

Epidemiology of Injuries Sustained by Elite Under-18 Rugby Players

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Context: The physical nature of rugby is responsible for the high incidence of injuries, but no researchers have examined the epidemiology of injuries sustained by elite under-18 rugby players.

Objective: To investigate the incidence of injuries sustained by players on the Spanish national under-18 rugby team during their participation in 4 European championships (2014–2017) and the types of play in which they occurred.

Design: Cohort study.

Setting: European rugby championships.

Patients or Other Participants: Ninety-eight under-18 rugby players.

Main Outcome Measure(s): All injuries sustained during the championship periods were recorded per the World Rugby protocol.

Results: A total of 40 injuries were logged over the 4 championships. The incidence of injury was higher during matches than during training ($P < .05$), with 138.0 (95% confidence interval [CI] = 136.5, 139.6) injuries per 1000 hours

of play compared with 1.2 (95% CI = 1.2, 1.3) per 1000 hours of training. With only 2 days of rest between games, the injury rate was higher than with 3 days of rest ($P < .05$). More injuries were sustained during the third quarter of the game: 13 (44.8%) versus 6 (20.6%) in the last quarter, 5 (17.3%) in the second quarter, and 5 (17.3%) in the first quarter.

Conclusions: The most common injuries during matches were sprains and concussions, and these injuries were more likely to occur during matches than during training. Most injuries were caused by tackles and occurred during the third quarter of the game. These findings indicate that teams should focus on teaching players skills to reduce injuries caused by tackles and warming up properly before returning to the field after halftime. The injury rate was higher with only 2 versus 3 days' rest between games. These results suggest that young players' matches should be at least 72 hours apart.

Key Words: epidemiology, youth players, incidence

Key Points

- The majority of injuries in rugby players under age 18 were caused by tackles and occurred during the third quarters of games.
- Before returning to the field after halftime, athletes should warm up properly and adopt techniques to refocus their concentration.
- Learning skills to reduce the number of injuries caused by tackles may also be beneficial.

Epidemiologic studies can aid in the development of strategies that reduce the incidence of sports injuries.^{1,2} Since rugby became a professional sport in 1995, the number of injury epidemiology studies has increased. However, different methods have been used to record these injuries, which led to the International Rugby Board's 2007 publication of a consensus document establishing the definitions and methods to be used.³ Several groups^{4–6} have reported high injury rates associated with professional rugby: 83.9 to 90.1 injuries per 1000 hours of play. However, few authors have examined the injuries sustained by adolescent rugby players. Because adult and adolescent players differ in physical form and maturity, levels of stress, and game speed, the data obtained for professional and adult players cannot simply be extrapolated to this age group. Injury-prevention programs aimed at professional and adult players may not be

appropriate for adolescents.⁷ Yet the number of youth players is increasing. In Spain, more than 20% of federation licenses correspond to players in this age group, so it is necessary to study this population.

We examined the incidence of injuries sustained by players on the Spanish national under-18 rugby team during 4 European championships and the types of play in which they occurred. To our knowledge, this is the first prospective study of its kind, and our aim was to establish injury-prevention strategies for this age group.

METHODS

We designed this prospective, longitudinal, cohort study to obtain level 3 evidence. Ethical approval was granted by the Universidad Camilo José Cela Ethics Board. Written

informed consent was acquired from all participants and their parents.

The injuries sustained by the male players of the Spanish national under-18 rugby team during the 2014–2017 European championships were recorded, and all injured players were followed until they recovered. A total of 98 players participated (ages = 17–18 years; the squad consisted of 26 players in each tournament). The 2014 and 2015 championships involved 47 players (5 played in both competitions), whereas the 2016 and 2017 championships involved 51 players (1 played in both competitions). All players were healthy at the beginning of each tournament. Training camp began 7 days before the first game. Baseline information was collected on all players, including normal playing position, age (years), height (cm), and body mass (kg).

All injuries sustained during the championship periods (including training and matches) were recorded. The 2014 and 2015 championships involved the team's participation in 3 matches separated by 2 days over 1 week; for the 2016 and 2017 championships, it involved 3 matches separated by 3 days over 9 days. *Match exposure* was calculated on the basis of 15 players (8 forwards and 7 backs) per match exposed for 70 minutes per match. *Training exposure* was calculated by summing the duration of different training activities and the number of players participating in each training session.

