural grass vs artificial turf with 95% CIs

Figure 16:

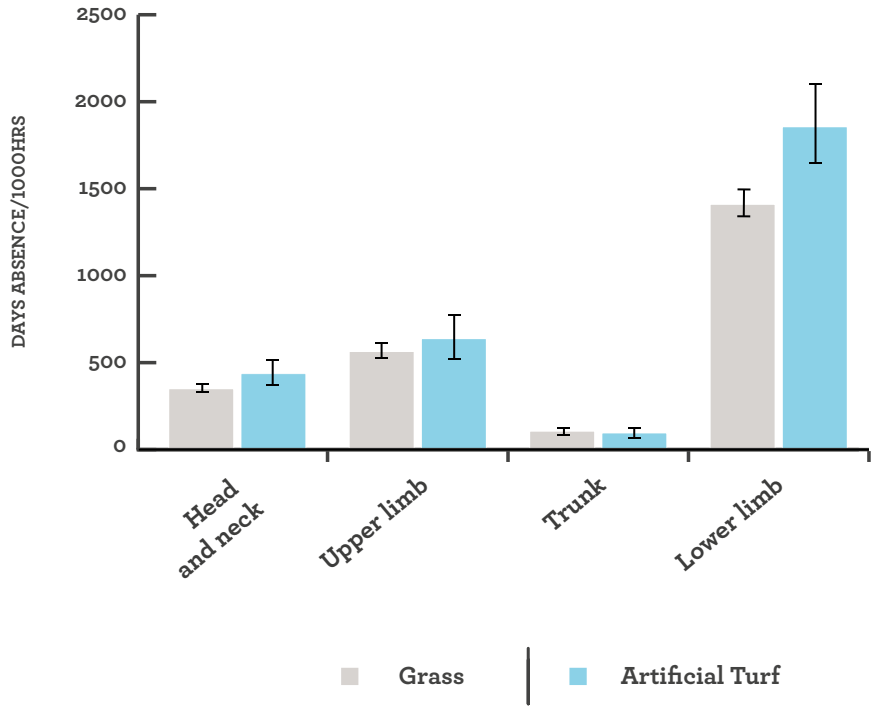

Figure 16: Days absence per 1000 hours of match injuries on natural grass vs artificial turf with 95% CIs

Similarly, when considering specific injury location, the incidence of injury did not differ between pitch surfaces (Figure 17). However, on artificial turf there was a greater severity of injuries to the posterior thigh (natural grass, 23 days; artificial turf, 46 days), foot/toe (natural grass, 10 days; artificial turf, 91 days) and neck/cervical spine (natural grass, 16 days; artificial turf, 43 days), resulting in a greater burden of injury on artificial turf at these injury sites (Figure 18 & 19). Severity was also higher on artificial turf for upper arm, but there were only eight of these injuries over the five-season period, meaning that one or two injuries had an exaggerated effect on severity values. Specifically focussing on foot/toe injuries, there were only 25 injuries on artificial turf over the five-season period, but the difference in severity of these injuries on the two surfaces warrants further investigation to determine whether, for example, choice of boots / stud configuration might impact these injuries.

Figure 17:

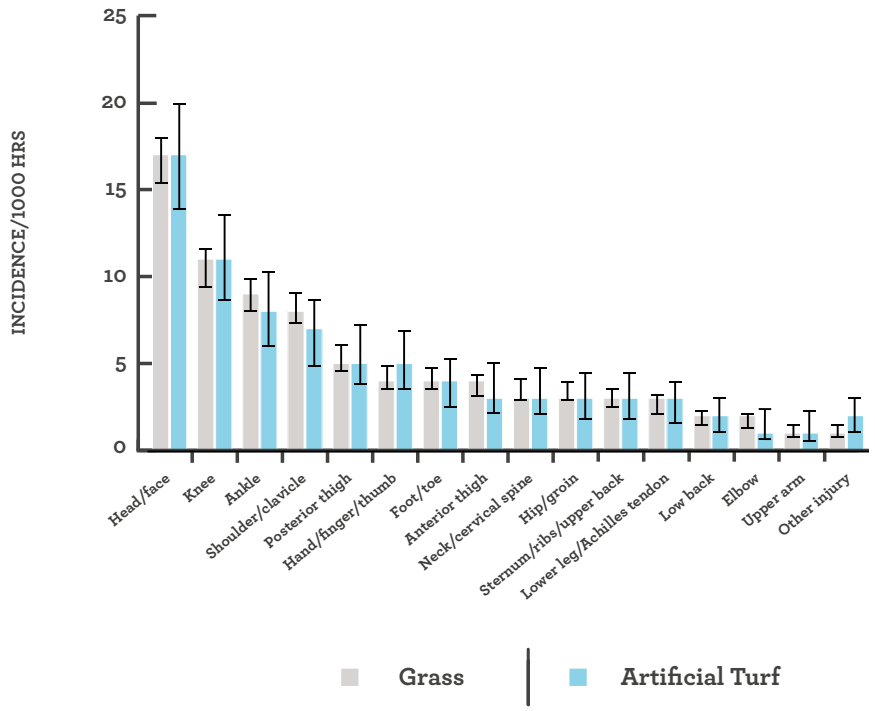

Figure 17: Incidence per 1000 player hours of match injuries by specific location on natural grass vs artificial turf with 95% CIs

Figure 18:

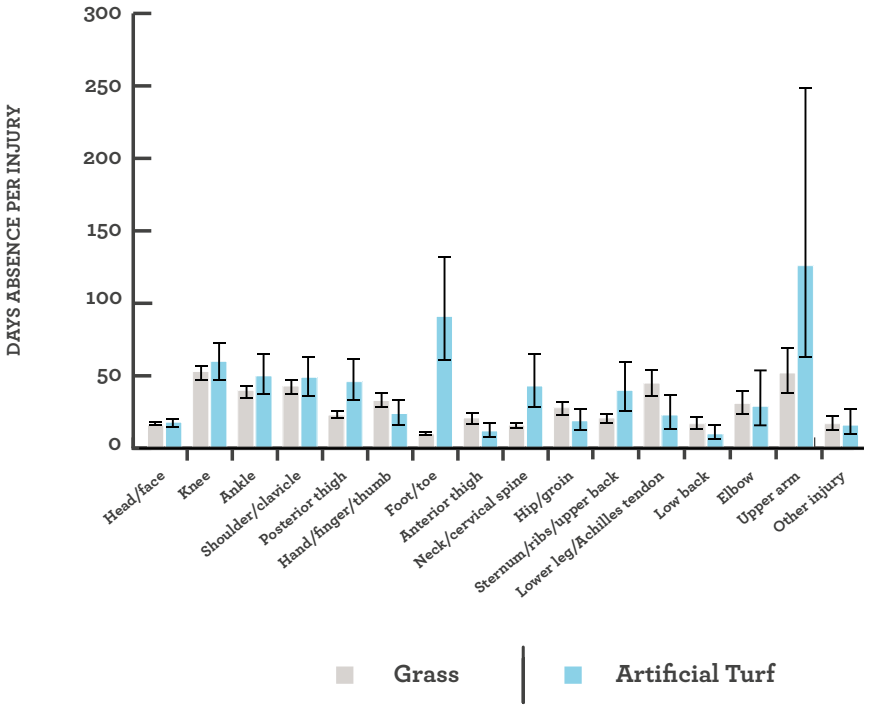

Figure 18: Mean severity (days absence) of match injuries by specific location on natural grass vs artificial turf with 95% CIs

