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Injuries in Professional Rugby Union

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Objective: To document injury rates in professional rugby players in the Rugby Super 12 competition and to act as a pilot study for future studies of rugby injuries.

Design: Prospective longitudinal study encompassing the 1997 Super 12 rugby season.

Setting: A New Zealand Super 12 rugby squad.

Patients and participants: 25 professional rugby players (replacement players were used for unavailable players, so although 30 different players were used during the season, there were only 25 in the squad at any one time).

Outcome measures: An "injury" was defined as something that prevented a player from taking part in two training sessions, from playing the next week, or something requiring special medical treatment (suturing or special investigations). An injury was "significant" if it prevented the player from being able to play one week after sustaining it (that is, if it made the player miss the next match).

Results: The overall injury rate was 120/1000 player hours. The rate of significant injuries was 45/1000 player hours. Those playing the position of "forward" had a higher overall injury rate than other players, but there was no difference in significant injury rate between the forwards and the backs. Injuries that caused players to miss game time occurred almost exclusively during the pre-season program or in the final third of the season. The majority of injuries were musculo-tendinous sprains or strains. The phase of play responsible for the majority of injuries was the tackle. The most frequently injured body part was the head and face. No catastrophic injuries occurred during the study period.

Conclusions: Injury rates increase with increasing grade of rugby, injury rates in the Super 12 competition being higher than in first grade rugby. There is very little quality data on rugby injuries, and the few studies available use different methods of data collection and injury definition. There is a pressing need for the collection of accurate ongoing epidemiological data on injuries in rugby.

Key Words: Professional—Rugby Union—Injury prevention—Prospective.

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The Rugby Super 12 competition, which started in March, 1996, was the world's first fully professional *Rugby Union competition. Twelve teams (5 from New Zealand, 4 from South Africa, and 3 from Australia) played in a "round robin" competition, with the top four teams going on to play in a semifinal "knock-out" round. The winners of this round played in the final.

There were "home" and "away" games, so teams had to travel between South Africa and Australasia (a time difference of 8–10 hours) and often play the very next weekend (in ~5 to 7 days). In addition, some of the games in South Africa (in Johannesburg and Pretoria) were played at high altitudes. The need for rapid acclimatization to changes in time zone and/or altitude was a new challenge for most of the players.

Pre-season training for the 1997 Super 12 competition started in early December 1996. From December 1996 to December 1997, top New Zealand players essentially had no break from regular rugby games. Not only was there constant play, but the intensity of play was at a higher level for a greater period of time than usual, and there were significant added stresses caused by time zone and altitude acclimatization.

Each team had a squad of 25 players, 15 of whom participated in each game. During the 12-week 1996 Super 12 competition, 24 extra players were drafted into the 5 New Zealand teams because of injuries sustained by the existing players, or to replace players who dropped out to participate in the Hong Kong Seven tournament. There was concern from the media, All Black management, and team medics about the high injury rates to these players and the possible long-term effects of nonstop rugby lasting for several months with little or no "off time" in which players could recover and have injuries treated.

Very few prospective studies have been published on injury rates in senior rugby, and comparison between them is difficult because of differing definitions of "injury" and data collection methods. To date, no data has been published on injury rates in this new professional arena.

The purpose of this study was to prospectively document the injuries affecting professional rugby players, to compare these with injuries seen in other grades of rugby, and to act as a pilot study for a future, more comprehensive, prospective study involving more Super 12 teams.

*In this paper the term "Rugby" is used to indicate Rugby Union (unless otherwise stipulated).

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METHODS

The author was team doctor to one of the Super 12 teams in the 1996 and 1997 competitions. He attended the preseason training camps and personally assessed all existing injuries from the previous season, traveled with the team to all preseason and Super 12 games, and attended most training sessions during the year. He was, therefore, able to personally assess and follow up all injuries and illnesses during the competition. All injuries were recorded.

An "injury" was defined as that which prevented a player from taking full part in two training sessions, from playing the next week, or one that required special medical treatment (such as suturing or special investigation). This definition was chosen to allow direct comparison with the Rugby Injury Prevention Program (RIPP) study that is examining injury prevention in New Zealand club rugby (8,13,16). This is an ongoing study from which several papers have already been published, and from which more data is to be released. Injuries were further classified as "minor," if they caused the player to miss less than 1 week of play, "moderate," if from 1 to 3 weeks were missed, or "severe" if more than 3 weeks were missed.

