Injury incidence and characteristics in South African school first team rugby: A case study

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Background: Despite its apparent popularity, participation in the sport of rugby union is accompanied by a significant risk of injury. Concerned parties have recently questioned whether this risk is acceptable within school populations. This is difficult to assess within the South African schools' population as no recent longitudinal injury studies exist.

Objectives: To determine the training habits, rugby-related exposure and injury risk within a population of South African high school first team rugby players.

Methods: Training and match exposure in both school and provincial competition were examined and the resultant injuries were longitudinally observed for the duration of a South African high school rugby season.

Results: Match (79, 95%CI 52-105 injuries/1 000 h) and training (7, 95%CI 3-11 injuries /1000h) injury incidences were demonstrated to be greater than previously reported incidences in similar populations in England and Ireland. Weeks where players were exposed to both school and provincial competition (34, 95%CI 19-49 injuries /1 000 h) had significantly ($p<0.05$) greater injury incidences than during school competition alone (19, 95%CI 12-26 injuries /1 000 h).

Conclusion: The injury risk demonstrated was greater than expected and represents reasons for concern. Possible reasons for the high injury incidence recorded may be the frequency of games played within the season, and the overlap of school and provincial competitions. It should be noted that these results were taken from one school over one season and might not be representative of the incidence of school rugby injuries overall. However, this research demonstrates the need for a multischool longitudinal study within South African schools rugby to determine the overall risk.

Keywords: rugby union, youth, injury risk, provincial, multi-competition

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Rugby union is a collision sport, with more than 2.8 million players in 120 countries worldwide. [1] In recent years, the game has been exposed to increasing levels of scrutiny regarding the safety of participation. [2-3] Meta-analysis has revealed that the mean injury incidence is 81, 95%CI 63-105 injuries /1 000 h in matches and 3, 95%CI 2-4 injuries /1000 h in training for professional players. [4]

Recently public interest groups have questioned whether the overall risk of injury, particularly at school level, is acceptable. They have even gone as far as to suggest that tackling should be banned from school rugby. [2] In their response, World Rugby have called for longitudinal injury surveillance research to be undertaken at school level in order to accurately quantify the risks to school rugby players. [3] Some research on this topic exists, [5-10] but because of the variation in the methods of reporting and injury definitions applied, it is difficult to make comparisons across studies. [3]

In the largest and most comprehensive study of this subject to date, Palmer-Green et al. reported a match injury incidence of 35, 95%CI 29-41 injuries /1 000 player h during matches with a mean injury severity of 30 days (95%CI 25-35) for English school level players. [7] These authors also found that in training, the injury incidence was 1.7 injuries / 1 000 h and mean severity was 27 days (95%CI 9-45). [8] The Rugby Injury Surveillance in Ulster Schools project reported a match injury incidence of 29 per 1 000 player hours, but did not provide training data. [5]

In South Africa, landmark studies performed in 1982 and 1987 estimated the "missed subsequent match" injury incidence to be 7, 95%CI 0-21 injuries /1000 player h. [9-10] These studies were conducted before the advent of professionalism in rugby union, and the game has since changed significantly. Subsequent to these studies, the focus of youth rugby injury research has been on the national provincial weeks tournaments. [11-13] At these tournaments, it was reported that the match injury incidence was 29, 95%CI 18-39 injuries /1 000 h at U18 level. [11] This research reports the injury profile of a single provincial competition week, but falls short of the type of longitudinal injury surveillance methodology required to make effective risk evaluations regarding the safety of the game at this level. [3]

Therefore the aim of this present study was to provide a preliminary longitudinal injury case study of a single U19 South African school rugby team. It describes the training habits and exposure levels typical of the South African school rugby system, and provides insights into the injury risks for players at this level.

Methods

Participants

The team investigated is from a well-established rugby playing school that was ranked in the Top 20 rugby schools in South Africa at the end of the 2016 rugby season across a range of ranking systems. Players were aged between 16 and 18 years on the 1st of January 2016, and were members of the school's first XV rugby squad. The player cohort comprised 23 players (14 forwards and 9 backs) with physical characteristics as presented in Table 1.