Figure 19:

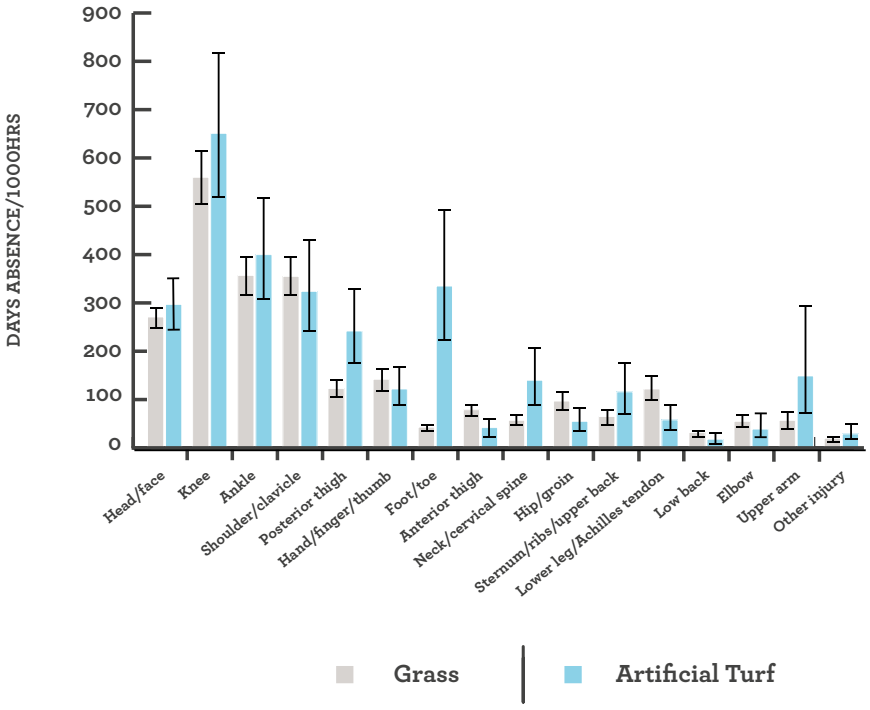

Figure 19: Days absence per 1000 hours of match injuries by specific location on natural grass vs artificial turf with 95% CIs

The pattern of injuries by game event is similar on both surfaces in terms of injury incidence (Figure 20), with the highest incidence of injuries occurring in the tackle. Within the tackle however, a greater injury severity was seen when tackling on artificial turf compared with natural grass (Figure 21) resulting in significantly greater injury burden associated with tackling on artificial turf (Figure 22). The reason for greater severity of injuries when tackling on artificial turf are not yet clear from the available data.

Figure 20:

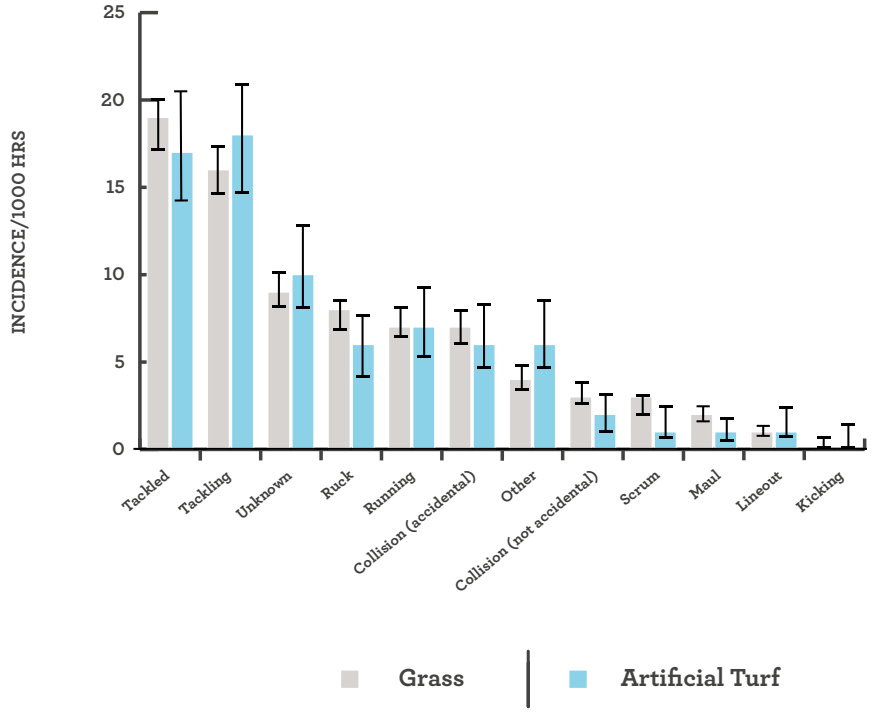

Figure 20: Incidence per 1000 player hours of match injuries by game event on natural grass vs artificial turf with 95% CIs

Figure 21:

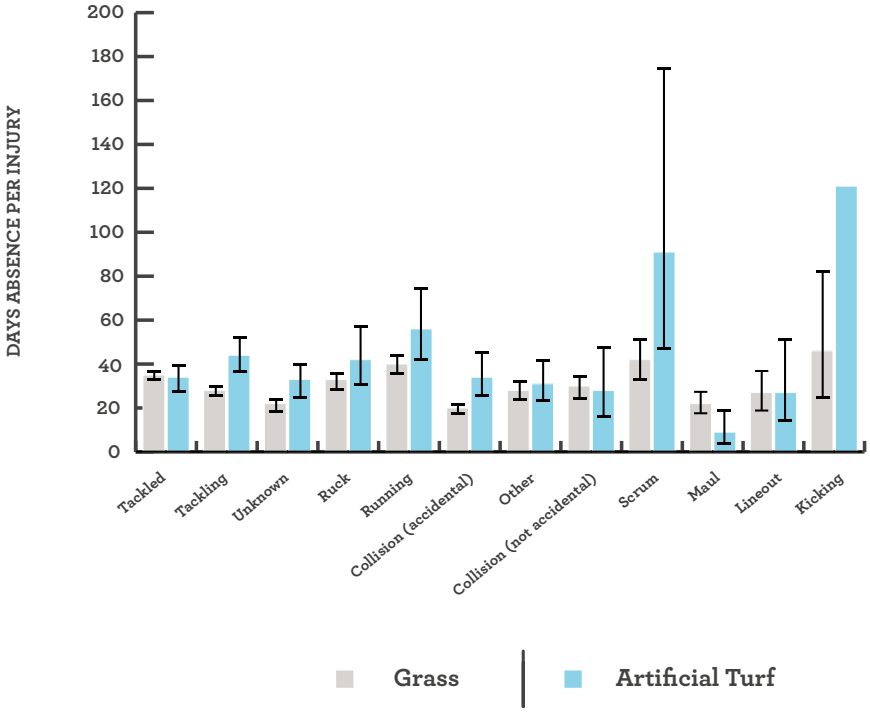

Figure 21: Mean severity (days absence) of match injuries by game event on natural grass vs artificial turf with 95% CIs. Due to only one kicking injury being recorded on AGPs over the five-season period, the confidence intervals associated with this injury event are very wide, meaning the graph is not interpretable when they are included. For this reason the confidence intervals associated with kicking injuries on AGPs have been removed for clarity in the graph. The confidence intervals that were removed were 17-859 days.

