Tackle-injury epidemiology in *koshuis* rugby players at Stellenbosch University

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Background. The tackle is an important component of rugby union. The tackle situation carries the highest risk for injury for both the ball carrier and tackler. Little is known about the epidemiology of tackle injuries in *koshuis* rugby players.
Objectives. To (*i*) calculate the tackle-related injury rate, (*ii*) determine if the tackler or ball carrier is more susceptible to injury, and (*iii*) determine the most common location and type of injury during tackles.
Methods. Data were collected by means of injury report forms from the medical centre during *koshuis* matches of 2012 and 2013. All data collected were captured into an online database. Only data related to tackle injuries were evaluated for this retrospective, descriptive epidemiological study.
Results. The tackle led to 61% of all injuries (11.4 injuries/1 000 playing hours). The tackler sustained 23% more injuries than the ball carrier. Injuries to the face (3.1 injuries/1 000 playing hours, 95% confidence interval (CI) 2.8 - 3.3) were most prevalent. The most common type of injury was lacerations (3.4 injuries/1 000 playing hours, 95% CI 3.2 - 3.7).
Conclusion. The tackle contributed to 61% of all injuries, making it the most dangerous phase of play. The tackler is more at risk than the ball carrier, especially for injuries to the face, with lacerations having the highest prevalence. For the ball carrier the location of the most injuries was the head, although joint sprains were the most common type of injury for the ball carrier.

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Since rugby union became a professional sport in 1995, the number of tackles has increased substantially.[1] The increase in the number of tackles in match play may be due to law changes or strategies used by coaches and teams. In rugby union, a tackle occurs 'when a ball carrier (attacking player) is held by one or more opponents and is brought to ground'. The opposition player (defending player) is referred to as the tackler.[2] The major aim of tackling is to prevent the attacking team from gaining territory and scoring points. The contact nature of the tackle event attributes to muscle damage, which is measured by increased circulating creatine kinase (CK) activity. Elevated CK levels can also result from high-speed running, especially in backline players where high force, eccentric work is performed several times during a match. Literature has shown a positive relationship with increased frequency of tackles and muscle damage in both players (i.e. tackler and ball carrier). A reduction in neuromuscular function may be associated with muscle damage and thereby predispose players to injury.[3,4]

The physical nature of the tackle exposes both players to injury.[3] According to Brooks and Kemp[5] rugby has the highest risk of injury during a match compared with any other team sport. The basic skill of tackling is the most frequent phase of play as it is used by both teams while they are defending. The study by Quarrie and Hopkins[1] revealed that tackles accounted for up to 58% of all injuries during match play in professional New Zealand teams from 2003 to 2005, making it the most high-risk phase of play.

The law of energy conservation is of prevalence during tackle situations as the total momentum of the two players before the tackle is redistributed between them at impact. Speed differentiation between the players contributes to the risk associated with the tackle event, as the player with the lower momentum was more frequently injured.[1] Furthermore, the distribution of the momentum emphasises the players' physical conditioning, body position and velocity during the tackle.[3]

By comparing current literature, it is clear that a higher overall incidence of injuries correlates with a higher level of play, given that players become bigger and stronger due to more sophisticated conditioning programmes, more training time, and participating in longer seasons.[6-8] Thus players are able to generate higher forces during collision events, which exposes them to a higher potential risk of injuries. Young players (17 - 21 years) are especially at higher risk when they compete at a more competitive level as they are still going through musculoskeletal developmental changes, which may be seen in some *koshuis* (university residence) rugby players.[8]

A *koshuis* rugby team typically consists of university players at different skill and conditioning levels. There are no studies in South Africa, to the researchers' knowledge, assessing rugby tackle injuries in *koshuis* rugby players. It may be that these players are at greater risk for injury, as they do not train frequently even though the level of competition is high. Few studies have specifically investigated tackle-related injuries, and discrepancies are found in the literature regarding the most frequent body part injured, type of injury, as well as the risk for the ball carrier or tackler to sustain an injury.

