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Original research

Tackling the tackle 1: A descriptive analysis of 14,679 tackles and risk factors for high tackles in a community-level male amateur rugby union competition during a lowered tackle height law variation trial

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ABSTRACT

Objectives: In rugby union (rugby), the tackle is the most frequent cause of concussion and thus a target for intervention to reduce concussion incidence. The aim of this study is to describe tackle characteristics and factors associated with illegal high tackles in amateur community-level rugby during a lowered (armpit level) tackle height law variation trial.
Design: Prospective observational cohort study.
Methods: Video surveillance of a single season, four-league competition with coding of video data according to a predefined coding framework. Descriptive statistics of tackle detail and logistic regression was performed to analyse factors associated with high tackles.
Results: One hundred and eight matches with 14,679 tackles and a mean of 137 (±30) tackles per match were analysed. High tackles (above armpit level) had significantly greater odds of occurring in the lower (2nd–4th) leagues (OR: 1.95; 95 % CI: 1.6–2.4; $p < 0.001$), front-on tackles (OR: 1.61; 95 % CI: 1.3–2.0; $p < 0.001$), arm tackles (OR: 1.65; 95 % CI: 1.3–2.1; $p < 0.001$), bent-at-waist ball carrier (OR: 1.93; 95 % CI: 1.6–2.4; $p < 0.001$), falling/diving ball carrier (OR: 2.21; 95 % CI: 1.6–3.1; $p < 0.001$), and an upright tackler (OR: 3.38; 95 % CI: 2.7–4.2; $p < 0.001$). A falling/diving tackler had significantly lower odds of being associated with a high tackle (OR: 0.44; 95 % CI: 0.3–0.6; $p < 0.001$).
Conclusions: Overall mean tackles per match were similar to those of senior amateur and elite rugby. League, tackle type, tackle aspect, and player body positions were associated with high tackles. These findings reiterate the need for ongoing efforts to identify and implement mitigating strategies to reduce tackle-related injury risk.
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Practical implications

- Mean match tackles in this community amateur cohort were similar to those of senior male amateur and elite rugby, in a cohort that is likely less well conditioned than senior and elite cohorts.
- Lower league, tackle type (arm), tackle aspect (front-on), and player body positions (upright tackler; low ball carrier) were associated with high tackles.

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- These findings reiterate the need to address injury and concussion risk in the tackle.
- Safe tackle technique training interventions may provide valuable additional benefits, particularly in less well conditioned community level cohorts.

1. Introduction

Rugby Union (rugby) is a team sport with over 7.6 million players globally.[1] Rugby match play requires frequent, purposeful, often forceful physical contact between players. The primary aim of these physical inter-player contests, that require a high degree of technical skill,[2] is to advance towards the opposing team's goal line to score points. The injury incidence in rugby is high, but comparable to other collision sports.[3]

Concussion is a significant health problem in sport[4] with medico-legal consequences for sport governing bodies[5] and growing concerns regarding long-term player health.[6–8] It is one of the most prevalent injuries in rugby, accounting for 28 % of all injuries with an incidence of 22.2 concussions per 1000 match hours in professional rugby.[9] In amateur rugby, concussion comprises 16 % of all injuries with 4.1–9.3 concussions per 1000 match hours (6–9 concussions per 1000 h in the present cohort).[10,11] Concussion incidence has increased approximately 4-fold since 2010.[9,10] Scientific advances, and increased awareness and education have led to improved identification and management of concussion.[3] During the last decade, the definition of concussion has changed substantially in contrast to some definitions of concussion around the early–mid 2000s (e.g. loss of consciousness is no longer a requirement).[3,12] Nonetheless, there is likely a real change in concussion incidence across all playing levels,[9,10] due to increased player physicality and game demands (e.g. increased number of tackles per match).[3,13]