Injuries were recorded using the World Rugby protocol of Fuller et al.³ A *primary injury* was defined as any injury that prevented a player from fully taking part in training sessions or that prevented him playing in a match for more than 24 hours. A *recurrent injury* was defined as a repeat injury that was sustained after recovery from a previous injury and affected the same location. Injury severity was based on the number of days between the injury and the return to normal physical condition (2–3 days, *minimal injury*; 4–7 days, *mild injury*; 8–28 days, *moderate injury*; >28 days, *severe injury*). *Normal physical condition* was deemed to have been regained when the injured player was again able to follow the normal training plan or had become “game fit.” The following information was collected for each injury: date the injury was sustained, date when normal physical condition was regained, use of protection, player's field position, location of injury, type of injury, Orchard code,⁸ contact or noncontact injury, primary or recurrent injury, injury sustained during training or a match, type of play in which the injury was sustained, time point during match when the injury was sustained, whether the injury was caused by a foul (and if so, whether this was designated as dangerous play), playing surface, diagnostic tests performed, and treatments prescribed. All data were collected by the team physician and stored in an Excel spreadsheet (Microsoft Corp, Redmond, WA) following the format used by Fuller et al.³ The team physician was present for all training and matches during the training camp and tournament. The number of minutes spent in training, the type of training undertaken, and the number of matches played by each athlete were also recorded.

Statistical Analysis

Player baseline results were expressed as mean \pm standard deviation and other data as frequencies and

percentages. Injury incidences were reported as injuries per 1000 player-match-hours with 95% confidence intervals (CIs), and injuries per 1000 player-training-hours were calculated. Frequencies were compared using the χ^2 test, and statistical significance was assumed if the *P* value was $<.05$. All calculations were performed using SPSS (version 20.0; IBM Corp, Armonk, NY).

RESULTS

The mean age, height, and weight of the players for the 4 years examined were 17.3 ± 0.5 years, 181 ± 6.7 cm, and 88.4 ± 12.7 kg, respectively. We examined a total of 210 player-match hours and 2145 player-training hours over the 4 championship periods.

Forty injuries were sustained over the 4 championships, 29 during matches compared with only 11 during training ($P < .05$; Table 1). The incidence of injuries was higher during matches than during training (138.0 [95% CI = 136.5, 139.6] per 1000 hours of play versus 1.2 [95% CI = 1.2, 1.3] per 1000 hours of training).

Injuries sustained during matches with 2 days' rest between games amounted to 19, as opposed to 10 with 3 days' rest between games ($P < .05$); the incidence of injuries was 180.9 (95% CI = 178.3, 183.5) per 1000 hours of play versus 95.2 (95% CI = 93.3, 97.1) per 1000 hours of training.

The median time out due to injury was 6.5 days, and the interquartile range was 28 days. One player who experienced tears of the anterior cruciate ligament, medial collateral ligament, and medial meniscus was out for 214 days. In total, 17 injuries (42.5%) were logged as minimal, 3 (7.5%) as mild, 7 (17.5%) as moderate, and 13 (32.5%) as severe (Table 2).

The injuries most commonly sustained during matches were sprains (27.6%) and concussions (24.1%; Table 3). The body regions injured most often were the head (24.1%), knee (17.2%), and ankle (13.8%; Table 4). During training, the injuries most frequently sustained were tendinopathies (45.5%) and sprains (36.4%; Table 3). Combining injury location and injury type for specific diagnoses, ankle sprains occurred most often during matches and Achilles tendinopathies occurred most commonly during training.

More injuries were sustained during the third quarter of the game: 13 (44.8%) compared with 6 (20.6%) in the last quarter, 5 (17.3%) in the second quarter, and 5 (17.3%) in the first quarter.

Of the 29 players (93.1%) injured during a game, 27 used some form of protection (eg, mouthguard or head guard); only 2 players (6.9%) used none.

Regarding player position, backs were most frequently injured during matches (15, 51.7%) compared with forwards (14, 48.3%) and during training (7, 63.3%) compared with forwards (4, 36.4%). These values were not different.

Trauma caused all match injuries. However, during training, 5 injuries (45.5%) were sustained through non-traumatic mechanisms and 6 (54.5%) by trauma.

