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Match injuries in English schoolboy rugby union

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ABSTRACT

Objective This study describes the incidence, severity and burden of match injuries in schoolboy rugby union in England, across three age groups: under-13 (U13), under-15 (U15) and under-18 (U18).

Methods Data regarding 574 24-hour time-loss match injuries and 18 485 player-hours of match exposure were collected from a total of 35 schools (66 teams) in the 2017/18, 2018/19 and 2019/20 seasons. Injury incidence (injuries/1000 hours), severity (mean and median days lost) and burden (days lost/1000 hours) were calculated for each age group, injury region, event, playing position and match period and were compared using Z scores.

Results The U18 age group had a significantly higher injury incidence (34.6 injuries/1000 hours, 95% CI 31.5 to 38.1) and burden (941 days/1000 hours, 95% CI 856 to 1035) than both the U13 (incidence=20.7 injuries/1000 hours, 95% CI 14.1 to 30.3, p=0.03; burden=477 days lost/1000 hours, 95% CI 325 to 701, p<0.01) and U15 (incidence=24.6 injuries/1000 hours, 95% CI 20.6 to 29.5, p<0.01; burden=602 days lost/1000 hours, 95% CI 503 to 721, p<0.01) age groups, but no significant differences were found between the U13 and U15 age groups. Contact events accounted for 87% of known injury events, with the tackle responsible for 52% (U13), 48% (U15) and 62% (U18) of all injuries. Concussion was the most common injury type in all age groups (U13=4.8 injuries/1000 hours; U15=6.4 injuries/1000 hours; U18=9.2 injuries/1000 hours), but the incidence was not significantly different between age groups.

Conclusion Injury incidence and burden was higher in U18 than U13 and U15 age groups. Concussions and the tackle are priority areas at all age groups and should be the focus of injury prevention strategies.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Injury incidence increases with both age and playing level.
⇒ To date, there has been no comparison of different age groups within an English schoolboy setting.

WHAT THIS STUDY ADDS

⇒ Injury incidence and burden is significantly higher at under-18 than at under-13 and under-15.
⇒ The tackle is responsible for the most injuries at all age groups.
⇒ Concussion is the most common injury type at all age groups.

HOW MIGHT THIS STUDY AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The findings indicate that the focus of injury prevention strategies should be on concussion and the tackle.
⇒ The findings highlight the need to understand the nature of specific game events and their propensity to cause injury.

INTRODUCTION

Rugby union (henceforth rugby) is one of the most popular sports played by young people in England,[1] but has been under increasing scrutiny due to the potential for injury.[2] At the professional level, injuries in rugby have been researched extensively, demonstrating that it has one of the highest injury incidences of all team sports[3]; however, due to differences in player physique, game speed and laws of the game, these findings cannot be applied to the youth population.[4]

Studies have described injuries in youth rugby populations, with under-18 (U18) schoolboy rugby players in England reported to have an injury incidence of 35 injuries/1000 hours,[5] U18 schoolboys in Ireland an incidence of 29 injuries/1000 hours and subelite under-19 players in England an incidence of 34 injuries/1000 hours.[6] All three studies found that, within the same age group, a higher playing level was associated with an increased risk of injury.

A systematic review of rugby-related injuries found a clear association between increasing age and a higher injury incidence, but there were wide variations in the definitions and methodologies used.[7] Much of the research in a youth setting has focused on players in the oldest youth age group (U18), with less attention on younger age groups. In England, players aged 14–18 years were reported to have an injury incidence of 30 injuries/1000 hours, but the rates in different age groups were not described.[8] Using rugby-related insurance claims in New Zealand, it was found that players aged 7–12 years had a 9% chance of

Table 1 Schools and teams providing epidemiological data

	Under-13		Under-15		Under-18		Overall	
Season	Schools, n	Teams, n	Schools, n	Teams, n	Schools, n	Teams, n	Schools, n	Teams, n
2017/18	8	9	11	12	17	18	19	39
2018/19	3	3	9	9	14	15	16	27
2019/20	4	4	10	10	20	22	21	36
Overall	12	13	20	20	30	33	35	66

making a claim due to injury during a season, compared with a 36% chance in players aged 13–17 years.[9] In English youth rugby, there are differences between age groups in relation to length of matches (under-13 (U13): 50 min; under-15 (U15): 60 min; U18: 70 min), number of players (U13: 13; U15/18: 15), maximum pitch size (U13: 90×60 m; U15/18: 100×70 m), players permitted in the scrum (U13: 6; U15/18: 8) and laws regarding lineouts (U13: none; U15: uncontested; U18: contested) and maximum tackle height (U13: armpit; U15/18: shoulder).[10]