Injuries in rugby are primarily due to the tackle contest.[14–16] A tackle occurs when a defending player attempts (or defending players attempt) to impede or stop the ball-carrying attacking player from gaining territory and scoring points.[17] The tackle is responsible for more than 50 % of all injuries,[3,15,18] 64 % of all head injuries,[19] and 74 % of concussions.[10] It is the contact event with the highest propensity to cause head injuries (0.33 injuries per 1000 tackles) and concussions (0.29 concussions per 1000 tackles) in community rugby.[19] In comparison to the next most common contact events in rugby (rucks and mauls), the propensity for concussion in tackles is ~6-fold higher than in rucks and ~15-fold higher than in mauls.[19]

Accordingly, due to its high propensity to cause concussion, the tackle event has become an obvious target for research and tackle-related interventions that could reduce concussion incidence.[3,20] The body position of the tackler during the tackle influences concussion risk and incidence. Tucker et al. showed that the tackle situation with the highest head injury risk occurs when both the tackler and ball carrier are upright in the tackle, i.e. the heads of both ball carrier and tackler(s) are in close proximity.[14] The study investigated the occurrence of head injury assessments (HIAs) in elite rugby. In practical terms, an HIA event may be considered as a proxy for a suspected or potential concussion. Indeed, the odds of an HIA for the tackler are 4.25 times higher when the tackle height is above the level of the armpit of the ball carrier, i.e. the tackler's head makes contact with the ball carrier's head or shoulder, compared with below the level of the ball carrier's armpit, and 1.4 times more likely for an upright tackler than for a bent-at-the-waist tackler. Similarly, the odds of an HIA for the ball carrier are ~2 times higher for an upright ball carrier compared with a bent-at-the-waist ball carrier. Other risk factors that increase the risk for an HIA (and therefore a player's risk to sustain a suspected or potential concussion) in a tackle event are an accelerating tackler, tackler speed, and tackle type (e.g. arm tackle, shoulder tackle, etc.).[21] The HIA process does not apply at the community level.

Research describing the tackle and tackle-related injury risk factors in community rugby is sparse. Therefore, as part of a tackle law variation trial,[11] we sought to describe tackle characteristics based on video surveillance during a single season, four-league amateur community-level rugby competition conducted under the lowered, armpit-level maximum legal tackle height law variation. In addition, we investigated factors that were associated with 'high tackles under the new law', during this lowered maximum tackle height season.

2. Methods

This study represents a secondary analysis of a larger, overarching tackle height law variation trial.[11] The first year (2018) of the study was conducted using the standard shoulder-level maximum tackle height law. In the second year (2019) of the larger study, the maximum legal tackle height was lowered from the ball carrier's shoulder to the armpit. Ball carrier actions in the tackle were not included in the law variation in this study, whereas other law variation trials may include sanctioning of specific ball carrier actions. Matches were filmed to allow for coding and data analysis. The Ethical approval for this study was granted by the Health Research Ethics Council of Stellenbosch University (reference number N20/02/017).

The 'Koshuis' ('koshuis' translates to 'residence') rugby competition is the Stellenbosch University rugby club's intra-university competition between teams from the various university residences, divided into four leagues, with ~42 teams (annual variations in residences' ability to field full teams in various league due to student rotation) participating in the competition.[22] The competition is played over 14 weeks (usually April–October, as in 2019). Matches are scheduled on a recurring, weekly basis, i.e. one weekly match on the same weekday. Teams from a single league compete on six adjacent rugby fields in matches lasting 60 (1st–3rd leagues) or 50 min (4th league). The competition is considered as a lower level of play and therefore, match times are adjusted in accordance with the lower playing standard. First league teams represent the highest level and have 1–2 training sessions per week. The lower leagues train infrequently or not at all, particularly in the lowest (4th) league. The competition is played under World Rugby's 'Recognise and Remove' concussion management policy.[23]

All players participating in any form of rugby sanctioned by the university, including players in the residence competition, are required to register with the rugby club. During the digital registration process, players were required to provide consent for the study. All registered, consenting players taking part in the residence competition were eligible for the study. All players were registered university students aged 18 years and older.