Information collected included: the player's position, mechanism of injury, whether it occurred during a game or at training, nature of injury, treatment, and time missed as a result of the injury.

RESULTS

The study began in early December, 1996, with the first pre-season training camp, and ended after the semifinal round at the end of May, 1997. There were 15 games (3 preseason, 11 round robin, and 1 semifinal) one "7's" tournament, and one "10's" tournament. This equates to 327 player-hours of game time.

Five players attended the first preseason camp with injuries from the previous season that prevented them from taking part in full training at that time. Three of these injuries had occurred during the NPC (National Representative) competition in September, and two in overseas representative games in November. One player was fit to play and train fully after 3 weeks, three were fit to play after 8 weeks, and one was not fit for 3 months and missed all preseason games and the first Super 12 game. In addition, 2 players had chronic conditions (patella tendinitis and compartment syndrome) that did not prevent training or playing, but that required surgery at the end of the Super 12 season.

There were 36 (69.6%) minor injuries, 9(19.6%) moderate injuries, and 6 (10.8%) severe injuries during the study period. Ten injuries occurred during training, thirty-nine during game time, and two during other activities. The two injuries that were not rugby-related were both minor: one occurred during a golf game, and the other was a laceration from a seat on the team bus that required suturing! Both were discounted from the analysis of figures. This equates to one injury for every 8.3 hours of game time (0.14 injuries per player per game).

In addition, a severe injury occurred in a player from the squad who was training for the Hong Kong Seven. This resulted in 5 months of rest, but because the injury was not directly related to the Super 12 campaign, it was not counted in the figures.

Four players were enrolled in the squad during the season as replacements for injured players.

Positions injured

Table 1 shows the total number of injuries and a breakdown of severity for each position. The "corrected injury" column reflects the fact that some positions played are represented by two players in the team, whereas others have only one player. Taking this into account, Number 8 was the most commonly injured position, with full back and lock the next two most commonly injured.

Backs comprised 46.7% of players but had only 34.7% (17) of the total injuries, whereas forwards comprised 53.3% of players and had 65.3% (34) of total injuries. Of the 15 moderate-to-severe injuries (that is, those that caused the player to miss more than 1 week of play), the forwards had 8 and the backs 7, which is directly in proportion to their representation in the team.

All 25 players in the original squad sustained at least one injury during the season. Thirteen players had one injury, six had two injuries, four had three injuries, one had six injuries, and one had seven injuries. Five of the six players who had three or more injuries were forwards.

Injury site

The most commonly injured body site was the head and face, accounting for 26.5% of total injuries (Table 2). Of these, 46.2% were lacerations requiring suturing or Steristrips, 38.5% were head injuries (all Grade 1 as classified by Cantu [2]), and 14.3% were eye injuries. The knee (12.2%) and the ankle (10.2%) were the next most commonly injured sites, with the rest of the injuries being evenly distributed among other sites.

Injuries to the knee (26.6%) and ankle (20%) accounted for almost half of the moderate and severe injuries (Table 3).

TABLE 1. *Injury data by position*

	Number in team	injuries	injuries*	mild	moderate	severe
number 8	1	8	16	6	0	2
Full back	1	5	10	4	1	0
Locks	2	9	9	7	2	0
Flankers	2	6	6	4	0	2
Centre	1	3	6	2	0	1
Hooker	1	3	6	3	0	0
Prop	1	6	6	4	2	0
Wing	2	5	5	3	2	0
Half back	1	2	4	1	1	0
1st 5/8	1	1	2	0	1	0
2nd 5/8	1	1	2	1	0	0

* injuries corrected for positions that have two players in the team

TABLE 2. *Injury site incidence*

	Total Injuries	Mild
Head	11	11
Knee	6	2
Ankle	5	2
Groin	4	2
Shoulder	4	2
Low back	3	1
Elbow	3	2
Neck	3	3
Thigh/hip	3	3
Eye	2	2
Calf	2	1
Hand/wrist	2	2
Upper arm	1	1

There were only two neck injuries during the study period. One was in a front row player who had occipital pain and headaches following a scrum session. This settled well with a trigger point injection of Xylocaine in the trapezius. X-rays showed degenerative changes in the lower cervical spine. The other neck injury was a forced flexion injury against the ground in a ruck. The player had immediate neck pain and left arm paraesthesia and weakness. X-rays were normal and his neurologic signs and symptoms settled after a few hours. He re-entered play 1 week later with no further symptoms.