Procedures

Data regarding all injuries and training exposure throughout the 2016 school rugby season (including the preseason) from 25 January to 6 August 2016 were collected by the team's Strength and Conditioning coach. The team's physiotherapist confirmed

all injury diagnoses. These were later retrospectively analysed to determine injury incidence. Ethical approval for the study was obtained from the Leeds Beckett University Ethics Committee.

Injuries were classified according to the "time-loss" definition provided by the 2007 International Rugby Board (IRB) consensus statement [14]. Injury severity was calculated as the total number of days elapsed from the day of injury until a player returned to full training or match participation. [14] Injuries were recorded on an MS Excel spreadsheet with a coding system which included the injury date, body site, type of injury, whether the injury occurred during a match or training session, whether the injury occurred as the result of a contact/collision event, and the date that the player returned to full participation following injury.

Match and training exposure times were individually recorded for each player during each on-field participation. When squad players were not selected for the school's first XV matches, their exposure in the second XV matches was recorded. These involvements were then summed to provide the overall team match and training exposure time. Gym sessions were not included in the analysis. Over the course of the study period, players were involved in a multistage provincial trials process, and depending on progression through the trials, players were exposed to additional rugby involvement through provincial training and games. Table 2 provides a summary of how the training week is affected when players have to attend both school and provincial training sessions. Exposure and injuries due to provincial involvement were treated separately to school team involvement. Where it was not possible for the investigator to directly observe these provincial training sessions and matches, exposure time was collected via a player report. Figure 1 provides the comparative amount of time spent per week on school and provincial rugby throughout the season. In order to determine the effect of playing for both school and provincial teams simultaneously, injury incidence was compared for weeks where players represented school-only, province-only and school and province combined.

Table 1. Physical characteristics of school player cohort (n=23)

	Whole group (n=23)	Backs (n=9)	Forwards (n=14)	Likelihood and magnitude of difference
Stature (cm)	178 ± 6	176 ± 7	180 ± 6	*Likely, medium*
Body Mass (kg)	88.4 ± 13.3	78.7 ± 6.8	95.7 ± 12.4	*Very likely, very large*
Vertical Jump (cm)	50 ± 8	54 ± 6	47 ± 7	*Very likely, large*
1RM bench press (kg)	94 ± 15	90 ± 14	98 ± 16	*Unclear, medium*
5RM squat (kg)	132 ± 23	120 ± 22	140 ± 21	*Likely, large*
40m sprint (s)	5.4 ± 0.3	5.2 ± 0.3	5.5 ± 0.3	*Likely, large*
Yo-Yo IRT1 (m)	933 ± 354	1217 ± 287	711 ± 216	*Most likely, very large*

1RM, one repetition maximum; 5RM, five repetition maximum; Yo-Yo IRT1, Yo-Yo intermittent recovery test one. Data presented as mean ± SD.
Likelihood represents the chance that the true value of the difference between groups is substantially positive or negative according to the following scale - <1%, almost certainly not; 1% to 5%, very unlikely; 5% to 25%, unlikely; 25% to 75%, possible; 75% to 95%, likely; 95% to 99%, very likely; >99%, almost certain. Magnitude of difference represents Cohen's effect size statistic. ESs of 0.2, 0.6, 1.2 and 2.0 were considered small, medium, large and very large respectively.