Figure 22:

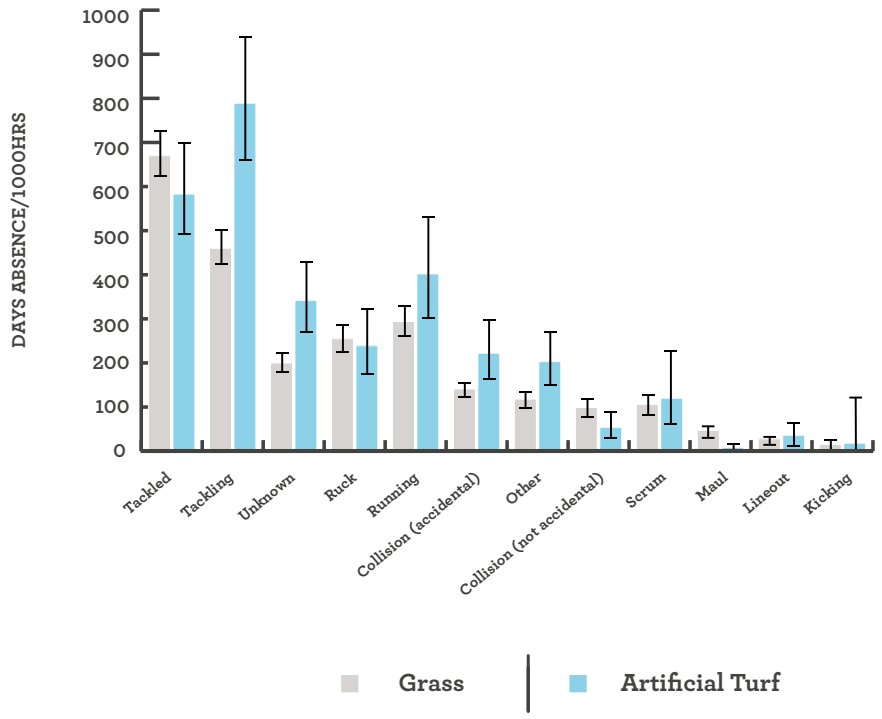

Figure 22: Days absence per 1000 hours of match injuries by game event on natural grass vs artificial turf with 95% CIs

Training Injuries

Exposure to artificial turf during training was less than exposure to natural grass, accounting for 23% of on-pitch training exposure. Two hundred and eighty-three training injuries were recorded on grass for the 2017-18 season while 100 were recorded for training on artificial turf. The incidence of training injury on grass was 4.2 per 1000 hours and was 4.9 on artificial turf (Figure 23). The average severity of training injuries was 35 and 46 days for grass and artificial turf, respectively (Figure 24). The burden of training injuries on natural grass was 144 days per 1000 hours and 222 days per 1000 hours for artificial turf (Figure 25). When aggregating the three seasons of training data, a similar trend to match injuries is apparent, with the incidence the same on both turf types while severity (and therefore burden) is significantly higher on artificial turf compared with natural grass (Figures 23-25). Mean severity on injury on artificial turf is eight days higher than on natural grass while the burden for training injuries is 155 days per 1000 hours compared with 123 per 1000 hours.

Figure 23:

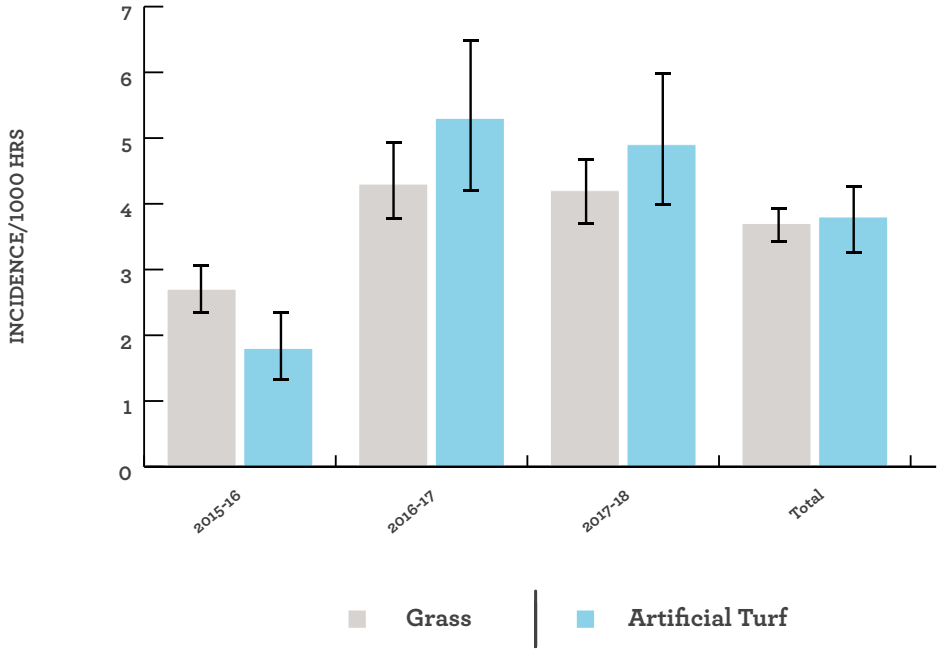

Figure 23: Incidence per 1000 player hours of training injuries on natural grass vs artificial turf with 95% CIs

Figure 24:

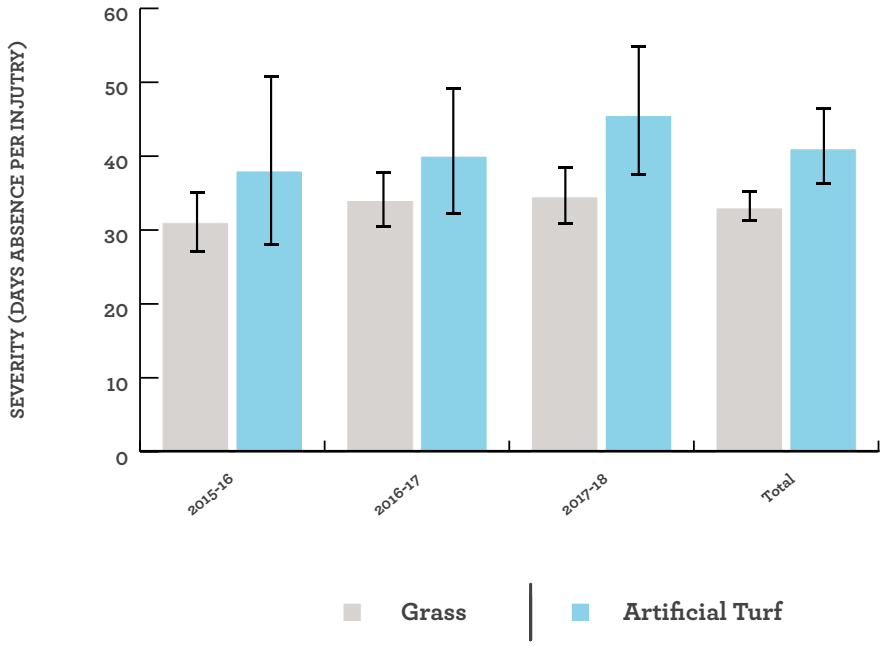

Figure 24: Mean severity (days absence) of training injuries on natural grass vs artificial turf with 95% CIs