The majority of injuries sustained during matches were caused by tackles (23 [72.4%]), with the tackled player experiencing most of these injuries (13 [44.8%]) compared with 8 [27.6%] sustained by the tackler. Three injuries

Table 1. Training and Match Injury Incidences^a Sustained by Spanish National Under-18 Rugby Team During the 2014–2017 European Championships

Event	Year									
	2014		2015		2016		2017		All	
	Injuries, No.	Incidence (95% CI)	Injuries, No.	Incidence (95% CI)	Injuries, No.	Incidence (95% CI)	Injuries, No.	Incidence (95% CI)	Injuries, No.	Incidence (95% CI)
Training	5	10.9 (10.6, 11.3)	3	7.9 (7.6, 8.2)	0	0	3	5.4 (5.3, 5.7)	11	1.2 (1.2, 1.3)
Matches	9	171.4 (167.8, 174.9)	10	190.4 (186.7, 194.2)	4	76.1 (73.8, 78.5)	6	114.2 (111.3, 117.1)	29 ^b	138.0 (136.5, 139.6)
Total	14	25.6 (25.2, 26.1)	13	27.7 (27.3, 28.2)	4	4.6 (4.48, 4.84)	9	14.1 (13.8, 14.4)	40	73.2 (72.5, 73.9)
Days between matches	Injuries, No.		Incidence (95% CI)		Injuries, No.		Incidence (95% CI)			
2	19 ^b		180.9 (178.3, 183.5)		10		95.2 (93.3, 97.1)			
3										

Abbreviation: CI, confidence interval.

^a Injuries/1000 player-hours (95% CI).

^b $P < .05$.

(10.3%) occurred during a ruck, 2 (6.9%) during a scrum, and 1 (3.4%) during a noncontact, collision, and maul situation.

During matches, 16 (55.2%) of the recorded injuries were sustained through foul play, and 2 (6.9%) of these fouls were categorized as dangerous play.

During matches, the incidence of injuries was 137.6 (95% CI = 135.8, 139.5) per 1000 hours of play on a grass surface and 133.3 (95% CI = 130.2, 136.4) on an artificial surface. During training, the incidence of injuries was 1.2 (95% CI = 1.2, 1.3) per 1000 hours on grass and 1.4 (95% CI = 1.3, 1.5) per 1000 hours on an artificial surface.

Finally, 5 (12.5%) of the 40 injuries required surgery; 4 of these occurred during a match and 1 during training.

DISCUSSION

To our knowledge, this is the first epidemiologic study of the injuries sustained by elite under-18 rugby players (the Spanish national team). The literature contains no data for any equivalent population; therefore, we cannot make any direct comparisons. Nor can we easily compare our findings with those obtained for populations of the same age but at different sporting levels, as the demands on the players vary substantially. Nevertheless, the number of injuries recorded in the present work was higher than those observed in club and academy players aged ≤ 18 years.^{9,10} This difference might be explained by the presumably greater competitiveness and size of our players and, therefore, the greater energy involved in their collisions. Investigators^{11,12} have found that professional players sustained more injuries than amateurs because of the more competitive nature of professional matches. However, because we did not record the number of tackles per game, the distances run, or the speeds at which distances were covered, it is difficult to

compare these results. The incidence of injuries among our players was, in fact, similar to that noted for the senior men's international team.¹³ International games are very intense, perhaps explaining why our players sustained more injuries than reported for professional players (81 per 1000 hours) in a recent meta-analysis.¹¹

With 2 rather than 3 days' rest between tournament games, the incidence of injuries was higher. With only 2 days' rest, the incidence of injuries was much higher than the values reported for professional players and men's senior international games.^{11,13} With 3 days between games, the incidence of injuries was similar to that recorded during the senior World Cup.^{4,6} Markers of muscle damage remained elevated 48 hours after a match, suggesting that players were not at full match readiness and were therefore more susceptible to injury.^{14,15} These findings suggest that the time between matches for <18 -year-old elite players should be at least 72 hours.

In our study, the injury rate during training was 1.2 per 1000 hours, similar to that reported for rugby academies and schools in England (1.4 and 2.1 per 1000 hours, respectively).¹⁶ Among professional players, an incidence of 3 injuries per 1000 hours has been documented.¹¹ Our players sustained more injuries during matches than during training, which was consistent with reports of other authors^{9,11,16} for professional players of similar ages.