Table 2. In-season weekly training schedule for a South African high school rugby first team during weeks representing the school only or school and province combined

	School-only		School and province combined	
Day	**Activity**	**Time (mins)**	**Activity**	**Time (mins)**
Monday	Gym	45	Provincial training	100
	Aerobic training and small sided games	60	(combination of attack, defence and unit skills)	
	Total	**105**	**Total**	**100**
Tuesday	Warm up and skills	20	Warm up	20
	Defence	30	Provincial match	60
	Breakdown	30		
	Units skills (backs/forwards)	30		
	Total	**110**	**Total**	**80**
Wednesday	Rest		Rest	
	(Occasional additional lineout session for forwards)	(30)		
	Total	**(30)**	**Total**	**0**
Thursday	Gym	30	Gym	30
	Speed and Agility	20	Speed and Agility	20
	Attack skills and structure	45	Breakdown/defence	30
	Unit skills (backs/forwards)	30	Attack structure	30
			Unit skills (backs/forwards)	30
	Total	**125**	**Total**	**140**
Friday	Captains run	30	Captains run	30
	Total	**30**	**Total**	**30**
Saturday	Warm up	30	Warm up	30
	Match	70	Match	70
	Total	**100**	**Total**	**100**
Sunday	Rest / recovery		Rest / recovery	
	Total	**0**	**Total**	**0**
Total for week		**470**		**450**

Statistical analyses

Injury incidence was calculated for matches, training and overall rugby exposure as the number of injuries per 1 000 player hours for both school and provincial rugby exposure. Independent injury incidences were further calculated for periods of the season where players participated in school-only (17 weeks), province-only (five weeks) and school and province combined (six weeks) rugby. 95% confidence intervals (95%CI) were calculated according to the methods of Knowles et al.[16] Injury incidence between different groups (e.g. backs vs. forwards) or studies was compared by calculating incidence rate ratios (IRR) and magnitude-based inferences (MBI) using a custom designed spreadsheet (www.sportsci.org). [15] MBI represents the likelihood that the true value is substantially positive or negative according to the following scale - <1%, *most unlikely*; 1% to 5%, *very unlikely*; 5% to 25%, *unlikely*; 25% to 75%, *possibly*; 75% to 95%, *likely*; 95% to 99%, *very likely*; >99%, *most likely*. Injury severity was calculated as the mean ± SD number of days absence from training and match play. However, given the practical nature of this study, the size of effect was assessed calculating Cohen's effect size (ES) statistic. [15] ESs of 0.2, 0.6, 1.2 and 2.0 were considered *small, medium, large and very large* respectively. [15] Injury burden was calculated as the total number of days absent from training and match play.

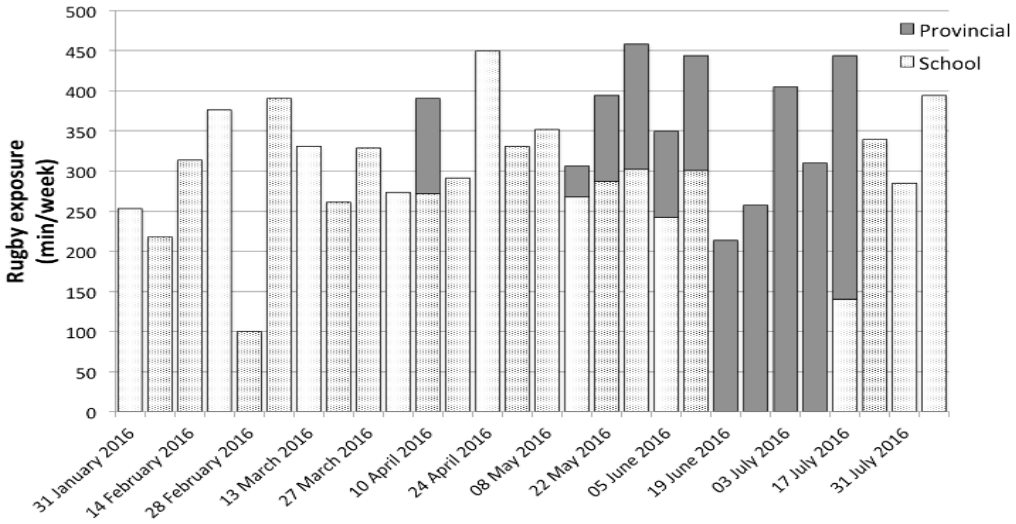

Fig. 1. *Average weekly exposure of South African high school rugby players to school and provincial rugby.*

Table 3. Comparison of injury incidence during matches and training for backs and forwards for all exposures