Figure 25:

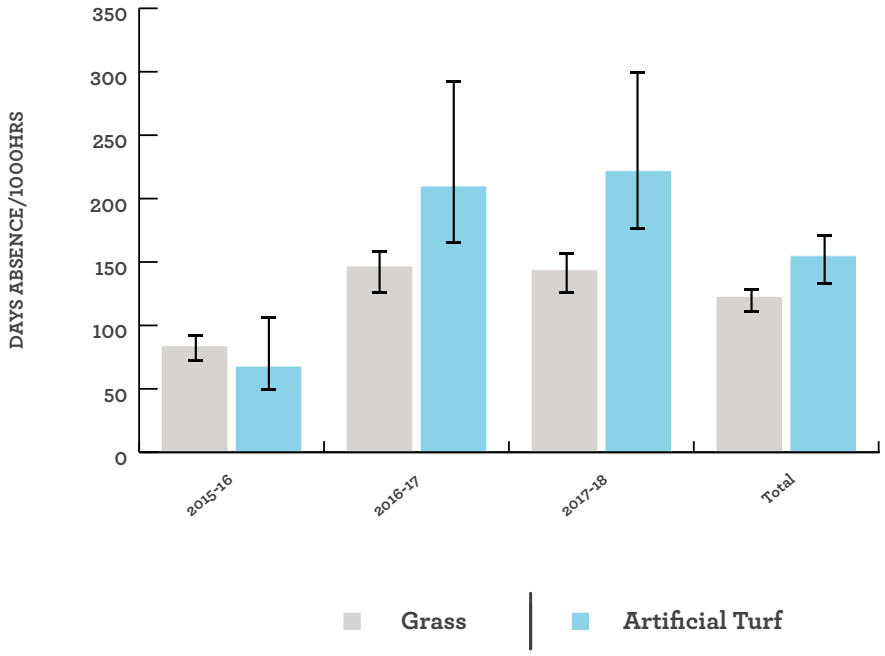

Figure 25: Days absence per 1000 hours of training injuries on natural grass vs artificial turf with 95% CIs

TRAINING INJURY EVENT

Figure 26 outlines the training events associated with injuries during the 2017-18 season compared with the rest of the surveillance period (2002-17). The 2017-18 season saw an increase in the incidence of injuries associated with rugby skills contact training, with a value of 8.2 (95% CIs: 7.2-9.3) apparent for the 2017-18 season, compared with 5.1 (95% CIs: 4.9-5.3) for the period 2002-17. Furthermore, the incidence of injury during non-weights conditioning sessions rose to 7.7 per 1000 hours (95% CIs: 6.3-9.4) which is significantly greater than the incidence for the surveillance period of 5.0 per 1000 hours (95% CIs: 4.7-5.3). The incidence of injury in the remaining training event categories remained similar to that of 2002-2017 period (further detail surrounding incidence by severity grouping can be seen in Table 2.

Figure 26:

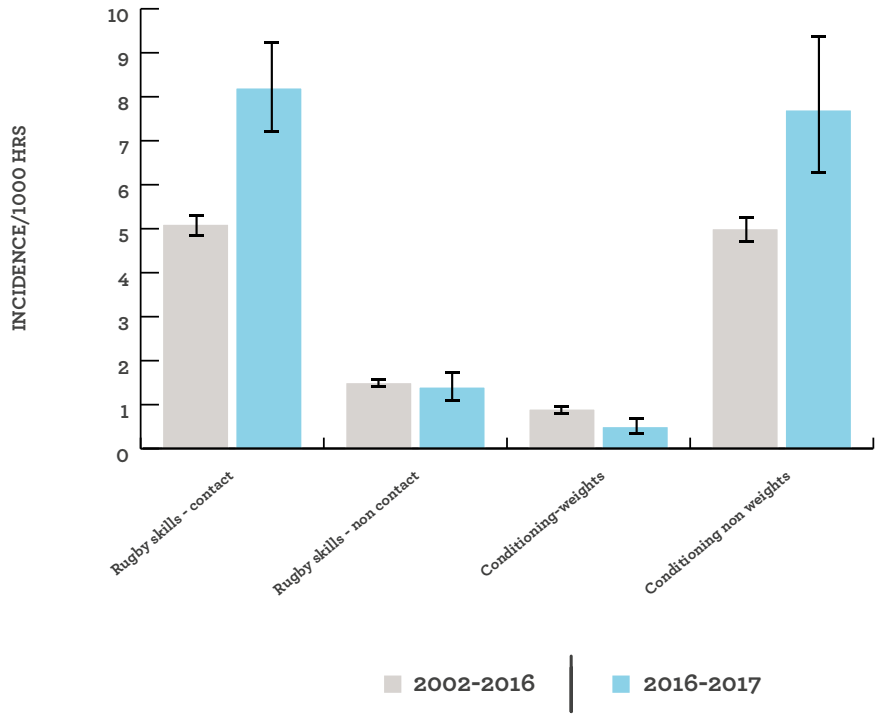

Figure 26: Incidence rates of training injuries by session type. Rugby skills – contact includes both full-contact and semi-contact sessions. Error bars show 95% CIs

Given the higher incidence of contact training injuries during the 2016-17 and 2017-18 seasons, further investigation was undertaken into the types of contact training, types of injury, severity of injury and mechanisms of injury seen in this category. Table 7 shows the incidence, average severity and burden of injuries associated with both "full-contact" and "semi-contact" training. During the 2017-18 season in "full-contact" training sessions, the most commonly occurring injury was concussion, while the most common injury mechanisms were running and accidental collisions, accounting for 17% and 12% of injuries in "full-contact" sessions, respectively. In "semi-contact" sessions, hamstring injuries and concussions were the joint most commonly occurring injuries with running and accidental collisions being the most common injury mechanisms, accounting for 34% and 12% of injuries in "semi-contact" sessions, respectively.

Table 7: **Breakdown of incidence, severity and burden of semi and full contact training 2012-2018.**

	FULL CONTACT TRAINING			SEMI-CONTACT TRAINING		
	INCIDENCE	SEVERITY	BURDEN	INCIDENCE	SEVERITY	BURDEN
2012-13	9.0	22	199	4.1	40	163
2013-14	10.8	26	278	4.5	14	64
2014-15	4.4	32	141	4.8	32	151
2015-16	11.1	28	306	3.2	25	78
2016-17	16.2	35	562	4.7	37	175
2017-18	13.2	44	577	6.0	32	195
2012-17	10.3 (9.4-11.3)	28 (26-31)	297 (271-326)	4.2 (3.8-4.6)	30 (27-33)	126 (115-139)

INJURY DIAGNOSIS

Summary of the most common and highest burden match injuries

For the seventh successive season, concussion was reported as the most commonly occurring match injury (Figure 27a). Concussion remains the most common match injury. Hamstring injuries were the second most common match injuries with 6.4 per 1000 hours, while MCL injuries were the third most common at 4.1 per 1000 hours. Thigh Haematomas and AC joint injuries make up the rest of the top five match injuries with an incidence of 4.0 and 3.8 per 1000 hours, respectively.