Table 2. Number and Proportion of Injuries by Severity During Training and Matches

Event	Injury Severity, No. (%)				
	Minimal	Mild	Moderate	Severe	All
Training	9 (81.8)	1 (9.1)	0	1 (9.1)	11 (100)
Matches	8 (27.6)	2 (6.9)	7 (24.1)	12 (41.4)	29 (100)
All	17 (42.5)	3 (7.5)	7 (17.5)	13 (32.5)	40 (100)

Table 3. Training and Match Injuries by Injury Type

Injury type	No. (%)		
	Training	Matches	All
Concussion	0	7 (24.1)	7 (17.5)
Dislocation or subluxation	0	2 (6.9)	2 (5.0)
Sprain or ligamentous injury	4 (36.4)	8 (27.6)	12 (30.0)
Fracture	1 (9.1)	1 (3.4)	2 (5.0)
Other bone injury	0	2 (6.9)	2 (5.0)
Lesion of meniscus, cartilage, or disk	0	2 (6.9)	2 (5.0)
Muscle rupture, tear, strain, or cramps	0	3 (10.3)	3 (7.5)
Tendon injury or rupture, tendinopathy, or bursitis	5 (45.5)	0	5 (12.5)
Hematoma, contusion, or bruise	1 (9.1)	4 (13.8)	5 (12.5)
All	11 (100)	29 (100)	40 (100)

Table 4. Training and Match Injuries by Injury Location

Injury Location	No. (%)		
	Training	Matches	All
Head or neck	0	7 (24.1)	7 (17.5)
Neck or cervical spine	0	2 (6.9)	2 (5.0)
Upper back, sternum, or rib	0	1 (3.4)	1 (2.5)
Lower back	0	1 (3.4)	1 (2.5)
Shoulder or clavicle	0	3 (10.3)	3 (7.5)
Wrist	0	1 (3.4)	1 (2.5)
Hand, finger, or thumb	1 (9.1)	2 (6.9)	3 (7.5)
Hip or groin	0	1 (3.4)	1 (2.5)
Anterior thigh	0	1 (3.4)	1 (2.5)
Posterior thigh	0	1 (3.4)	1 (2.5)
Knee	1 (9.1)	5 (17.2)	6 (15.0)
Lower leg or Achilles tendon	4 (36.4)	0	4 (10.0)
Ankle	4 (36.4)	4 (13.8)	8 (20.0)
Foot or toe	1 (9.1)	0	1 (2.5)
All	11 (100)	29 (100)	40 (100)

The most common injuries sustained during matches were in the minimal category, followed by those of a severe nature. This differs from data in 8- through 17-year-old players in England, among whom moderate injuries were the most frequent.¹⁷ However, injury severity was defined in terms of the time an injury prevented an athlete from playing. These differences might therefore be explained by the level of medical attention and the rehabilitation efforts that the national team offered compared with clubs and academies.

Ankle sprains were the most common injuries during matches. Similar results have been reported for English academy players⁹ and Australian school players,¹⁰ among whom sprains were the most frequent (but in the shoulder), followed by contusions. Among professional players, the most often reported injuries were muscle-tendon injuries and sprains.^{6,11} Concussion was the second most common injury among our players; this differed from data on nonelite under-18 players and professionals.^{6,10,11} During the 2015 adult World Cup competition, the head and knee were most often affected.⁶ However, among nonelite under-18 players, the injured areas differed.⁷ During training, the most frequent injuries were tendinopathies, followed by sprains. Similar results have been reported by other authors.¹⁶

We found that the most match injuries occurred during the third quarter and the least during the first quarter; other authors noted comparable findings.¹¹ This may indicate that fatigue plays a part in injury.¹⁸ Among professional rugby league players, tackling skills diminished with fatigue, perhaps underpinning a relationship between fatigue and tackling injuries.¹⁹ Alternatively, the high incidence of third-quarter injuries may reflect an incomplete warm up after halftime when returning to the game.²⁰ Reduced cognitive performance might also increase the risk of injury,²¹ and techniques should be adopted that refocus the players' concentration.

The match injuries sustained by our players were all induced by trauma, with tackling being the most injury-provoking activity and the tackled player the most commonly injured. Similar findings have been reported for same-age and adult professional players.^{6,7,9,11,22} During training, however, the numbers of injuries caused by trauma and overuse in our players were consistent.

Earlier researchers either did not specify when the injuries occurred²³ or when they examined training injuries, focused on traumatic rather than overuse conditions.¹¹

Our work was limited by the fact that the study participants were all players in the Spanish national under-18 team. Extending the study to other national teams might help to confirm or refute the findings presented.

CONCLUSIONS

Among players in the Spanish under-18 national rugby team, the injury rate was higher with 2 versus 3 days' rest between games. Thus, matches should be spaced at least 72 hours apart for these young players. The most common injuries sustained were sprains and concussions, and these were more likely to occur during matches than during training. Tackling caused the most match injuries, which typically occurred in the third quarter of the game. These findings suggest that teams should warm up properly before returning to the field after halftime. Emphasis should also be placed on teaching athletes skills to reduce the number of injuries caused by tackles.

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