		All competition			Match vs. training	
		Overall	**Matches**	**Training**	**MBI**	**IRR (95%CI)**
All players	**Injuries (N)**	54	42	12		
	Incidence	23	84	7	*most likely*	12.0 (6.8 – 21.2)
	(95%CI)	(17 - 30)	(59 - 110)	(3 - 10)		
Backs	**Injuries (N)**	25	21	4		
	Incidence	25	94	5	*very likely*	18.8 (2.6 – 134.8)
	(95%CI)	(15 - 35)	(54 - 134)	(0 - 10)		
Forwards	**Injuries (N)**	29	21	8		
	Incidence	22	76	8	*most likely*	9.5 (4.0 – 22.7)
	(95%CI)	(14 - 29)	(44 - 109)	(2 - 13)		
Backs vs. forwards	**MBI**	*trivial*	*possibly*	*unclear*		
	IRR	1.1	1.2			
	(95%CI)	(0.7 to 1.8)	(0.7 to 2.1)			

MBI, magnitude based inference; IRR, incidence injuries ratio

Injuries indicates the total number of injuries that occurred. Incidence is the number of injuries per 1 000 hours of exposure time (95%CI). MBI represents the likelihood that the true value is substantially positive or negative according to the following scale - <1%, most unlikely; 1% to 5%, very unlikely; 5% to 25%, unlikely; 25% to 75%, possibly; 75% to 95%, likely; 95% to 99%, very likely; >99%, most likely. IRR represents the incidence rate ration with 95% confidence intervals.

Results

Exposure

In total, players were exposed to 2 088 hours of rugby activity during the school season (training 1 668 hours, matches 420 hours). This equated to a total of 78 scheduled training sessions and 20 interschool matches over the season (training to match ratio approx. 4:1).

Participation in provincial rugby led to an additional 221 hours of rugby exposure (training 142 hours, matches 79 hours). Consequently, on average, each school player was exposed to an additional 4 ± 5 (range 0 to 14) training sessions and 4 ± 3 (range 1 to 8) matches (training to match ratio approx. 1:1).

Incidence of injury

Match vs. training

Overall, a total of 54 time-loss injuries were sustained (42 match, 12 training). The overall injury incidence was 23 injuries per 1 000 player exposure hours (95%CI 17-30). The match injury incidence (84 injuries per 1 000 match hours; 95%CI, 59-110) was most likely greater that the training injury incidence (7 injuries per 1 000 training hours; 95%CI 3-10) (IRR 12.0 95%CI 6.8-22.1) (Table 3). Injury incidence for school and provincial

Table 4. Comparison of injury incidence during matches and training for backs and forwards for school and provincial exposures

		School competition			Match vs. training		Provincial competition			Match vs. training
		Overall	Matches	Training	MBI	IRR (95%CI)	Overall	Matches	Training	MBI
All players	Injuries (N)	45	33	12		11.3 (6.1 – 21.0)	9	9	0	*unclear*
	Incidence	22	79	7	*most likely*		41	114	0	
	(95%CI)	(15 - 28)	(52 - 105)	(3 - 11)			(14 - 68)	(40 - 188)	0	
Backs	Injuries (N)	22	18	4		16.5 (2.1 – 128.3)	3	3	0	*unclear*
	Incidence	26	99	6	*very likely*		23	70	0	
	(95%CI)	(15 - 37)	(54 - 145)	(0 - 12)			(-3 - 50)	(-9 - 149)	0	
Forwards	Injuries (N)	23	15	8		7.9 (3.7 – 16.6)	6	6	0	*unclear*
	Incidence	18	63	8	*most likely*		64	167	0	
	(95%CI)	(11 - 26)	(31 - 95)	(2 - 8)			(13 - 115)	(33 - 300)	0	
Backs vs. forwards	MBI	*possibly*	*possibly*	*unclear*			*unclear*	*unclear*	*unclear*	
	IRR (95%CI)	1.4 (0.9 to 2.4)	1.6 (0.8 to 2.9)							

MBI, magnitude based inference; IRR, incidence injuries ratio
Injuries indicates the total number of injuries that occurred. Incidence is the number of injuries per 1 000 hours of exposure time (95%CI). MBI represents the likelihood that the true value is substantially positive or negative according to the following scale - <1%, most unlikely; 1% to 5%, very unlikely; 5% to 25%, unlikely; 25% to 75%, possibly; 75% to 95%, likely; 95% to 99%, very likely; >99%, most likely. IRR represents the incidence rate ration with 95% confidence intervals.