The burden of match injuries (days absence per 1000 players hours) rose during the 2017-18 season to 3401 days per 1000 hours (as seen in Figure 1c). For the third year in succession, concussion was the highest burden of any injury at 338 days per 1000 hours (Figure 27b). The burden of hamstring injuries remained high during the 2017-18 season at 259 days absence per 1000 hours. MCL, radial fractures and ankle syndesmosis injuries made up the rest of the top five at 197, 148 and 138 days absence per 1000 hours respectively. This is the first-time radial fractures have appeared in the top five highest burden injuries. It is important to monitor these injuries to identify whether this is a one season occurrence or whether these injuries are becoming more common.

The most common match injuries

Figure 27a:

2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Concussion 6.7	Concussion 10.5	Concussion 13.4	Concussion 15.8	Concussion 20.9	Concussion 17.9
Hamstring muscle 4.9	Thigh haematoma 4.2	Hamstring muscle 4.4	AC joint 3.1	Hamstring muscle 6.8	Hamstring Muscle 6.4
Ankle syndesmosis 3.8	MCL 3.7	Thigh haematoma 3.4	Hamstring muscle 3.1	MCL 4.2	MCL 4.1
MCL 3.6	Ankle lat. lig. 2.9	MCL 3.3	Calf muscle 2.1	AC joint 3.7	Thigh Haematoma 4.0
Thigh haematoma 3.3	Hamstring muscle 2.5	AC joint 2.9	Ankle lat. lig. 2.0	Thigh haematoma 3.0	AC Joint 3.8

Figure 27a: Ranking of the top five most common match injuries each season for 2012-18 with the associated incidence rates (injuries per 1000 hours)

The highest burden match injuries

Figure 27b:

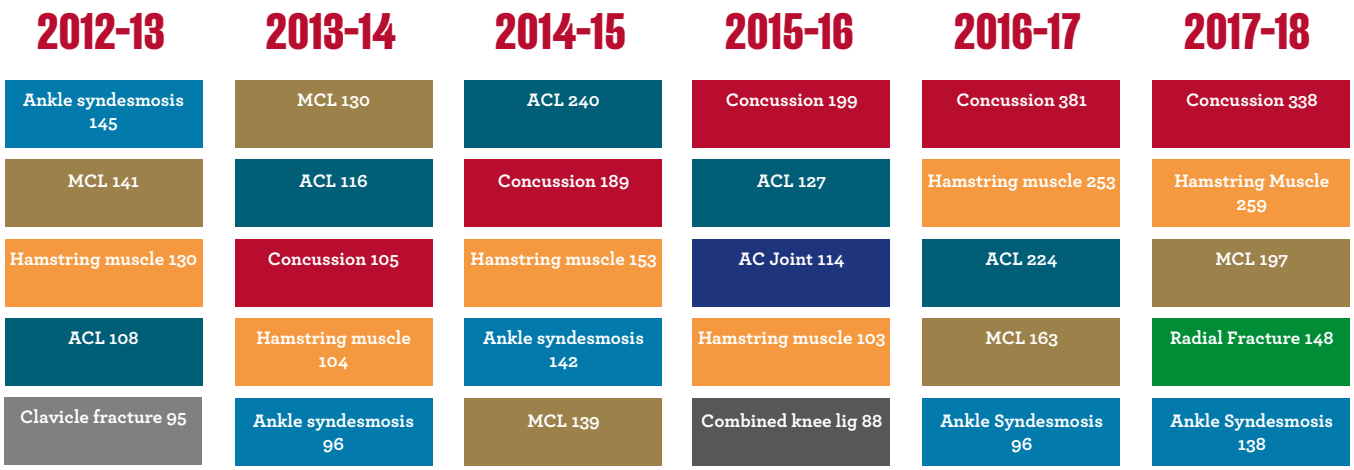

Figure 27b: Ranking of the top five highest burden match injuries for each season 2012-18 with the associated days absence per 1000 hours (Figure in brackets represents average severity for that injury type)

Summary of the most common and highest burden training injuries

The most common training injuries remained similar to that which has been seen since 2002, with hamstring and calf muscle injuries remaining the two most common (Figure 28a). Hamstring injuries returned as the most common match injury at 0.44 per 1000 hours. Calf injuries were the second most common injury at 0.27 per 1000 hours. For the third consecutive year, concussion is in the top five training injuries, as the third most common training injury at a rate of 0.21 per 1000 hours. Hamstring injuries returned as the highest burden training injury at 12.8 days absence per 1000 hours. Calf injuries dropped to 9.4 days absence per 1000 hours from 11.5 during the 2017-18 season. ACL injuries, shoulder dislocations and ATFL injuries rounded out the top five (Figure 28b).

The most common training injuries

Figure 28a:

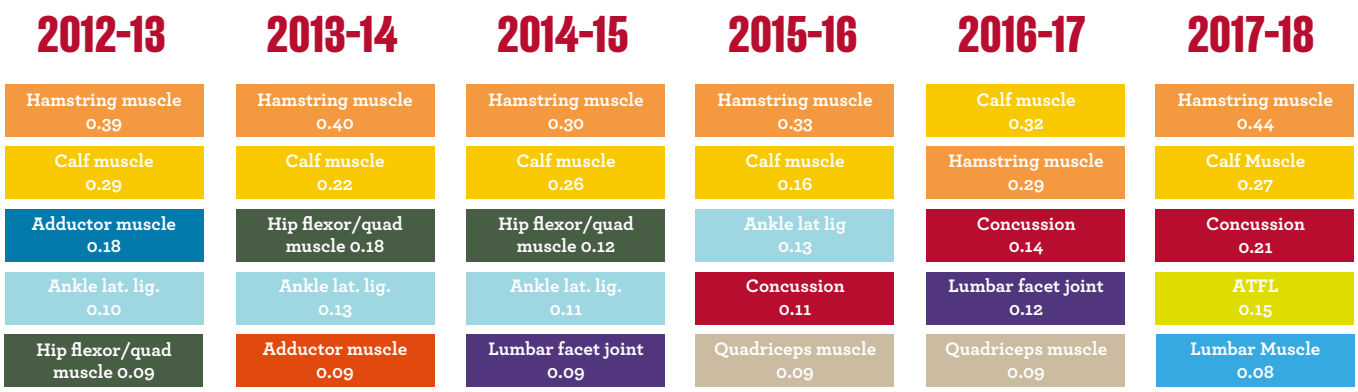

Figure 28a: Ranking of the top five most common training injuries each season 2012-16 with associated incidence rates

Highest burden training injuries

Figure 28b:

2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Hamstring muscle 9.5	Hamstring muscle 8.2	Hamstring muscle 7.2	Hamstring muscle 11.4	Calf muscle 11.5	Hamstring muscle 12.8
ACL 6.3	Calf muscle 4.5	Calf muscle 6.3	Calf muscle 3.8	Hamstring muscle 10.8	Calf muscle 9.4
Lumbar disc/nerve root 5.3	Lumbar disc/nerve root 3.9	ACL 5.3	Ankle lat. lig 2.3	ACL 6.3	ACL Injury 6.8
Calf muscle 4.9	Ankle lat. lig 2.4	Lumbar disc/nerve root 5.0	Combined knee lig 2.3	L5/ S1 prolapse 2.5	Shoulder Dislocation 5.8
Lumbar soft tissue 4.5	Shoulder Dislocation 1.9	Ankle lat. lig 4.6	L5/S1 prolapse 2.2	Concussion 2.4	ATFL 4.1