Therefore, well-designed epidemiological studies are needed to investigate the risk of injury. These data can assist coaches and trainers in increasing the safety of the players by improving their tackling technique, thereby minimising the risk for injury. If coaches are aware of the areas of play with increased risk of injury, they can design training drills to minimise the risk thereof.

The primary objective of this study was to analyse tackle injury epidemiology and the risk thereof in *koshuis* rugby players at Stellenbosch University over the 2012 and 2013 seasons. More specifically, the objectives were to determine (*i*) the amount of tackle-related injuries per 1 000 playing hours in university *koshuis* rugby matches, (*ii*) if the tackler or ball carrier is more susceptible to injury, and (*iii*) the most common injury type and injury location during tackles in university *koshuis* rugby matches.

Methods

This study followed a retrospective, descriptive design that spanned over two *koshuis* rugby seasons (2012 - 2013).

Population

The study included male rugby players between the ages of 18 and 25 years that participated in Stellenbosch University's *koshuis* rugby league during the 2012 and 2013 seasons. Ethical clearance was obtained from the Stellenbosch University Research Ethics Committee: Human Research (Humanities) as well as the Institutional Research and Planning Committee (Proposal number: HS1034/2014).

Instruments and data collection procedure

Data were collected in the medical centre using an adapted version of the International Rugby Board's (IRB) Rugby Injury Consensus Group (RICG) standardised injury report form to ensure validity and repeatability and to present the data in a form that is comparable to other studies.[9] The researchers, who were assisting the onsite medical doctor, collected data verbally from the injured player or a witness after a medical diagnosis was given. Once recorded, anonymous data were captured in an online database with limited access. Only data related to tackle injuries were evaluated for the purpose of this study. It is assumed that all injuries were reported and the injury report forms were completed accurately. Severity and time-loss due to injury was not accurately determined on-site and was therefore not used for the purpose of this study. With the data collection in the medical centre, it was sometimes unclear whether the injured player was the tackler or the ball carrier during the tackle event. Injuries to these players were categorised as 'Uncertain Player' injuries. This was accounted for in the overall calculations, but could not be used for specific player comparisons.

Statistical analyses

Injury rate and 95% confidence intervals (CIs) were calculated by means of Microsoft Excel 2010 to compare the rate of injuries per 1 000 playing hours.[10] The injury rate was calculated as the number of injuries (to each group, i.e. tackler, ball carrier or overall) divided by the exposure time (in hours) multiplied by 1 000. The difference was considered statistically significant if the 95% CIs did not overlap. The 95% CIs were calculated by means of the following formula:

$$95\%\ CI = \left(\frac{\text{injury rate}}{1\,000}\right) \pm 1.96\left(\frac{\sqrt{\text{no. injuries}}}{\text{exposure time}}\right) \times 1\,000$$

Results

Tackle-related injury rate

From 253 injuries, the overall injury rate calculated to 18.9/1 000 playing hours with the tackle contributing to 11.4 injuries/1 000 playing hours (61%). None of the tackle-related injuries were due to foul play or a violation of the laws.

Tackler and ball carrier injury susceptibility

Over the two seasons, the tackler sustained a significantly higher injury rate than the ball carrier (Fig. 1).

Injury location

Table 1 summarises the injury location of the players over the two seasons. Overall, the head sustained the highest injury rate per 1 000 playing hours, followed by the face, shoulder and knee, respectively.

The tackler most commonly sustained injuries to the face, while the head was the most commonly injured site among the ball carriers (Table 1).

Only slight differences occurred in shoulder, knee and ankle injuries between the tackler and ball carrier (Table 1).

Injury type

Table 2 summarises the injury type of the players over the two seasons. Over both seasons, the most common injury types, in order of magnitude were lacerations, joint sprains and concussions.

Lacerations were the most common type of injury among tacklers. This was followed by joint sprains and concussions. Among ball carriers, joint sprains were most prevalent followed by lacerations, concussions, ligament injuries, and fractures with the same injury rate (Table 2).

Skin injuries included skin abrasions and lacerations. Only the tackler sustained skin abrasions. The tackler also sustained significantly more lacerations than the ball carrier for both seasons (Table 2).