In addition to the standardised injury surveillance protocols in place during the two-year study, two additional sources of data were collected in year two. Firstly, videographers were trained to provide wide-angle video recordings of each match from especially erected scaffolding placed strategically between the fields. Secondly, each match referee was also fitted with a head-strap mounted GoPro camera (Version 7, with image stabilisation technology) and the entire match was filmed from both these sources.

Video files were stored on a secure, centralised data storage facility. A video analysis coder was assigned to each of the four leagues. Match video files were coded using NacSport Basic (NacSport, Las Palmas de Gran Canaria). A coding framework was developed in collaboration with a Rugby Football Union working group and subject-expert co-authors.[24] The coding framework and definitions are attached as supplementary materials (Supplementary 1).

Tackler- and ball carrier-associated variables were coded separately and matched to tackles according to time stamps. Therefore, following export of the coding data, the data were parsed through custom-built scripts (based on the coding framework) to 1) check and flag any possible errors or impossible data combinations, which were then manually checked with the original, raw video data and re-exported, and 2) to

address technical database organisational limitations (e.g. tackler detail from two separate tackles occurring within 2 s of each other assigned to a single tackle). This process was performed by a research data scientist and compared to raw video data and coding by RVT (first author).

Tackle characteristics based on the coding framework are reported through descriptive statistics (mean ± SD, median and range, frequency). Match exposure represents the number of matches per league multiplied by the number of players exposed (30), multiplied by the time exposed (match duration - leagues 1–3: 1 h, 60 min; league 4: 0.83 h, 50 min). Total match tackles were compared between leagues using the Kruskal-Wallis test.

For analysis (Table 1; see supplementary tables for definitions), tackles were categorised as either 'high tackle under the new law' or 'not high' (including legal and other illegal tackles). Logistic regressions with corresponding 95 % confidence intervals and the level of significance set at $p < 0.05$ were performed to identify factors associated with 'high tackles under the new law'. Odds ratios (ORs) >2 or <0.5 were deemed of practical relevance. Factors investigated were league, tackle type, tackle aspect, and tackler and ball carrier body positions on contact in the tackle (independent variables). All of the independent variables were categorical (nominal) variables, and a reference category was chosen if appropriate. For example, for tackler position on contact, "bent at waist" was chosen as the reference or comparator based on the study aim. Tackle height, whether high (=1) or not high (=0), was the binary dependent variable. Two methods were used for additional analyses to account for missing data, i.e. multiple imputation and the addition of a binary independent variable to the logistic regression.[25,26] The 2nd–4th leagues were grouped together for improved statistical power, in addition to the lower playing standard in comparison to 1st league. Tackle types were also grouped based on the proportions observed in the descriptive statistics, i.e. tackle types with low proportions were grouped to ease interpretability when performing the logistic regression. The logistic regression model was assessed with Hosmer and Lemeshow's goodness-of-fit test, which yielded a p-value of 0.49, indicating a good logistic regression model fit. Multicollinearity was assessed by calculating a variance inflation factor (VIF). The calculated VIF is 1.15, indicating a low level of multicollinearity.

The Kappa statistic was used to test inter- and intra-coder reliability. It is commonly used in rugby video analysis studies.[27] Kappa provides a value from 0 to 1 to represent agreement, and ranges between 0.01–0.2, 0.21–0.4, 0.41–0.6, 0.61–0.8, and 0.81–0.99 are considered slight, fair, moderate, substantial, and almost perfect, respectively.[28] Each coder coded one half of a match that was randomly selected and recoded the same segment at least 1 week later to allow for both inter- and intra-rater reliability testing to be performed. Intra-reliability Kappa values ranged between 0.95 and 0.97 and inter-reliability values ranged between 0.95 and 0.98. Therefore, the reliability between coders was deemed to be 'almost perfect'.