It is important that injuries are investigated to inform population-specific and context-specific injury prevention strategies. This study describes and compares the incidence, severity and burden of match injuries in U13, U15 and U18 schoolboy rugby union players in England.

METHODS

This was a prospective cohort study, describing rugby-related injuries in English secondary schools (ages 11–18 years). In total, 102 team-seasons of data were collected from 66 different teams, across 35 schools (state: n=10; independent: n=25) (table 1).

Recruitment and participants

This study was conducted over three rugby seasons (2017/18 to 2019/20). Each season ran from September until April, with the majority of U15 and U18 matches being played between September and December. Email invitations were sent to 85 schools in 2017/18, 164 schools in 2018/19 and 278 schools in 2019/20. There was no limit to the number of teams each school could include, but only boys' teams in the U13, U15 and U18 age groups were eligible for inclusion. Information sheets and consent forms were sent to schools electronically.

Variables

Methods are in line with the consensus statement on injury definitions and data collection procedures for studies of injury in rugby union.[11] A 24-hour time-loss definition was used, where injuries were recorded if a player was unable to take a full part in training or match play for >24 hours from midnight at the end of the day that the injury was sustained. Match exposure was classified as play between teams from different schools and was calculated by multiplying the length of the match (U13: 0.83 hours; U15: 1 hour; U18: 1.17 hours) by the number of players (U13: 13; U15/18: 15).

Data collection

A project co-ordinator, normally a coach or therapist, was nominated by each school. To ensure that they understood the data collection process, they received instructions from a member of the research team. They collected information on the team (squad list, age group), their matches (date, match duration, opponent, outcome) and match injuries (date, return to play date, match quarter, playing position, event, site, type), returning this via a secure electronic link. After submitting data, feedback was provided and clarifications requested, if required.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Equity, diversity and inclusion

Our author team consisted of one woman and four men with experience ranging from junior researchers through to experienced principal investigators. While both state-funded and private schools were invited to participate, the majority of schools volunteering to take part were private schools.

Statistical analysis

Injury incidence was calculated as the number of injuries per 1000 player-hours (injuries/1000 hours). Injury severity was the number of full days that elapsed from the date of injury until the date of the player's return to full participation in team training and availability for match selection. Injury burden was calculated by multiplying mean injury severity by injury incidence,[12] giving days lost per 1000 player-hours (days lost/1000 hours).

To allow for comparison with other studies, a 7-day time-loss injury incidence was also calculated. Injuries with unknown or estimated days-lost were included when calculating incidence, but excluded for severity and burden calculations. Injury severity was grouped into categories.[11] Specific injury sites were grouped into regions: head and neck (head, neck), upper limb (shoulder, upper arm, elbow, forearm, wrist and hand), torso (chest, trunk and abdomen, thoracic spine, lumbar spine) and lower limb (hip and groin, pelvis and buttock, thigh, knee, lower leg, ankle, foot).

Analysis was conducted in Microsoft Excel and on IBM SPSS Statistics V.25. Injury incidence and burden were

Table 2 An overview of the injury incidence, severity and burden for each age group

	Under-13	Under-15	Under-18
Injuries, n	26	119	429
Exposure, hours	1259	4834	12393
Incidence, injuries/1000 hours (95% CI)	20.7 (14.1 to 30.3)	24.6 (20.6 to 29.5)	34.6 (31.5 to 38.1)[3,5]
Severity, mean days (95% CI)	23 (14 to 32)	25 (20 to 29)	27 (24 to 30)
Severity, median days (IQR)	20 (6 to 35)	20 (7 to 34)	22 (10 to 34)
Burden, days lost/1000 hours (95% CI)	477 (325 to 701)	602 (503 to 721)	941 (856 to 1035)[3,5]