Joint injuries included joint sprains and ligament injuries (Table 2). The rate of joint sprains was significantly higher in the ball carrier than in the tackler. The ligament injuries of tacklers and ball carriers were not significantly different.

The tackler sustained significantly more concussions than the ball carrier (Table 2).

Discussion

Tackle-related injury rate

The overall injury rate of 18.9 injuries/1 000 playing hours was observed. This is a higher rate than observed in high school rugby

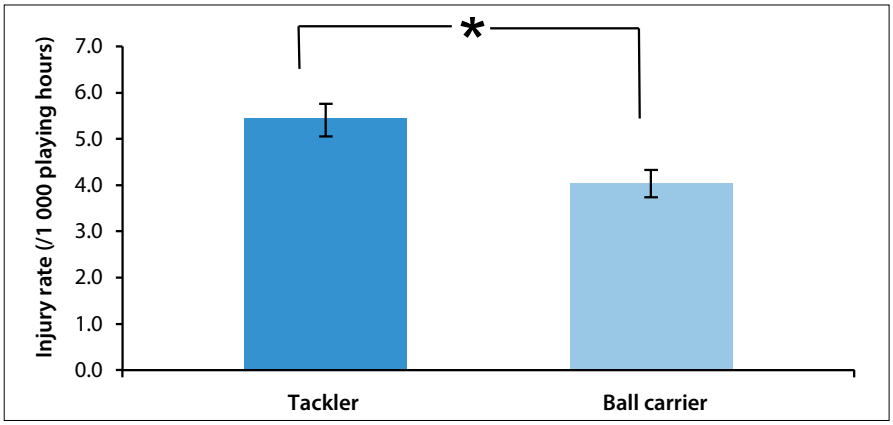


Fig. 1. Injury susceptibility (rate/1 000 playing hours) to tackler (n=*73) and ball carrier* (n=*54) during the tackle situation (*Statistically significant difference* p<*0.05).*

Table 1. Injury location and overall and respective injury rates (per 1 000 playing hours)

Body location	Tackler		Ball carrier		Overall	
	Rate	95% CI	Rate	95% CI	Rate	95% CI
Head*	1.3	1.2 - 1.5	0.9†	0.8 - 1.0	3.1†	2.8 - 3.3
Face*	1.8†	1.6 - 2.0	0.4	0.4 - 0.5	2.8	2.6 - 3.1
Neck	0.0	-	0.1	0.1 - 0.2	0.3	0.2 - 0.4
Lower back	0.1	0.0 - 0.1	0.0	-	0.1	0.0 - 0.1
Pelvis	0.0	-	0.1	0.0 - 0.1	0.1	0.0 - 0.1
Shoulder	0.9	0.8 - 1.0	0.8	0.7 - 1.0	1.9	1.7 - 2.1
Clavicle	0.0	-	0.1	0.1 - 0.2	0.2	0.2 - 0.3
Upper arm	0.1	0.0 - 0.1	0.1	0.0 - 0.1	0.1	0.1 - 0.2
Elbow	0.0	-	0.1	0.0 - 0.1	0.1	0.0 - 0.1
Wrist	0.1	0.1 - 0.2	0.1	0.0 - 0.1	0.2	0.2 - 0.3
Hand	0.3	0.2 - 0.4	0.1	0.0 - 0.1	0.4	0.3 - 0.5
Hip	0.1	0.0 - 0.1	0.0	-	0.1	0.0 - 0.1
Groin	0.0	-	0.1	0.0 - 0.1	0.1	0.0 - 0.1
Knee	0.4	0.3 - 0.5	0.6	0.5 - 0.7	1.0	0.9 - 1.2
Lower leg	0.1	0.0 - 0.1	0.1	0.0 - 0.1	0.1	0.1 - 0.2
Ankle	0.3	0.2 - 0.4	0.4	0.4 - 0.5	0.8	0.7 - 1.0
Total	5.5	5.1 - 5.8	4.0	3.7 - 4.3	11.4	10.9 - 11.9

* Statistically significant difference between tackler and ball carrier ($p<0.05$).
† Most prevalent body location.