Table 5. Comparison of injury severity (days) during matches and training for backs and forwards for all exposures

		All competition			Match vs. training	
		Overall	Matches	Training	MBI	Effect Size
All players		15 ± 36	18 ± 40	3 ± 2	*likely*	*small* (0.42)
Backs		5 ± 4	5 ± 4	3 ± 1	*most likely*	*trivial*
Forwards		24 ± 47	32 ± 54	3 ± 2	*likely*	*medium* (0.62)
Backs vs. forwards	MBI	*likely*	*very likely*	*most likely*		
	Effect Size	*small* (0.55)	*medium* (0.71)	*trivial*		

MBI, magnitude based inference. Data are presented as mean ± SD.
MBI represents the likelihood that the true value is substantially positive or negative according to the following scale - <1%, most unlikely; 1% to 5%, very unlikely; 5% to 25%, unlikely; 25% to 75%, possibly; 75% to 95%, likely; 95% to 99%, very likely; >99%, most likely. Effect size is Cohen's effect size (ES) statistic. ESs of 0.2, 0.6, 1.2 and 2.0 were considered small, medium, large and very large respectively

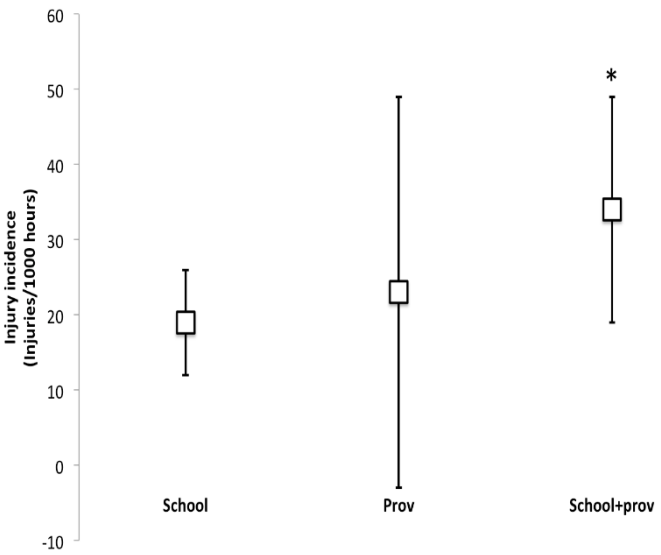

Fig.2. *Injury incidence during periods where players are exposed to only school, only provincial and to school and provincial rugby. * indicates likely difference from school rugby.*

exposures are provided in Table 4.

Backs vs. forwards

Backs had a *possibly* greater match injury incidence than forwards in school rugby (backs 99, 95%CI 54-145 vs. forwards 63, 95%CI 31-95 injuries /1 000 h, IRR 1.6, 95%CI 0.8 – 2.9) (Table 4). When playing provincial rugby forwards had a *likely* higher match injury incidence than backs (backs 70, 95%CI 9-149 vs. forwards 167, 95% CI 33-300 injuries /1 000 h, IRR 2.4, 95%CI 0.5 – 10.7).