Bold events were compared across age groups. Significant differences are denoted by: 3, vs U13; 5, vs U15.

calculated with 95% Poisson CIs. The log of the rate ratio was used to calculate Z scores, with the assumption of normality of the data. Z scores with corresponding p values were used to compare injury incidence and burden within (regions, events, playing positions and match periods) and between (U13 vs U15; U13 vs U18; U15 vs U18) age groups. When making three or less comparisons, a Bonferroni correction[13] was used to minimise the chance of type 1 error. Where more than three comparisons were made, a Holm-Bonferroni correction[14 15] was used to minimise the risk of type 2 error.

Mean severity was calculated with 95% CIs and median severity with an IQR. Mean severity was compared using a two-tailed independent t-test with a Bonferroni correction,[12] and median severity was compared using analysis of variance. P values <0.05 were considered statistically significant.

RESULTS

In total, 18485 match player-hours (U13: 1259 player-hours; U15: 4834 player-hours; U18: 12393 player-hours) and 574 match injuries (U13: n=26; U15: n=119; U18: n=429) were collected (table 2).

Incidence

The U18 age group had a significantly higher injury incidence (34.6/1000 hours, 95% CI 31.5 to 38.1) than both the U13 (20.7/1000 hours, 95% CI 14.1 to 30.3, p=0.03) and U15 (24.6/1000 hours, 95% CI 20.6 to 29.5, p<0.01) age groups, but U13 and U15 were not different (table 2). The incidence reflects one injury per team every 4.5 matches at U13, every 2.7 matches at U15 and every 1.7 matches at U18. Incidence for 7-day time-loss injuries was 15.1/1000 hours (n=19; 95% CI 9.6 to 23.7) at U13, 14.5/1000 hours (n=70; 95% CI 11.5 to 18.3) at U15 and 22.2/1000 hours (n=275; 95% CI 19.7 to 25.0) at U18.

Severity

Mean severity of injuries was not different between age groups (table 2). The most common severity category (table 3) was 8–28 days for all age groups (U13=38%; U15=35%; U18=35%).

Burden

Burden was significantly greater in the U18 age group (941 days/1000 hours, 95% CI 856 to 1035) than both the U13 (477 days/1000 hours, 95% CI 325 to 701, p<0.01) and U15 (602 days/1000 hours, 95% CI 503 to 721, p<0.01) age groups; there were no significant differences between U13 and U15 (table 2).

Region

The head was the most common specific site of injury at all age groups (online supplemental table S1); there were no significant differences in the incidence of head and neck injuries across age groups. At U18, both the head and neck (13.1/1000 hours, 95% CI 11.2 to 15.2) and lower limb (12.2/1000 hours, 95% CI 10.4 to 14.3) had a significantly higher injury incidence than the upper limb (7.8/1000 hours, 95% CI 6.4 to 9.6, p<0.01) and trunk (1.1/1000 hours, 95% CI 0.7 to 1.9, p<0.01). Lower limb injuries at U18 had a greater incidence (12.2/1000 hours, 95% CI 10.4 to 14.3) and burden

Table 3 Injury severity categories for each age group

	Under-13		Under-15		Under-18	
	Injuries, n (%)	Incidence, injuries/1000 hours (95% CI)	Injuries, n (%)	Incidence, injuries/1000 hours (95% CI)	Injuries, n (%)	Incidence, injuries/1000 hours (95% CI)
1–7 days	7 (27)	5.6 (2.7 to 11.7)	25 (21)	5.2 (3.5 to 7.7)	71 (17)	5.7 (4.5 to 7.2)
8–28 days	10 (38)	7.9 (4.3 to 14.8)	42 (35)	8.7 (6.4 to 11.8)	151 (35)	12.2 (10.4 to 14.3)
29–84 days	9 (35)	7.1 (3.7 to 13.7)	23 (19)	4.8 (3.2 to 7.2)	110 (26)	8.9 (7.4 to 10.7)
>84 days	0	–	5 (4)	1.0 (0.4 to 2.5)	11 (3)	1.0 (0.6 to 1.8)
Unknown	0	–	24 (20)	–	86 (20)	–

(330 days/1000 hours, 95% CI 281 to 387) than at U15 (incidence=6.2/1000 hours, 95% CI 4.3 to 8.9, p<0.01; burden=149 days/1000 hours, 95% CI 104 to 213, p<0.01) (table 4). Incidence, severity and burden for specific body sites and injury types are provided in online supplemental table S1.