Table 2. Injury type and overall and respective injury rates (per 1 000 playing hours)

Injury type	Tackler		Ball carrier		Overall	
	Rate	95% CI	Rate	95% CI	Rate	95% CI
Concussion*	0.7	0.6 - 0.9	0.4	0.4 - 0.5	1.4	1.2 - 1.6
Bone fracture	0.3	0.2 - 0.4	0.4	0.4 - 0 .5	0.8	0.7 - 1.0
Dislocation	0.1	0.1 - 0.2	0.0	-	0.1	0.1 - 0.2
Subluxation	0.0	-	0.1	0.0 - 0.1	0.1	0.0 - 0.1
Joint sprain*	1.0	0.8 - 1.1	1.3†	1.2 - 1.5	2.4	2.2 - 2.6
Ligament injury	0.3	0.2 - 0.4	0.4	0.3 - 0.5	0.8	0.7 - 1.0
Muscle strain	0.0	-	0.1	0.0 - 0.1	0.2	0.2 - 0.3
Contusion/bruise	0.2	0.2 - 0.3	0.3	0.2 - 0.4	0.5	0.4 - 0.6
Skin abrasion	0.2	0.2 - 0.3	0.0	-	0.4	0.4 - 0.5
Laceration*	1.9†	1.7 - 2.1	0.7	0.6 - 0.8	3.4†	3.2 - 3.7
Unsure	0.4	0.4 - 0.5	0.3	0.2 - 0.4	1.0	0.8 - 1.1
Other	0.1	0.1 - 0.2	0.0	-	0.1	0.1 - 0.2
Total	5.5	5.1 - 5.8	4.0	3.7 - 4.3	11.4	10.9 - 11.9

*Statistically significant difference between tackler and ball carrier ($p<0.05$).
† Most prevalent injury type.

players in 2008 (15.2 injuries/1 000 playing hours).[7] This trend is supported by Jakoet and Noakes,[6] McIntosh *et al.*[11] and Palmer-Green *et al.*,[8] who found an increase in injury rate with increased age and level of play.

A tackle-injury rate of 11.4 injuries/1 000 playing hours was observed for all players injured in the tackle situation. In the present study, the tackle contributed to 61% of all injuries. Literature reports the tackle to be the most dangerous phase of play as 40 - 64% of injuries were sustained as a result of a tackle.[5,7,8,12] This also holds true for *koshuis* rugby based on the data presented here.

Tackler and ball carrier injury susceptibility

This study found that throughout the two seasons, the tackler sustained a higher injury rate than the ball carrier, as they may have poor tackle technique. Quarrie and Hopkins[1] also support this finding (Table 1). This is contrary to other studies on higher levels of play, that found that the ball carrier is at greater risk than the tackler.[5,8,13] This might be because the players are well-trained, conditioned, and had a better tackle technique. This conclusion was supported by Hendricks and Lambert[3] who reported that at amateur level (as with some *koshuis* rugby players), the tackler is more at risk for injury, whereas at the professional level, the ball carrier has the greatest risk. Contrary to this, a systematic review of eleven studies found that adolescent ball carriers generally sustained more injuries (17 - 65%) than tacklers (19 - 40%).[14]

Injury location

Overall, the head sustained the highest injury rate, as also seen in the literature,[7,12,13,15] followed by the face. As there is no clear definition to distinguish between head and face injuries, this could be misinterpreted and should be specified on the injury report form. Even though shoulder and knee injuries were common, they showed a lower incidence rate compared with head and face injuries. Conversely some research found that the shoulder was one of the most frequently injured locations.[13]

The tacklers' most common injury was to the face, while the ball carriers' most common injury was the head (Table 1).

Shoulder injuries were the third most common type of injury for all players. This is consistent with the literature that found shoulder injuries to be the third most common for the two players combined.[7,11]

McIntosh *et al.*[11] found that the knee was the second most frequently injured body part for both players. However in this study the knee was the fourth most frequently injured body part (Table 1).