Injury types

Musculo-tendinous sprains and strains (28.6%) and contusions (22.4%) accounted for just over half of all injuries (Table 4). Other significant types were ligament sprains (16.3%), lacerations requiring suturing (12.2%, all on the head and face), and head injuries (10.2%).

Mechanism of injury

The phase of play in which most injuries occurred was in the tackle (no distinction was made between being tackled and attempting a tackle), closely followed by rucks and mauls (Table 5). The majority of the injuries responsible for missed playing time were also sustained in tackles. In contrast, the "set play" phases of play were responsible for very few injuries.

The training injuries were distributed among the different phases of training. The numbers involved were too small to show any clear pattern (Table 6), but 34% of the injuries were new injuries, whereas 17% were recurrences of previous injuries.

TABLE 3. *Moderate and severe injuries*

	Moderate	Severe
Knee	2	2
Ankle	2	1
Groin	1	1
Shoulder	0	2
Low back	2	0
Elbow	1	0
Calf	1	0

TABLE 4. *Injury types*

Type of injury	Number
Musculo-tendinous sprain	14
contusion	11
ligament sprain	9
laceration (sutured)	6
head injury	5
fracture	1
dislocation	1
hernia	1
ligament rupture	1

Cumulative injuries through the season

Injury incidence was distributed fairly evenly throughout the season, but the majority of moderate and severe injuries occurred either in the preseason period or after week 8 (the seventh game) of the season (Fig. 1). There was no game played in week 4.

There was a marked increase in players being unavailable for selection because of injury toward the end of the season (Fig. 2).

DISCUSSION

As yet, there have been no prospective studies looking at injuries in International or Professional rugby. Previous studies have looked at overall injury rates among schoolboy, women's, and differing grades of men's rugby. In schoolboy rugby, there is an increased injury rate with increased age (5,6,14,18) and also with increased grade (6,14). This is thought to be a result of increasing player weight and speed, with increased age making injury more likely. There is also, presumably, a higher level of aggressiveness resulting in injury among older children who play rugby voluntarily, compared with younger children for whom it is a compulsory activity.

Women players have a higher injury rate than children, but adult men have the highest injury rate (9,12), with the injury rate increasing through the grades so that the highest rates are in the (highest) Senior A and Under 21 (Colts) grades (13).

In this study, the overall injury rate was one injury every 8.3 player hours of game time (or 120 injuries per 1000 player hours of game time). In another study with a similar injury definition, Seward and colleagues (16) found an overall injury rate of 62/1000 player hours among first grade players and 53/1000 player hours among all grades. Hughes and Fricker (10) found an injury rate of 48.8/1000 player hours among first grade players, but this study collected data through a questionnaire. For comparison, Seward and colleagues in the same study reported a similar overall injury rate among Australian Rules Football players (68/1000 player hours) but a much higher incidence among Rugby League players (173/1000 player hours). Comparison of overall injury rates between different studies is difficult because most studies use self reporting or questionnaires as methods of data collection, and these methods are less reliable than direct collection of data (1,14,16).

TABLE 5. *Game time injuries*

	mild	mod	severe
tackle	11	2	5
ruck/maul	13	1	0
scrum	1	2	0
line out	1	0	1
running	1	0	1

These figures support the continuance of the trend for increasing injury rates with increasing grade of rugby into Super 12 rugby, although the numbers in this study are too small to reach significance. There were several reasons to expect an increased reported injury rate in the Super 12 competition. First, there were added stresses, such as overseas travel, time zone differences, and altitude changes (in this study, however, there were no significant injuries in the games that involved travel to South Africa or adjusting to altitude). Second, the games were played at a greater level of intensity than ordinary club games. It is difficult to quantify this, but the games appeared to be played at a faster pace and with harder tackling and fewer breaks in play (in soccer, for instance, it is well recognized that in matches with highly skilled teams the ball is in play for longer periods [19]. Comparison of Super 12 games with club games may show that the ball is in play for longer periods in higher-grade football). Third, in this study, the players had easy access to their team Doctor. Fourth, with intensive physiotherapy and medical monitoring of players, there may have been a greater tendency to hold players back from playing when they may have been capable of playing at a more relaxed "club game" level or even playing against their doctor's advice.