Event

Contact events accounted for 87% (n=20), 88% (n=93) and 87% (n=324) of known injury types at U13, U15 and U18, respectively, with the tackle responsible for 52% (U13), 48% (U15) and 62% (U18) of all injuries. The tackle had a significantly higher injury incidence at U18 (18.7/1000 hours, 95% CI 16.5 to 21.3) than at U15 (10.6/1000 hours, 95% CI 8.0 to 13.9, p<0.01). Burden of tackle injuries was also significantly greater at U18 (637 days/1000 hours, 95% CI 560 to 725) than at U13 (294 days/1000 hours, 95% CI 167 to 518, p=0.03) and U15 (352 days/1000 hours, 95% CI 267 to 463, p<0.01) (table 4).

Compared with all other injury events, the tackle had a higher injury incidence at U15 (10.6/1000 hours, 95% CI 8.0 to 13.9, p<0.01) and U18 (18.7/1000 hours, 95% CI 16.5 to 21.3, p<0.01) and a greater injury burden at U13 (294 days/1000 hours, 95% CI 167 to 518, p<0.05), U15 (352 days/1000 hours, 95% CI 267 to 463, p<0.01) and U18 (637 days/1000 hours, 95% CI 560 to 725, p<0.01).

Playing position

There were no significant differences in injury incidence or burden between forwards and backs within any age group, however U18 forwards had a significantly higher burden (911 days/1000 hours, 95% CI 798 to 1041) than that of U15 forwards (559 days/1000 hours, 95% CI 434 to 721) (p<0.01) (table 4).

Match period

At U15, the incidence and burden were higher in the second half (incidence=25.2/1000 hours, 95% CI 19.6 to 32.4; burden=563 days/1000 hours, 95% CI 438 to 724) than the first (incidence=12.8/1000 hours, 95% CI 9.0 to 18.2, p<0.01; burden=298 days/1000 hours, 95% CI 210 to 424, p<0.01 (table 4). At both U15 and U18, Q3 (U15=29.0/1000 hours, 95% CI 20.8 to 40.3; U18=29.0/1000 hours, 95% CI 23.6 to 35.7) had a significantly higher injury incidence than Q1 (U15=8.3/1000 hours, 95% CI 4.5 to 15.4, p<0.01; U18=17.4/1000 hours, 95% CI 13.3 to 22.8, p=0.02).

Concussion

Concussions accounted for 23% of all recorded injuries at U13 (n=6; 4.8/1000 hours, 95% CI 2.1 to 10.6), 26% at U15 (n=31; 6.4/1000 hours, 95% CI 4.5 to 9.1) and 27% at U18 (n=114; 9.2/1000 hours, 95% CI 7.7 to 11.1). No significant differences were found between age groups for concussion incidence, although the burden of concussion injuries was significantly higher at U18 (273 days/1000 hours, 95% CI 227 to 328) compared with U15 (162 days/1000 hours, 95% CI 114 to 230, p=0.03).

The incidence and burden of concussions associated with tackles at U18 was significantly higher than all other events (p<0.01); the incidence (3.8/1000 hours, 95% CI 2.8 to 5.0) and burden (115 days/1000 hours, 95% CI 86 to 153) of concussions associated with tackling were significantly higher (p<0.01) than those of concussions associated with being tackled (incidence=1.5/1000 hours, 95% CI 0.9 to 2.3; burden=47 days/1000 hours, 95% CI 30 to 75) (table 5).

DISCUSSION

This three-season study builds on previous work within an English secondary schoolboy setting,[5 8] but is the first to describe and compare rugby union injuries across three different age groups. There were three key findings: (1) the incidence and burden of injury was significantly higher at U18 than U13 and U15 age groups; (2) the tackle was the event most commonly associated with injury at all age groups; (3) concussion was the most common injury type in all age groups.