Figure 28b: Ranking of the top five highest burden training injuries each season 2012-16 with associated days absence per 1000hours. (Figure in brackets represents average severity for that injury type)

HAMSTRING INJURIES

Hamstring injuries returned as the most common (Figure 27a) and highest burden (Figure 27b) training injury during 2017-18 season. The incidence of match related hamstring injuries in 2017-18 was similar to that of 2016-17 (6.4 per 1000 hours vs 6.8 per 1000 hours). The incidence of training related hamstring injuries remained stable in the 2017-18 season at 0.4 per 1000 hours from 0.3 per 1000 hours in the 2015-16 and 2016-17 seasons. The burden of hamstring training injuries was 12.5 days per 1000 hours, which remains higher than the mean for the study period as a whole (7.3 days per 1000 hours). The average severity of hamstring training injuries in 2017-18 was 29 days and 41 days for match hamstring injuries. The mechanism by which these injuries occur during match play is dominated by running, with rucking and tackling the next most commonly seen injury mechanisms. In particular, the larger number of match injuries associated with the ruck may contribute to the rise in average severity of hamstring injuries as whole, with injuries occurring from this mechanism accounting for an average of 64 days during 2017-18 compared with running injuries which had an average severity of 32 days. A season-by-season breakdown of training related hamstring injuries can be seen in Table S5.

ENGLAND SENIOR MEN'S SIDE

Summary of England match and training injury risk

The incidence of match injuries for the England senior men's side for the 2017-18 season remained stable (105 per 1000 hours) compared with the 2016-17 season (113 per 1000 hours) and the surveillance period as whole (127 per 1000 hours: Table 8). The total number of matches played was 11 during the 2017-18 season, and the number of match injuries sustained was 23. The average severity of match injuries during the 2017-18 season was 30 days absence, which is over the mean for the surveillance period as a whole (19 days per 1000 hours). With a substantial increase in the severity and only a slight decrease in incidence from the previous season, the overall burden of injuries increased from 1774 days per 1000 hours in 2016-17 to 3131 per 1000 hours in the 2017-18 season, which is substantially greater than the surveillance period mean of 2311 days absence per 1000 hours.

During the 2017-18 season, the mean incidence of training injuries rose for both rugby skills related injuries (12.2 per 1000 hours) and strength and conditioning (1.8 per 1000 hours) when compared to the 2016-17 season (Table 9). The rugby skills injury incidence was double that of the surveillance period average (6.1 per 1000 hours) while the strength and conditioning injury incidence remained lower than the surveillance period mean (4.6 per 1000 hours). The burden of training injuries rose substantially above the mean for the surveillance period for rugby skills injury to 579 days absence per 1000 hours (compared to 96 days per 1000 hours). A breakdown of injury severity groupings can be seen in table 10. The number of injuries in the 29-84 days injuries groups was substantially higher for training as well as the 84+ day category, which explains the large rise in the overall burden for training injuries for the 2017-18 season.

Note: *The relatively small number of England senior men's training sessions and training injuries included in the study each season means that the training injury risk for England should be interpreted with caution. The small sample size means that any differences in risk are much more likely to have arisen "by chance" rather than to be the result of a "true" difference, reflected in the wide 95% confidence intervals.*

Match Injuries

Table 8: **England match injury incidence, average severity and burden since 2002-03 (95% confidence intervals shown in brackets where appropriate: Asterisk indicate world cup year.)**

SEASON	TOTAL NUMBER OF INJURIES	INJURIES / 1000 HOURS	INJURIES PER MATCH	AVERAGE SEVERITY	DAYS ABSENCE / 1000 HOURS	DAYS ABSENCE PER MATCH
2002-03	53	221 (169-289)	4.4	19	4264 (4010-4533)	85
2003-04*	83	207 (167-256)	4.1	11	2371 (2225-2527)	47
2005-06	30	136 (95-195)	2.7	10	1391 (1243-1556)	28
2006-07	30	136 (95-195)	2.7	28	3836 (3586-4104)	77
2007-08*	55	162 (119-205)	3.2	24	3876 (2852-4901)	78
2008-09	23	96 (57-135)	1.9	8	813 (480-1145)	16
2009-10	23	88 (52-125)	1.8	19	1712 (1012-2411)	34
2010-11	14	78 (37-119)	1.5	23	1789 (852-2726)	36
2011-12*	16	62 (31-92)	1.2	29	1754 (894-2613)	35
2012-13	31	111 (78-158)	2.2	24	2618 (1841-3722)	52
2013-14	19	86 (55-135)	1.7	20	1509 (963-2366)	34
2014-15	27	113 (78-165)	2.3	23	2604 (1786-3797)	52
2015-16*	39	163 (119-223)	3.3	13	2043(1492-2795)	41
2016-17	27	113 (78-165)	2.3	16	1774 (1217- 2587)	35
2017-18	23	105 (70-158)	2.1	30	3131 (2081-4712)	62
MEAN (2002-17)	34	127 (116-139)	2.5	19	2311 (2111-2530)	46

*Rugby world cup year

Training Injuries

Table 9: England training injury incidence, average severity and burden, 2002-03 to 2017-18. (95% confidence intervals shown in brackets where appropriate).

	RUGBY SKILLS			STRENGTH AND CONDITIONING		
SEASON	INJURIES/ 1000 HOURS	AVERAGE SEVERITY	DAYS ABSENCE/ 1000 HOURS	INJURIES/ 1000 HOURS	AVERAGE SEVERITY	DAYS ABSENCE/ 1000 HOURS
2002-03	4.5 (2.6-8.0)	15	69 (60-80)	4.0 (1.0-15.9)	4	16 (8-32)
2003-04*	7.6 (5.3-11.0)	12	89 (80-99)	6.3 (3.8-10.3)	13	79 (68-90)
2005-06	0.6 (0.1-4.0)	4	2 (1-6)	-	-	-
2006-07	9.8 (5.9-16.3)	15	149 (131-169)	-	-	-
2007-08*	7.3 (4.5-10.1)	9	74 (46-103)	2.5 (0.5-4.6)	12	34 (7-61)
2008-09	6.5 (3.0-10.0)	20	135(62-209)	12.1 (4.2-20.0)	18	233 (81-385)
2009-10	5.3 (3.4-8.3)	8	46 (30-73)	4.0 (2.0-8.6)	6	26 (12-55)
2010-11	1.7 (0.8-3.5)	7	12 (6-26)	4.4 (1.8-10.5)	5	22 (9-53)
2011-12*	3.2 (1.4-5.1)	22	70 (31-110)	2.8 (0.4- 5.3)	18	51 (6-95)
2012-13	3.7 (1.6-9.0)	20	58 (24-134)	1.1 (0.2-7.8)	9	10 (1-71)
2013-14	7.9 (4.7-13.3)	11	87 (52-147)	3.9 (1.3-12.1)	14	57 (18-177)
2014-15	3.31.6-6.9	25	85 (50-145)	2.3 (0.6-9.2)	2	3 (1-80)
2015-16*	15.7 (11.6-21.3)	9	135 (99-183)	7.3 (4.7-11.3)	8	55 (36-85)
2016-17	7.7 (4.1-14.3)	44	337 (181-626)	0.8 (0.1-5.7)	17	13 (2-93)
2017-18	12.2 (7.8-19.1)	47	579 (369-908)	1.8 (0.8-4.3)	32	57 (24-137)
MEAN 2002-17	6.1 (5.4-6.9)	18	96 (84-109)	4.3 (3.4-5.4)	12	62 (49-78)

*Rugby world cup year

Table 10: England match and training injury count by severity grouping, 2002-03 to 2017-18. (95% confidence intervals shown in brackets where appropriate).