In this study, 5 of the 25 (20%) members of the playing squad presented with injuries at the pre-season training camp that prevented them from being able to train at that time. The RIPP study (17), in a retrospective questionnaire, showed that 42% of players reported a chronic or current injury at pre-season, but neither the type nor severity was specified and there was no medical input. Therefore, it is difficult to compare the RIPP results with those of the current study.

Because an existing injury increases the likelihood of further injury (17), players should be encouraged to have an end-of-season medical exam in order to identify and treat all injuries before the start of the next season. This will also allow completion of the pre-season conditioning program.

The most commonly injured positions were number 8 and Full back. Other studies have confirmed that the loose forwards (number 8 and flankers) are the players most often injured (7,10,13) and that the Full Back is the most commonly injured of the backs (7,13), but in none of these studies have the different injury rates between positions reached statistical significance. Significant injuries in the current study were evenly distributed among the forwards and backs but the numbers involved were too small to allow any pattern of significance to develop.

The majority of injuries were musculo-tendinous sprains and strains and contusions. This is in accordance with the results of other studies with similar definition of injury (3,9,10,13,16). The most commonly injured site was the head, mainly lacerations and head injuries. Most other studies of men's rugby show head and neck injuries to be the largest group of injuries (9,10,12,13,16).

Tackling accounted for the most injuries overall, as well as most of the injuries that prevented players from being available the following week. This is in accordance with most other studies (1,3,4,8,10,15,17) which report tackling to be the cause of 36–50.4% of all injuries. In defining the term "tackle," the study made no distinction between a person making a tackle or being tackled. Most studies that do distinguish between the two show that being tackled is more likely to cause an injury than making a tackle (1,3,10). Close attention has been paid to this phase of the game because of the high injury rates associated with tackling, and improved tackling technique has been suggested as a means of reducing injury rates. No studies have looked at a series of tackling injuries with slow motion replay to see how often poor technique is a factor in injury causation. All Super 12 matches are televised, and, as most tackles occur in open play on the player with the ball (and therefore are filmed), this provides a valuable opportunity to look at the role of poor tackling technique as a cause of injury. Very few injuries occurred in the "set play" phases of the game (involving line outs and scrums); this is in keeping with the results reported by Hughes (10).

Players were not questioned as to whether their injury was a result of foul play. Foul play has been shown to be a significant factor in injuries, with between 5% (3) to 32.7% (12) of all injuries resulting from it. This significant cause of injuries needs to be examined in the professional arena.

Previous studies have shown that the preseason period is the time in which injuries are most likely to occur among all grades and ages (3,8,10,11,12). Some studies have also shown an increase in the injury rate after a break in fixtures (midseason, for example) and after the Christmas break in the Northern Hemisphere season (12). In the current study, the injuries that prevented player participation the following week showed a definite pattern; except for one injury in the second Super 12 game, all these injuries occurred either in the preseason period or in the last 6 games. Player unavailability because of injury (or injury prevalence) was highest in the last 5 games, and resulted in a lack of first choice players during the semifinal and final rounds.

Possible reasons for increased significant injury rates

TABLE 6. *Training injuries*

	mild	moderate
team train	4	0
run	2	1
scrum	1	1
weights	0	1

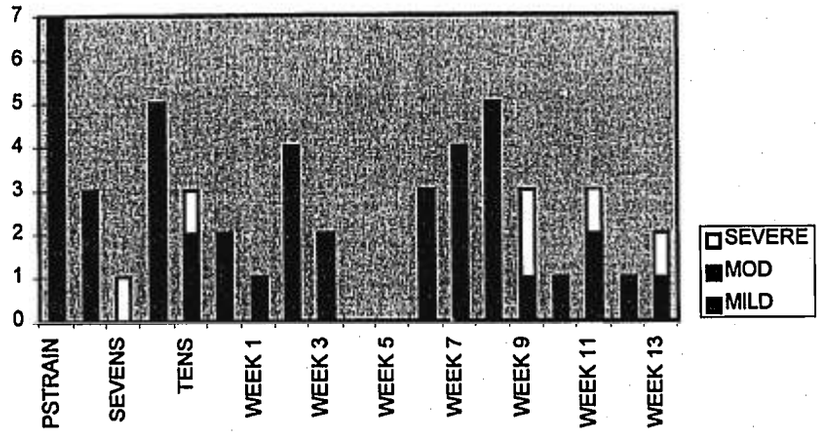

FIG. 1. Injuries through the season.

in the preseason games are reduced match fitness and the tendency to not put the best players in the games if they were not quite fit (because the matches were preseason matches, they were not considered to be as important as competition games).