The injury incidence for U18 players (34.6/1000 hours) in this study was similar to that previously reported in an English and Irish school setting.[5 6 16] A key finding is that injury incidence increased with age, in line with the findings of other studies of youth rugby, including a systematic review of youth rugby injuries[4] and a large study of rugby-related injury insurance claims in New Zealand.[9] It is possible that, as players mature, increases in mass, strength and speed produce greater forces within contact events,[17] which may also be increasing in frequency with age.[18] It is also possible that players are playing to a higher standard as they get older; comparisons between different levels within the same age group have shown that a higher level of play has a greater injury incidence.[5 16 19]

While injury incidence and burden increased significantly with age, mean and median severity of injury were similar in all three age groups. The greater mass, strength and speed of older players[17] might be expected to result in more severe injuries, but it is possible that younger players are managed more conservatively, increasing their time loss. In contrast, older players may perceive more pressure and have more of a desire to return to play sooner,[20] reducing their time loss. It is also possible that there are differences in the medical resources available to players of different ages, with more resources for rehabilitation available to the older players. Nevertheless, the findings of this study suggest that it is the greater injury incidence that is largely responsible for greater injury burden in older age groups, rather than differences in severity.

Injury event

The tackle was responsible for the most injuries at all age groups, which is consistent with previous findings across all levels of the sport.[4 5 21–23] In professional rugby union, it was highlighted that most injuries were associated with the tackle because it was the most common event,

Table 4 Injury region, event, playing position and match period for all injuries in each age group