Provincial vs. school rugby

Periods of the season when players participated in school-only rugby (17 weeks), province-only rugby (five weeks), and in school and province combined rugby (six weeks) were compared for overall injury incidence. Injury incidence was *likely* greater in the weeks where players participated in both school and province combined rugby compared with school-only participation (school-only 19, 95%CI 12-26 vs. school and province combined 34, 95%CI 19-49 injuries /1 000 h, IRR 1.8, 95%CI 1.1 – 3.0) (Figure 2). The difference between

Table 6. Comparison of injury severity during matches and training for backs and forwards for school and provincial exposures

		School rugby			Match vs. training		Provincial rugby			Match vs. training
		Overall	Matches	Training	MBI	IRR (95%CI)	Overall	Matches	Training	MBI
All players		13 ± 30	16 ± 34	3 ± 2	*possibly*	*small* (0.45)	27 ± 58	27 ± 58	-	*unclear*
Backs		5 ± 4	5 ± 5	3 ± 1	*most likely*	*trivial*	5 ± 4	5 ± 4	-	*unclear*
Forwards		20 ± 41	29 ± 48	3 ± 2	*likely*	*medium* (0.66)	38 ± 70	38 ± 70	-	*unclear*
Backs vs. Forwards	**MBI**	*likely*	*likely*	*most likely*			*unclear*	*unclear*	-	
	Effect Size	*small* (0.51)	*medium* (0.74)	*trivial*			*small* (0.56)	*small* (0.56)	-	

MBI, magnitude based inference. Data are presented as mean ± SD.
MBI represents the likelihood that the true value is substantially positive or negative according to the following scale - <1%, most unlikely; 1% to 5%, very unlikely; 5% to 25%, unlikely; 25% to 75%, possibly; 75% to 95%, likely; 95% to 99%, very likely; >99%, most likely. Effect size is Cohen's effect size (ES) statistic. ESs of 0.2, 0.6, 1.2 and 2.0 were considered small, medium, large and very large respectively

Table 7. Burden of injury in a South African high school rugby first team as a function of injury site and type

	Brain	Bone	Joint / Ligament			Muscle / Tendon		Total
	concussion	non-fracture	sprain	lesion of meniscus, cartilage or disc	muscle rupture/ tear/ strain/ cramp	tendon injury/ rupture/ tendinopathy/ bursitis	haematoma/ contusion/ bruise	
Head / Face	19 (1)						6 (1)	**25 (2)**
Neck / Cervical spine					2 (1)		4 (1)	**6 (2)**
Sternum / Ribs				3 (1)			1 (1)	**4 (2)**
Shoulder / Clavicle				10 (1)	110 (2)		14 (3)	**134 (6)**
Elbow						2 (1)		**2 (1)**
Hip / Groin					7 (2)			**7 (2)**
Anterior thigh							9 (3)	**9 (3)**
Posterior thigh					72 (7)			**72 (7)**
Knee			227 (11)			9 (2)	1 (1)	**237 (14)**
Lower leg / Achilles					20 (3)			**20 (3)**
Ankle			288 (10)					**288 (10)**
Foot / Toe		2 (1)					4 (1)	**6 (2)**
Total	**19 (1)**	**2 (1)**	**515 (21)**	**13 (2)**	**211 (15)**	**11 (3)**	**39 (11)**	**810 (54)**

Data are presented as injury burden, the total number of injury days followed by (number of injuries).

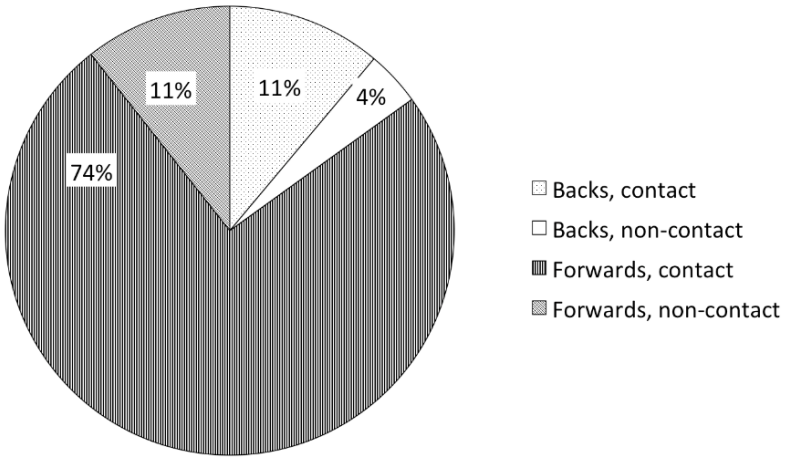

Fig.3. *Relative contribution of forwards and backs contact and non-contact injuries to the total team injury burden.*

provincial-only and school and province combined participation was *unclear* (provincial participation only 23, 95%CI -3-49 vs. school and provincial participation 34, 95%CI 19-49 injuries /1 000 h).