	MATCH				TRAINING			
SEASON	2-7 DAY	8-28 DAY	29-84 DAY	84+ DAY	2-7 DAY	8-28 DAY	29-84 DAY	84+ DAY
2002-03	38	8	6	1	9	4	0	1
2003-04*	51	25	6	1	23	18	4	0
2005-06	21	6	0	3	14	0	1	0
2006-07	11	15	2	4	8	4	3	0
2007-08*	30	15	9	1	14	13	1	0
2008-09	11	7	4	1	8	6	0	1
2009-10	9	12	2	0	11	3	3	1
2010-11	4	6	3	1	6	1	0	0
2011-12*	10	1	3	2	8	7	2	1
2012-13	11	11	8	1	1	3	1	1
2013-14	11	4	4	0	21	15	4	1
2014-15	19	4	3	1	10	3	2	1
2015-16*	27	18	1	0	37	16	2	0
2016-17	19	4	3	1	4	1	5	1
2017-18	11	6	4	2	10	4	6	4
MEAN (2002-17)	19 (17-21)	10 (8-12)	4 (3-5)	1 (0.6-1.6)	12 (10-14)	7 (6-9)	2 (1-3)	0.6 (0.3-1.2)

*Rugby world cup year

RFU INJURY SURVEILLANCE PROJECT METHODS

Written informed consent was obtained from 725 registered Premiership squad players for the 2017-18 season, there were no players that formally refused consent. A total of 391 team games were included in the analyses for the 2017-2018 season.

Injuries from consented first team squad (including academy players that trained regularly with the first team) players sustained in training and in all matches in the Premiership and European Competitions (Champions and Challenge Cup) were included. Injuries sustained while players represented England were reported and analysed separately.

Match and training injury data, and training exposure data, were provided by all 12 Premiership clubs in 2017-2018. A complete set of data was collected from all 12 Premiership clubs and the England senior men's side.

Medical personnel at each Premiership club and the England senior team reported the details of injuries and illnesses sustained by a player at their club/team that were included in the study group together with the details of the associated injury event using an online medical record keeping system. Strength and conditioning staff recorded the squad's weekly training schedules and exposure on a password protected online system. Team match days were also recorded by strength and conditioning staff.

Injury and illness diagnoses were recorded using the Orchard Sports Injury Classification System (OSICS) version 10.1. This sports specific injury classification system allows detailed diagnoses to be reported and injuries to be grouped by body part and injury pathology.

The definitions and data collection methods utilised in this study are aligned with the IRB (now World Rugby) Consensus statement on injury definitions and data collection procedures for studies of injuries in rugby union.

CURRENT PUBLICATIONS & PRESENTATIONS

Further detailed information on injury risk in this cohort of players can be obtained from the following peer reviewed publications that have been produced as part of the Premiership injury surveillance project

Publications

Fuller, G.W., Cross, M.J., Stokes, K.A., Kemp, S.P.T. King-Devick concussion test performs poorly as a screening tool in elite rugby union players: a prospective cohort study of two screening tests versus a clinical reference standard. 2018. doi: 10.1136/bjsports-2017-098560

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SUPPLEMENTARY DATA

Table S1: Match injury incidence, severity and burden 2002-18

SEASON	TOTAL NUMBER OF MATCH INJURIES	INJURIES / 1000 HRS (95% CI)	INJURIES PER CLUB PER MATCH	AVERAGE SEVERITY (DAYS) (95%CI)	DAYS ABSENCE / 1000 HRS (95% CI)	DAYS ABSENCE PER CLUB PER MATCH
2002-03	748	100 (92-107)	2.0	16 (15-17)	1556 (1444-1667)	31
2003-04	653	88 (82-95)	1.8	20 (19-22)	1773 (1637-1909)	35
2005-06	482	75 (68-82)	1.5	21 (19-23)	1591 (1449-1733)	32
2006-07	755	90 (84-97)	1.8	21 (20-23)	1879 (1745-2013)	38
2007-08	660	83 (77-89)	1.7	19 (18-21)	1613 (1490-1736)	32
2008-09	769	100 (93-107)	2.0	23 (21-25)	2285 (2123-2446)	46
2009-10	636	80 (73-86)	1.6	22 (20-24)	1722 (1588-1856)	34
2010-11	746	93 (86-99)	1.9	21 (20-23)	1917 (1779-2054)	38
2011-12	655	82 (76-88)	1.6	27 (25-29)	2222 (2052-2392)	44
2012-13	588	73 (67-79)	1.5	25(23-27)	1784 (1645-1936)	35
2013-14	739	91 (85-98)	1.8	26 (24-28)	2247 (2091-2415)	46
2014-15	645	79 (73-85)	1.6	29 (27-31)	2369 (2193-2560)	47
2015-16	447	62 (57-68)	1.2	29 (26-32)	1808 (1648-1984)	36
2016-17	778	96 (90-103)	1.9	33 (31-35)	3150 (2936-3379)	63
2017-18	717	92 (86-99)	1.8	37 (34-40)	3401 (3161-3659)	66
MEAN (2002-17)	664	85 (83-87)	1.7	24 (23.5-24.5)	1994 (1954-2035)	40