	Under-13				Under-15				Under-18			
	N	Incidence, injuries/1000 hours (95% CI)	Severity, mean days (95% CI)	Burden, days/1000 hours (95% CI)	N	Incidence, injuries/1000 hours (95% CI)	Severity, mean days (95% CI)	Burden, days/1000 hours (95% CI)	N	Incidence, injuries/1000 hours (95% CI)	Severity, mean days (95% CI)	Burden, days/1000 hours (95% CI)
Region												
Head and neck	7	5.6 (2.7 to 11.7)	23 (6 to 40)	128 (61 to 268)	45	9.3 (7.0 to 12.5)^{T}	22 (15 to 28)	203 (152 to 272)^{T}	162	13.1 (11.2 to 15.2)^{T,U}	25 (21 to 29)	322 (276 to 376)^{5,T}
Upper limb	7	5.6 (2.7 to 11.7)	29 (8 to 51)	164 (78 to 343)	35	7.2 (5.2 to 10.1)^{T}	28 (17 to 40)	205 (148 to 286)^{T}	97	7.8 (6.4 to 9.6)^{T}	34 (26 to 41)	262 (215 to 320)^{T}
Trunk	2	1.6 (0.4 to 6.4)	43 (0 to 103)	68 (17 to 273)	8	1.7 (0.8 to 3.3)	28 (8 to 47)	46 (23 to 91)	14	1.1 (0.7 to 1.9)	17 (7 to 26)	19 (11 to 32)
Lower limb	10	7.9 (4.3 to 14.8)	15 (6 to 24)	118 (63 to 219)	30	6.2 (4.3 to 8.9)^{T}	24 (14 to 34)	149 (104 to 213)^{T}	151	12.2 (10.4 to 14.3)^{5,T,U}	27 (22 to 32)	330 (281 to 387)^{3,5,T}
Unknown	0	–	–	–	1	–	–	–	5	–	–	–
Event												
Tackle	12	9.5 (5.4 to 16.8)	31 (13 to 38)	294 (167 to 518) A,M,N,R,S	51	10.6 (8.0 to 13.9) A,M,N,O,R,S	26 (18 to 33)	352 (267 to 463) A,M,N,O,R,S	232	18.7 (16.5 to 21.3) 5,A,L,M,N,O,R,S	30 (26 to 34)	637 (560 to 725) 3,5,A,L,M,N,O,R,S
-Tackled	8	6.4 (3.2 to 12.7)	30 (9 to 51)	192 (96 to 384)	26	5.4 (3.7 to 7.9)	23 (14 to 32)	173 (118 to 255)	133	10.7 (9.1 to 12.7)^{5,K}	29 (23 to 34)	366 (309 to 434)^{5}
-Tackling	4	3.2 (1.2 to 8.5)	32 (1 to 63)	102 (38 to 271)	25	5.2 (3.5 to 7.7)	29 (16 to 42)	219 (148 to 324)	99	8.0 (6.6 to 9.7)	31 (25 to 38)	305 (250 to 371)
Ruck	3	2.4 (0.8 to 7.4)	15 (0 to 33)	37 (12 to 113)	19	3.9 (2.5 to 6.2)	26 (13 to 38)	101 (64 to 158)^{M,S}	45	3.6 (2.7 to 4.9)^{L,M,S}	27 (18 to 35)	129 (96 to 172)^{M,S}
Accidental collision	3	2.4 (0.8 to 7.4)	17 (0 to 37)	41 (13 to 128)	18	3.7 (2.3 to 5.9)	27 (12 to 41)	99 (63 to 158)^{M,S}	34	2.7 (2.0 to 3.8)^{L,M,S}	25 (15 to 34)	93 (67 to 130)^{M,S}
Other	0	–	–	–	4	0.8 (0.3 to 2.2)	23 (0 to 50)	41 (15 to 110)^{M}	24	1.9 (1.3 to 2.9)^{L,M,S}	30 (17 to 44)	85 (57 to 127)^{M,S}
Running	3	2.4 (0.8 to 7.4)	10 (0 to 21)	23 (7 to 71)	9	1.9 (1.0 to 3.6)	24 (5 to 43)	44 (23 to 85)^{M,S}	24	1.9 (1.3 to 2.9)^{L,M,S}	26 (14 to 38)	74 (50 to 111)^{M,S}
Scrum	1	0.8	17	14	4	0.8 (0.3 to 2.2)	5 (0 to 9)	7 (3 to 20)	6	0.5 (0.2 to 1.1)	8 (1 to 15)	7 (3 to 16)
Maul	1	0.8	9	7	1	0.2	4	1	5	0.4 (0.2 to 1.0)	22 (2 to 37)	15 (6 to 36)^{5}
Lineout	0	–	–	–	0	–	–	–	2	0.2 (0 to 0.6)	38 (0 to 112)	18 (5 to 73)
Unknown	3	–	–	–	13	–	–	–	57	–	–	–
Playing position												
Forwards	14	24.1 (14.3 to 40.7)	21 (10 to 32)	501 (297 to 846)	60	23.3 (18.1 to 30.0)	24 (17 to 31)	559 (434 to 721)	217	32.8 (28.7 to 37.5)	28 (24 to 32)	911 (798 to 1041)^{5}
Backs	12	17.7 (10.1 to 31.2)	26 (11 to 40)	457 (260 to 805)	56	24.8 (19.1 to 32.3)	26 (18.34)	649 (500 to 843)	179	31.0 (25.6 to 35.8)	28 (24 to 33)	875 (756 to 1013)
Unknown	0	–	–	–	3	–	–	–	33	–	–	–
Match period												
First half	8	12.7 (6.4 to 25.4)	28 (8 to 47)	351 (176 to 702)	31	12.8 (9.0 to 18.2)	23 (15 to 32)	298 (210 to 424)	129	20.8 (17.5 to 24.7)^{5}	29 (23 to 35)	605 (509 to 719)^{5}
-Q1	1	3.2	69	219	10	8.3 (4.5 to 15.4)	30 (9 to 51)	249 (134 to 463)	54	17.4 (13.3 to 22.8)	35 (24 to 46)	610 (468 to 797)^{5}
-Q2	7	22.2 (10.6 to 46.7)	22 (6 to 38)	483 (230 to 1013)	21	17.4 (11.3 to 26.7)	21 (12 to 29)	356 (232 to 546)	75	24.2 (19.3 to 30.4)	25 (19 to 31)	605 (482 to 758)
Second half	15	23.8 (14.4 to 39.5)	22 (11 to 33)	526 (317 to 872)	61	25.2 (19.6 to 32.4)^{F}	22 (16 to 29)	563 (438 to 724)^{F}	160	25.8 (22.1 to 30.1)	27 (22 to 31)	694 (595 to 811)
-Q3	9	28.6 (14.9 to 55.0)	21 (7 to 34)	588 (306 to 1130)	35	29.0 (20.8 to 40.3)^{1}	25 (15 to 35)	729 (523 to 1015)^{1,2}	90	29.0 (23.6 to 35.7)^{1}	27 (21 to 33)	787 (640 to 968)
-Q4	6	19.1 (8.6 to 42.4)	24 (5 to 44)	464 (208 to 1033)	26	21.5 (14.6 to 31.6)	19 (11 to 27)	408 (278 to 599)	70	22.6 (17.9 to 28.6)	27 (20 to 33)	601 (475 to 759)
Unknown	3	–	–	–	27	–	–	–	140	–	–	–