Injury severity

The mean severity of all injuries sustained was 15 ± 36 days. Data on the severity of injuries for backs and forwards in school and provincial competition are provided in Tables 5 and 6. Overall, there was a *likely small* difference in the severity of injuries sustained in matches and training (match 18 ± 40 vs. training 3 ± 2 days, ES = 0.42). A *very likely medium* difference was present for match injury severity between backs and forwards (backs 5 ± 4 vs. forwards 32 ± 54, ES = 0.71). The effect of this was that despite sustaining a similar number of overall injuries

(backs 25 vs. forwards 29), forwards contributed 85% of the team injury burden (Figure 3).

Nature of injury

The lower limb was the most commonly injured body area for both backs (88%, 22 of 25) and forwards (66%, 19 of 29). Forwards experienced a greater proportion of upper limb injuries relative to backs (backs 0%, 0 of 25 injuries vs. forwards 24%, 7 of 29). Injury incidence and severity were combined to provide the total injury burden by injury site and type (Table 7). The most costly injuries were ligament sprain type injuries to the knee and ankle which when combined accounted for 64% (515 of 810 days) of the total season injury burden. The majority of injuries (69%, 37 of 54) occurred as a result of contact events. There was a *possibly small* difference in the severity of contact versus non-contact injuries (contact 19 ± 42 vs. non-contact 7 ± 13, ES = 0.34). In total, 692 (85%) training days were lost to contact injury and 122 (15%) days were lost to non-contact injury.

Discussion

This is the first study since 1987 to determine the incidence, severity and nature of injury in a South African high school rugby first team using a longitudinal approach to data collection. The key finding of this study was that the injury incidence observed in this player cohort was much larger than would be expected for a group of school-level rugby players. Given that this was a case study, the sample examined was not large enough to provide definitive analysis of the risks that players are exposed to within this category. However, the observations highlighted here illustrate the need for a larger study of this type that incorporates multiple schools.

This study shows that in this cohort, the match injury incidence (79, 95%CI 52-105 injuries/1 000 h) is *most likely* higher than that reported for similar population groups in England (35, 95%CI 29-41 injuries/1 000 h; IRR 2.3, 95%CI 1.6-3.1), [7] Ireland (29, 95%CI 18-40 injuries /1 000 h; IRR 2.7, 95%CI 1.7-4.3)[5] and Scotland (11, 95%CI 5-18 injuries /1 000 h; IRR 7.2, 95%CI 3.9-13.3). [6] Similarly, the training injury incidence in this study (7, 95%CI 3-11 injuries /1 000h) was *very likely* greater than that reported in England (2, 95%CI 1-3 injuries /1 000 h; IRR 3.5, 95%CI 1.7-7.1). [8] Despite the greater injury incidence, the mean severity of match injuries (16 ± 34 days) in this cohort, was likely lower than in England (30 ± 30 days) [7] and Ireland (24 ± 20 days). [5] Similarly, the severity of training injuries was *very likely* lower in this cohort (3 ± 2 days) than the England group (27 ± 55 days). [8] Some of the differences between these studies might be explained by different reporting methods (e.g., whether the researcher was also the primary data collector) in these studies. [3] Despite these inconsistencies, it is still evident that the injury incidence in this study is higher than previously reported. [5-10] This is illustrated by the fact that the incidence reported here is comparable with the incidence in men's senior professional rugby (81 injuries per 1 000 training hours; 95%CI 63-105). [4] These results suggest that the risk of injury in South African school first team rugby is higher than what had previously been determined in other school cohorts. [9-10]