Data analysis was performed using Stata (StataCorp. 2021. *Stata Statistical Software: Release 12*. College Station, TX: StataCorp LLC) and R statistical software.[29]

All sport was cancelled in 2020 due to Covid-19 which precluded the planned collection of a second season of observational data under the lowered tackle law.

Table 1
Descriptive tackle detail.

League	High[a]	Not high	Total
First	414 (6 %)	6518 (94 %)	6932
Third	471 (13 %)	3133 (87 %)	3604
Second	194 (7 %)	2553 (93 %)	2747
Fourth	199 (14 %)	1197 (86 %)	1396
Tackle type			
Arm tackle	469 (9 %)	4894 (91 %)	5363
Shoulder tackle	184 (7 %)	2515 (93 %)	2699
Smother tackle	229 (14 %)	1439 (86 %)	1668
Jersey tackle	49 (7 %)	644 (93 %)	693
Tap tackle	1 (2 %)	47 (98 %)	48
unknown	346 (8 %)	3862 (92 %)	4208
Tackle aspect			
Side on	274 (7 %)	3581 (93 %)	3855
Front on	342 (12 %)	2587 (88 %)	2929
Oblique	246 (9 %)	2435 (91 %)	2681
From behind	67 (7 %)	863 (93 %)	930
unknown	349 (8 %)	3935 (92 %)	4284
Tackler body position pre-contact			
Medium	361 (7 %)	4490 (93 %)	4851
Upright	357 (18 %)	1637 (82 %)	1994
Low	48 (3 %)	1491 (97 %)	1539
unknown	512 (8 %)	5783 (92 %)	6295
Ball carrier body position pre-contact			
Medium	430 (8 %)	4922 (92 %)	5352
Upright	320 (11 %)	2663 (89 %)	2983
Low	47 (10 %)	416 (90 %)	463
unknown	481 (8 %)	5400 (92 %)	5881
Tackler body position on contact			
Bent @ waist	360 (8 %)	4180 (92 %)	4540
Falling or diving	140 (4 %)	3529 (96 %)	3669
Upright	423 (20 %)	1745 (80 %)	2168
unknown	355 (8 %)	3947 (92 %)	4302
Ball carrier body position on contact			
Bent @ waist	364 (9 %)	3507 (91 %)	3871
Upright	278 (11 %)	2234 (89 %)	2512
Falling or diving	85 (5 %)	1487 (95 %)	1572
unknown	551 (8 %)	6173 (92 %)	6724

[a] High tackle under the new law; %, n/row total.

3. Results

There were 116 completed matches, of which 108 matches were filmed and coded. Due to technical or logistical reasons, no video data was obtained for 8 matches. The overall total exposure for the season was 3415 player match hours. A total of 14,780 tackles were coded with a mean of 137 (SD ± 30) tackles per match, ranging from 113 (±17) tackles per match in the fourth league, 128 (±25) tackles per match in first league, 150 (±34) tackles per match in third league, to 161 (±23) tackles per match in third league. Following data script-parsing, a total of 14,679 analysable tackles were identified.

In comparison to 2nd and 3rd leagues, both 1st and 4th leagues had significantly fewer total median tackles per match (Fig. 1). Match duration was 50 min in 4th league and 60 min in 1st–3rd leagues. In terms of assessing between-league differences, the results using parametric and non-parametric statistics were similar.

The descriptive details of the 14,679 tackles are presented in Table 1. Of these tackles, detailed tackler- and ball-carrier-related coded data were available for 10,526 (72 %) and 9015 (61 %) tackles, respectively. There were 13,059 legal tackles, 1539 'high tackles under the new law' (n = 10 % of 14,679), and 81 other illegal tackles (e.g. late tackles, tackling a player in the air, etc.).

Factors associated with 'high tackles under the new law' (in comparison to non-high tackles) according to the lowered, armpit-level legal tackle height law variation[11] are summarised in Table 2.