Injury events are ordered based on the under-18 injury incidence. When comparing across age groups, significant differences are denoted by: 3, vs U13 or 5, vs U15. When comparing within an age group, significant differences are denoted by: 1: Q1, vs A, vs accidental collision; F, vs first half; K, vs tackling; L, vs lineout; M, vs maul; N, vs running; O, vs other; R, vs ruck; S, vs scrum; T, vs trunk; U, vs upper limb.

Table 5 Event and playing position for concussions in each age group

	Under-13				Under-15				Under-18			
	N	Incidence, injuries/1000 hours (95% CI)	Severity, mean days (95% CI)	Burden, days/1000 hours (95% CI)	N	Incidence, injuries/1000 hours (95% CI)	Severity, mean days (95% CI)	Burden, days/1000 hours (95% CI)	N	Incidence, injuries/1000 hours (95% CI)	Severity, mean days (95% CI)	Burden, days/1000 hours (95% CI)
Overall												
Overall	6	4.8 (2.1 to 10.6)	26 (5 to 47)	125 (56 to 278)	31	6.4 (4.5 to 9.1)	25 (16 to 35)	162 (114 to 230)	114	9.2 (7.7 to 11.1)	30 (24 to 36)	273 (227 to 328)[5]
Event												
Tackle	5	4.0 (1.7 to 9.5)	27 (3 to 51)	109 (45 to 261)	18	3.7 (2.3 to 5.9)[R]	26 (13 to 38)	95 (60 to 151)[R]	66	5.3 (4.2 to 6.8) A,M,O,R,S	30 (22 to 37)	157 (124 to 200) A,M,O,R,S
-Tackled	5	4.0 (1.7 to 9.5)	27 (3 to 51)	109 (45 to 261)	10	2.1 (1.1 to 3.8)	27 (9 to 45)	56 (30 to 104)	47	3.8 (2.8 to 5.0)[K]	30 (21 to 40)	115 (86 to 153)[K]
-Tackling	0	–	–	–	8	1.7 (0.8 to 3.3)	24 (7 to 40)	40 (20 to 79)	19	1.5 (1.0 to 2.4)	27 (14 to 41)	42 (27 to 66)
Ruck	0	–	–	–	2	0.4 (0.1 to 1.7)	22 (0 to 51)	9 (2 to 36)	18	1.5 (0.9 to 2.3)[M,S]	33 (16 to 49)	47 (30 to 75)[M,S]
Accidental collision	1	0.8	20	16	7	1.4 (0.7 to 3.0)	24 (3 to 44)	34 (16 to 72)	15	1.2 (0.7 to 2.0)	27 (12 to 42)	33 (20 to 54)[S]
Other	0	–	–	–	0	–	–	–	5	0.4 (0.2 to 1.0)	42 (5 to 79)	17 (7 to 41)[S]
Maul	0	–	–	–	0	–	–	–	1	0.1	27	2
Scrum	0	–	–	–	0	–	–	–	1	0.1	4	0
Unknown	0	–	–	–	4	–	–	–	8	–	–	–
Playing position												
Forwards	5	8.6 (3.6 to 20.7)	27 (3 to 51)	232 (97 to 558)	16	6.2 (3.8 to 10.1)	28 (13 to 42)	173 (106 to 282)	59	8.9 (6.9 to 11.5)	31 (22 to 40)	279 (216 to 360)
Backs	1	1.5	22	32	13	5.8 (3.3 to 9.9)	24 (11 to 38)	141 (82 to 242)	47	8.1 (6.1 to 10.8)	29 (20 to 37)	233 (175 to 311)
Unknown	0	–	–	–	2	–	–	–	8	–	–	–