Table S2: Training injury incidence, severity and burden since 2002-18

SEASON	TOTAL NUMBER OF TRAINING INJURIES	RUGBY SKILLS			STRENGTH AND CONDITIONING		
		INJURIES / 1000 HRS (95% CI)	AVERAGE SEVERITY (DAYS)	DAYS ABSENCE / 1000 HRS (95% CI)	INJURIES / 1000 HRS (95% CI)	AVERAGE SEVERITY (DAYS)	DAYS ABSENCE / 1000 HRS (95% CI)
2002-03	159	3.3 (2.7-4.0)	28	93 (90-97)	2.3 (1.7-3.0)	13	29 (27-31)
2003-04	217	1.7 (1.4-2.0)	26	44 (42-45)	1.3 (1.1-1.6)	17	23 (22-24)
2005-06	203	2.2 (1.9-2.6)	22	49 (47-51)	1.5 (1.2-1.9)	16	24 (22-25)
2006-07	209	2.1 (1.7-2.5)	18	37 (35-38)	1.6 (1.3-2.0)	16	25 (24-27)
2007-08	318	3.2 (2.7-3.7)	19	60 (51-68)	2.7 (2.2-3.1)	15	44 (36-52)
2008-09	258	2.5 (2.1-2.9)	26	63 (53-73)	2.4 (2.0-2.9)	17	41 (34-49)
2009-10	298	2.8 (2.4-3.2)	21	59 (50-67)	2.1 (1.7-2.4)	18	37 (30-43)
2010-11	340	3.1 (2.7-3.5)	25	76 (66-87)	2.6 (2.1-3.0)	17	41 (34-48)
2011-12	323	2.7 (2.4-3.1)	26	68 (59-78)	2.2 (1.8-2.6)	18	39 (32-46)
2012-13	335	3.2 (2.9-3.6)	33	106 (93-121)	2.0 (1.7-2.4)	24	49 (41-60)
2013-14	414	3.1 (2.7-3.5)	27	84 (75-95)	2.1 (1.7-2.4)	20	40 (34-47)
2014-15	325	2.7 (2.4-3.1)	29	71(61-82)	1.9 (1.6-2.3)	23	44 (38-51)
2015-16	304	2.4 (2.1-2.7)	28	69 (61-79)	1.4 (1.1-1.7)	37	41 (34-50)
2016-17	429	4.2 (3.8-4.7)	36	153 (137-171)	1.8 (1.5-2.2)	29	51 (42-62)
2017-18	438	4.1 (3.7-4.6)	36	148 (132-165)	1.8 (1.5-2.2)	37	66 (55-79)
MEAN (2002-17)	295	2.9 (2.8-3.0)	26	74 (71-77)	2.0 (1.9-2.1)	20	38 (36-40)

Table S3: New vs. recurrent match injury incidence, severity and burden 2002-18

SEASON	NEW INJURIES			RECURRENT INJURIES		
	INJURIES / 1000 HRS	AVERAGE SEVERITY (DAYS)	DAYS ABSENCE / 1000 HRS	INJURIES / 1000 HRS	AVERAGE SEVERITY (DAYS)	DAYS ABSENCE / 1000 HRS
2002-03	79	14	1084	19	23	438
2003-04	72	18	1333	13	33	435
2005-06	67	20	1372	10	29	279
2006-07	76	21	1574	8	33	261
2007-08	74	19	1444	9	20	169
2008-09	85	21	1800	14	34	485
2009-10	72	21	1515	8	29	207
2010-11	87	21	1776	6	25	141
2011-12	77	27	2106	5	23	116
2012-13	68	25	1659	5	26	125
2013-14	87	25	2157	4	25	90
2014-15	78	29	2300	3	31	69
2015-16	62	29	1759	<1	36	20
2016-17	94	33	3079	2	41	71
2017-18	86	36	3096	6	40	232
MEAN (2002-17)	77	23	1783	8	29	208

Table S4: New vs. recurrent training injury incidence, severity and burden 2002-18

SEASON	NEW INJURIES			RECURRENT INJURIES		
	INJURIES / 1000 HRS	AVERAGE SEVERITY (DAYS)	DAYS ABSENCE / 1000 HRS	INJURIES / 1000 HRS	AVERAGE SEVERITY (DAYS)	DAYS ABSENCE / 1000 HRS
2002-03	2.5	21	54	0.5	34	16
2003-04	1.3	21	27	0.3	36	12
2005-06	1.8	19	35	0.4	21	8
2006-07	1.7	17	30	0.2	15	3
2007-08	2.3	17	39	0.5	23	11
2008-09	2	21	41	0.4	27	11
2009-10	2.2	20	44	0.2	21	4
2010-11	2.7	20	53	0.1	58	8
2011-12	2.2	22	49	0.1	46	4
2012-13	2.6	29	69	0.1	33	4
2013-14	2.8	25	70	0.1	25	4
2014-15	2.2	28	61	0.1	33	3
2015-16	1.9	31	59	<0.1	24	0.6
2016-17	2.9	34	98	<0.1	34	1.4
2017-18	2.6	37	96	0.2	35	7
MEAN (2002-17)	2	23	52	0.2	31	6

Table S5: Hamstring training injury incidence and burden 2002-2018

SEASON	INCIDENCE/1000 HOURS	DAYS ABSENCE/1000 HOURS
2002-03	0.45	6.4
2003-04	0.21	4.2
2004-05	0.36	4.6
2006-07	0.32	5.1
2007-08	0.59	9.5
2008-09	0.36	5
2009-10	0.38	6.1
2010-11	0.45	6.9
2011-12	0.42	7.3
2012-13	0.39	9.5
2013-14	0.4	10.7
2014-15	0.3	7.2
2015-16	0.33	11.4
2016-17	0.29	8.3
2017-18	0.44	12.5
2002-17	0.38	7.3

Figure S6: The three most common match injuries lasting between 28 and 84 days. Numbers in brackets represent (number of cases; average severity of that injury in the category)

2013-14	2014-15	2015-16	2016-17	2017-18
Ankle Syndesmosis (10,40)	Hamstring (18,49)	Hamstring (10,49)	MCL (20,59)	MCL (15,60)
Hamstring (10,40)	MCL (8,53)	Concussion (9,39)	Concussion (11,43)	Concussion (14,52)
MCL (6,59)	Ankle syndesmosis (7,57)	MCL (9,54)	Ankle syndesmosis (7,59)	Hamstring (14,43)

Figure S7: The three most common match injuries lasting greater than 84 days. Numbers in brackets represent (number of cases; average severity of that injury in the category)

2013-14	2014-15	2015-16	2016-17	2017-18
ACL (5,244)	ACL (8,229)	PCL (5,137)	Hamstring (9,120)	Radial Fracture (6,164)
Combined Knee ligaments (3,191)	Ankle syndesmosis (3,119)	ACJ (4,142)	ACL (7,258)	Hamstring (6,144)
Pec Tear (3,122)	Ankle dislocation (2,157)	ACL (3,294)	Concussion (7,148)	Shoulder Dislocation (6,130)

Figure S8: The three most common training injuries lasting between 28 and 84 days. Numbers in brackets represent (number of cases; average severity of that injury in the category)

2013-14	2014-15	2015-16	2016-17	2017-18
Hamstring (13,44)	Hamstring (11,39)	Ankle Ligaments (12,52)	Hamstring (17,48)	Calf (15,51)
Calf (9,41)	Calf (9,45)	Hamstring (12,51)	Calf (14,49)	Hamstring (15,42)
Ankle Ligaments (5,40)	Ankle Ligaments (6,39)	Calf (5,40)	Ankle Ligaments (7,61)	Meniscus (5,57)

Figure S9: **The three most common training injuries lasting greater than 84 days. Numbers in brackets represent (number of cases; average severity of that injury in the category)**

2013-14	2014-15	2015-16	2016-17	2017-18
Hamstring (2,228)	ACL (3,252)	Hamstring (3,159)	Hamstring (5,99)	Shoulder Dislocation (5,206)
Shoulder Joint Sprain (2,103)	Lumbar Joinr Injury (3,142)	L5/S1 Prolapse (2,171)	ACL (4,240)	ACL (4,262)
Elbow Muscle Strain * (1,204)	Hamstring (2,115)	Rectus Abdominis Injury (2,159)	Calf (5,135)	Hamstring (4,137)

* In the event that a large number of high severity injuries occurred only once throughout the season, but there were no injuries which occurred more than once, the injury with the highest severity has been reported


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