Possible reasons for increased injury rates later in the season are cumulative physical and or mental fatigue caused by the stresses mentioned above (travel, changes in time zone/elevation, the intensity of the games themselves) or reduced fitness as a result of other minor injuries. No other studies show an increased injury rate at the end of a season, so ongoing data collection will be needed to discover whether this pattern continues in future Super 12 competitions. The increased injury rates after a break in fixtures reported in other studies (12) would support a longer off-season rather than a break midseason, if a reduction in the amount of fixtures was contemplated.

The study showed no evidence of an increased injury rate in the games at high altitude or in those following travel between Australia and New Zealand (those with the largest time zone change).

Injury rates at different stages of the game were not recorded in this study. Previous studies have shown the final quarter of the game to have the highest injury rates (1,10,17). This is believed to be a result of fatigue. It will be interesting to see whether the new substitution laws, which allow the replacement of injured or fatigued players, change the pattern of injury rates during the game.

The only specific type of injury that the authors wish to discuss in detail is head injuries. One of the biggest problems in the management of rugby players with head injuries is that some players will not report their injury. This not only obscures the cause and nature of the injury, but endangers the player, who may be returning to play before it is safe. Underreporting of injuries is probably more frequent among professional players because playing rugby is their occupation. Routine contact between the players and the team medical staff both during and after the match may improve the reporting of head injuries, but, even then, some players may disguise their symptoms. Head injury rates vary between 3.8% and 10% of all injuries sustained (3,7,11,12,17) In the current study, head injuries accounted for 12.8% of all game-time injuries. As discussed above, the definition of "injury" varies widely between studies, and so this figure is meaningless. To avoid this bias, it would be more sensible in future to record head injury rates in number per 1000 player hours (in the current study, 14.8/1000 game time hours). The cumulative effects of minor head injuries may be overestimated if only the more severe injuries are reported, so until all head injuries, especially the minor ones, are reported, the true effects of minor head injuries in rugby will be unknown.

The guidelines for concussion in Rugby recommend a 3-week stand-down after receiving any concussion. However, all head injuries in the current study were Grade 1, and the players recovered completely within 24

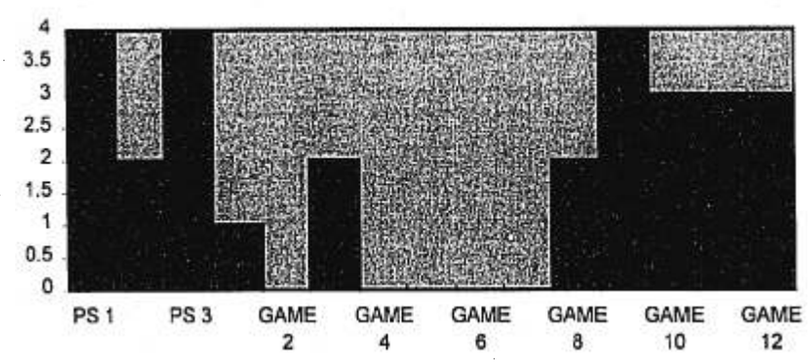

FIG. 2. Player unavailability by game.

hours of injury. They were therefore permitted to return to play the following week.

CONCLUSION

Direct comparison of overall injury rates with most other studies is difficult because of a wide variety of study designs. Overall, there is a lack of reliable epidemiological data on rugby injuries. The numbers in this study were small but the trend of increasing injury rates with increasing grade of rugby seems to be maintained in the results from the Super 12 competition. The injury incidence rate is comparable with that found in first grade Australian rugby league and first grade Australian rules football. Other patterns, such as injury types, positions injured, injury sites, and mechanisms of injury also match those in lower grades of rugby. One pattern that was different was the trend of increasing injuries toward the end of the Super 12 competition. Ongoing data collection is required to see whether injury rates increase over the next few seasons.

The Super 12 competition, which mandates the presence of a team Doctor and Physiotherapist at all matches, most training sessions, and on all away trips, is an excellent opportunity to collect accurate, ongoing epidemiological data on rugby injuries. The main aim of collecting data is to be able to reduce injury rates by identifying modifiable risk factors and by monitoring injury rates after any changes have been made to see if they have been successful.

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