Injury events are ordered based on the under-18 injury incidence. When comparing across age groups, significant differences are denoted by: 5, vs U15. When comparing within an age group, significant differences are denoted by: A, vs accidental collision; K, vs tackling; M, vs maul; O, vs other; R, vs ruck; S, vs scrum.

rather than because it caused the most injuries per event (propensity).[24] Currently, the number of contact events and their propensity to cause injury are unknown within youth rugby. This should be investigated to determine whether the greater tackle injury incidence in the older age group is due to a greater number of tackles during a match.

Research into tackles within both professional rugby[25] and U18 tournament rugby[26] found that better tackling technique was associated with a non-injury outcome. Technical deficiencies were also linked with an increase in head contact during a tackle in South African and New Zealand men's professional and semi-professional rugby.[27] A review of research into rugby union tackles concluded that safe tackle technique is effective technique.[28] While the U18 age group had the highest overall and tackle injury incidence, tackling is introduced in the under-9 age group,[10] so it is important that the development of good tackling technique is a focus at all ages.

A high proportion of injuries were to the lower limb in each age group (U13=38%; U15=25%; U18=35%), consistent with a meta-analysis of professional rugby injuries[3] and a previous study of schoolboy rugby injuries.[5] However, in the present study the most common specific injury site and type within all age groups was the head and nerve injury, respectively, reflecting the high incidence of concussion. The U18 concussion incidence (9.2/1000 hours) was greater than previously reported in Irish U18 players (6/1000 hours)[16] and English subelite U18 players (4/1000 hours).[6] The rates which were found in these two studies were more similar to that seen in the U13 (4.8/1000 hours) and U15 (6.4/1000 hours) age groups in the present study. As these studies were conducted several years before the current study, it is possible that concussion awareness improved, resulting in greater detection and reporting of concussion, which could explain the difference in concussion incidence.

The prevention of sports injuries is of great importance for sporting bodies across all levels of participation.[29] In a randomised controlled trial, schoolboy players who completed England Rugby's Activate exercise programme three or more times per week had both a 72% reduction in match injury incidence and a 59% reduction in concussion injury incidence than players in a control group.[8] When combined with the findings of this study and the knowledge that the tackle is responsible for more concussions than any other contact event, interventions that focus on tackle technique training, law change (eg, changes to the legal tackle height) and player preparation may be more effective at reducing injury risk than other interventions in this setting. Match events and characteristics of the tackle at different age groups should be investigated, to inform population-specific recommendations.

Limitations

There is a risk of selection bias. Schools that were better resourced and able to participate in the study were likely those competing at the higher level of schoolboy rugby. This is evidenced by the fact that only 10 of the 35 schools taking part were state schools, although it should be noted that these state schools often played fixtures against independent schools. Therefore, the findings of this study may represent more skilled rugby schools within competitive programmes, rather than typical secondary schools in England and this would likely result in an inflated injury risk. As many of the schools taking part only had the staff available to include one team, generally prioritising the U15 and U18 teams, this resulted in a smaller sample size for the U13 age group. The small sample size in some groups impacted analysis options, including, for example, the decision to employ Z-scores rather than Poisson regression. A further limitation is that injuries with estimated time-loss were removed from the severity and burden calculations, and since these tended to be more severe injuries, it is possible that severity is higher than stated within this study. Due to the requirement for player anonymity, only team-level data could be collected, meaning that it was not possible to develop an understanding of recurrent injuries or whether players were varying their playing positions. In addition, clustering effects were not accounted for in the analysis.

CONCLUSION

The U18 age group had a significantly higher injury incidence and burden than the two younger age groups. The tackle was associated with the most injuries at all age groups, however it is not known whether age-related changes in tackle incidence and burden are because there are more tackles per game or because individual tackles are more likely to cause injury. Understanding the number of contact events within the games at each age group would enable researchers to identify which events have the highest propensity for injury. Concussion was the most common type of injury at all age groups, and identifying and addressing issues with the tackle may also reduce the number of concussions.

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