When players participated in provincial rugby the match injury incidence was 114, 95%CI 40-188 injuries /1 000 h. This incidence is *very likely* higher than the English equivalent of Academy rugby (47, 95%CI 38-45 injuries /1 000 h) [7], and *most likely* higher than that reported for provincial Youth Week tournaments in South Africa (29, 95%CI 18-39 injuries /1 000h). [11] This injury incidence was similar to the injury rate reported for international rugby (123, 95%CI 85-177 injuries /1 000h). [4] This is consistent with observations that injury risk increases with playing level [4], but also indicates that the risk in this cohort is higher than previously reported for similar groups. [7]

The nature of injury described in this study was consistent with that previously described across school-, academy- and professional levels within the game. [4-11] The lower limb was the most frequently injured body part, and accounted for 76% of all injuries. Muscle and tendon injuries were the most frequent injury type, followed closely by joint and ligament injuries. Joint and ligament injuries resulted in the greatest injury burden, and accounted for 64% of the total time lost. The majority of injuries (69%) occurred as a result of involvement in a contact event. These results agree with previous research that determined that the tackle is the phase of play most likely to cause injury. [12-13]

It is difficult to determine why the injury incidence in this study was so high compared to other school cohorts. A possible explanation is that due to the heightened profile of school first team rugby in South Africa considerable resources are spent on the recruitment and strength and conditioning of players. Stronger and fitter players are able to exert greater force during tackles and collisions, and may be involved in these phases of play more frequently, thus exposing them to greater risk of injury. [7] This effect is demonstrated by the observation that despite greater body mass and strength (Table 1), forwards accounted for 85% of the total team injury burden (Figure 3). Injury incidence was higher in provincial matches for forwards, where the majority of players are likely to be better conditioned. The effect may not have been as pronounced for backs, as it is known that backs are exposed to fewer contact events during a match. [17]

A second possible explanation is that structure of the South African school rugby season, where players are regularly required to participate in two and sometimes three games per week, is not optimal. These periods lead to reduced opportunity for recovery, causing players to enter subsequent exposure bouts fatigued. [18] These periods reduce the time that could be spent on conditioning activities, thus these players may be less well prepared physically for matches later in the season.

A further contributing factor may be the overlap between school competition and provincial trials competition. It was demonstrated that in the weeks where players participated in both school and province rugby combined, the injury incidence was *likely* higher than when they participated in

school rugby only (school only 19, 95%CI 12 to 26 vs. school and provincial 34, 95%CI 19 to 49 injuries per 1 000 hours; IRR 1.8, 95%CI 1.1 – 3.0) (Figure 2). It is important to note that this effect is unlikely to be only due to increased match frequency. In both school-only (Easter Festivals) and provincial-only competition (Craven Week) players were exposed to periods where they played three matches in a week. It seems that the participation for two different teams in different competitions in the same week is an injury risk factor. This might be due to misalignment between schools and provincial training. In these weeks, due to pressure to complete the necessary technical/tactical work required, it is unlikely that adequate attention is paid to conditioning and recovery activities. In addition, playing within two different team environments may contribute to the accumulation of psychological and emotional stress within players. Efforts should be made to reduce congestion in this period of the season, or to reschedule these competitions to prevent overlap. Further research should aim to determine how the stress of two different playing environments (e.g. school and academy, or club and country) may affect player wellbeing and injury risk.

Conclusion

This is the first longitudinal injury research project to be undertaken in South African school rugby since the advent of professionalism. The injury risk demonstrated was much larger than would be expected for a cohort of schoolboy rugby players, which is reason for concern. Possible reasons for the high injury incidence recorded may be the frequency of games within the season, and the overlap of school and provincial competitions. However, a major limitation of this study is the small sample size used, and the fact that all players represented the same school team. This research demonstrates the need for a larger multischool longitudinal study with South African school rugby to determine the overall risk, and what can be done to mitigate these risks within this population.

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