In this study, ankle injuries were the 5th most frequent injury with the ball carriers having a higher rate of ankle injuries than the tackler. This is contrary to the finding of Collins *et al.*,[7] who found that the ankle was injured second most frequently for the tacklers and ball carriers combined. Lower limb injuries to the

ball carrier were usually as a result of loading with the weight of the tackler.[1]

Injury type

For both groups of players combined, the three most prevalent injury types were, in order, lacerations, joint sprains, and concussions.

The most common type of injury among the tacklers was lacerations followed by joint sprains and concussions. Among the ball carriers, joint sprains were the most prevalent followed by lacerations, and then equally by concussions, fractures and ligament injuries (Table 2). Other studies have shown lacerations and concussions were mostly caused by player-to-player contact, rather than player-to-surface contact. Protective headgear might decrease the amount of lacerations to the head, although for the purpose of this study it was not investigated.

Skin injuries comprised skin abrasions and lacerations. Only the tackler sustained skin abrasions. The tackler also sustained significantly more lacerations than the ball carrier in both seasons. All the lacerations were to the head and face area, correlating with the high incidence of head and face injuries for both players, especially the tackler. This could be as a result of the tackler being closer to the ground during impact. The tackler can also be dragged along the ground while the ball carrier is still moving forward, resulting in the tackler hitting the ground first – with or without the added weight of the ball carrier. It was also expected that the tacklers would sustain more lacerations as their heads are frequently exposed to contact with the ball carrier's legs during the tackle, especially when they aim too far below the waist of the ball carrier.[3]

For the ball carrier, joint sprains were the most common type of injury. The ball carrier also had a significantly higher rate of joint injuries than the tackler. This can be due to the way in which the ball carrier unexpectedly makes contact with the ground. The way in which the tackler forces the ball carrier to the ground may also restrict proper joint mechanics and predispose the ball carrier to joint sprains.

A limitation of this study is that data were dependent on the information collected on an injury report form in the medical room. The researchers are reliant on what the injured player, or a witness accompanying the injured player to the medical room, recall from the mechanism leading to the injury. Furthermore, the on-site doctor was not always able to determine the severity of injury and therefore some injuries were excluded from this study.

For future studies, the injury report form should be accompanied by video analysis. Our current injury report form should be revised, as some categories overlap. The specific categories should be defined (i.e. head and face) and data collectors should be educated accordingly to ensure validity and reliability of data. Injury severity and time-loss should be followed up to compare with the literature.

Conclusion

The present study found a total of 253 injuries during 2012 and 2013 in this *koshuis* rugby population. The tackle accounted for 153 injuries, with a rate of 11.4 injuries/1 000 playing hours. The tackler sustained a higher rate of injury than the ball carrier. The tackler most commonly sustained injuries to the face, with lacerations being the greatest contributor. The ball carrier sustained a lower injury rate and injuries were more equally distributed across the different body parts, with joint sprains being most common.

The player most frequently injured and the most common type of injury is in contrast with existing literature. This might be due to a different study population and level of play. *Koshuis* rugby players specifically have a high risk of injury, as they do not train more than twice a week, despite the matches being competitive.

The outcome of this study can assist in increasing the safety of the players. For example, a rule could be implemented that players need to attend at least one skill training session per week as faulty technique of the tackler may predispose them to injury. *Koshuis* rugby players compete at an amateur level and their experience, skill, and conditioning levels should be taken into account during team selection. By ensuring all competing players are at a similar level, injury rate could be reduced. Also, players should be able to pass a predetermined, rugby-specific test battery before they can be considered for team selection. If coaches are aware of the areas of play with increased risk of injury, they can design training drills to minimise the risk thereof. Pitch conditions as well as speed and body weight of players may also contribute to the risk for injury. As pitch conditions are partially controllable, proper pitch maintenance will assist in increased safety for players during a match.[14]

The aforementioned strategies might positively influence university rugby players as they will experience less discomfort as well as decreased playing and study time lost due to injury.

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