'High tackles under the new law' had significantly greater odds of occurring in leagues 2–4 combined than in the first league, holding all other variables in the model constant. Arm tackles and front-on tackles were associated with significantly greater odds of resulting in a 'high tackle under the new law'. Regarding players' body positions in the tackle, ball carriers that were bent at the waist, or falling/diving (OR > 2) whilst being tackled, had significantly greater odds of being associated with a 'high tackle under the new law'. Tacklers that were upright at the point of contact, compared to those who were bent-at-the-waist, had significantly greater odds (OR > 2) of being associated with a 'high tackle under the new law'. Conversely, a tackler that was falling/diving

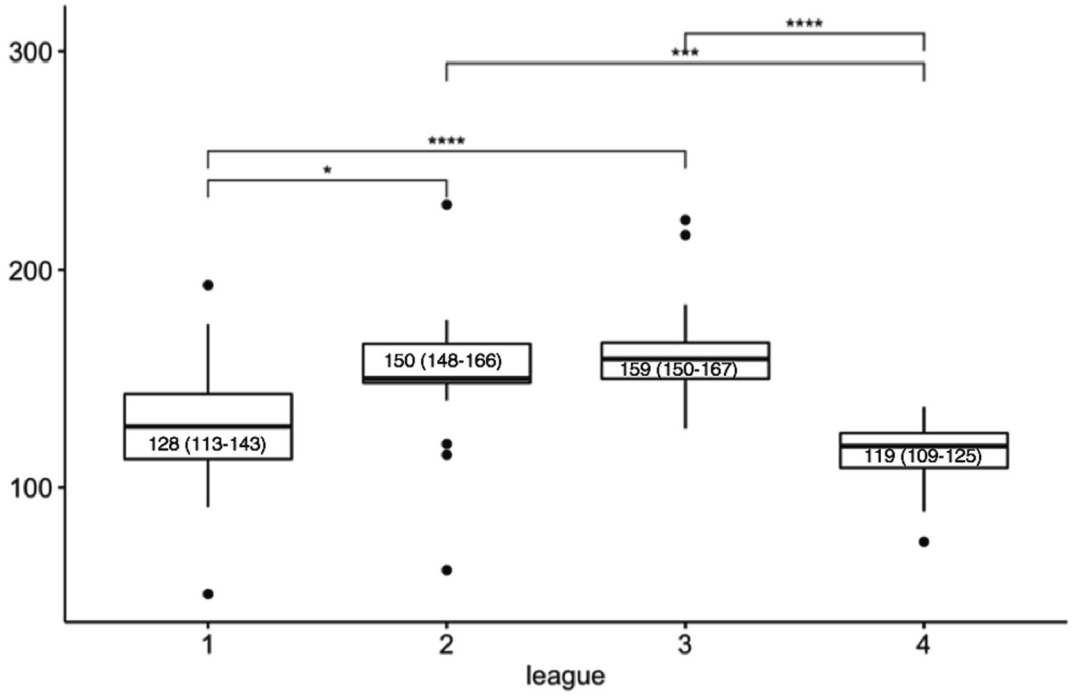

Fig. 1. Box and whisker plots (median and IQR) comparing total match tackles between leagues. The overall Kruskal-Wallis indicated that the median tackle count was significantly different by league ($p < 0.001$). A post-hoc analysis using Dunn's test for pairwise comparison (with Bonferroni correction) indicated that 1st league had a significantly lower median match tackle count than 2nd league (*$p < 0.05$) and 3rd league (****$p < 0.0001$). Similarly, 4th league had a significantly lower median tackle count than 2nd (***$p < 0.001$) and 3rd (****$p < 0.0001$) league.

(OR < 0.5) in the tackle, had significantly lower odds of being associated with a 'high tackle under the new law'.

4. Discussion

As a secondary analysis of an overarching tackle law variation trial, this study aimed to describe characteristics of the tackle in amateur, community-level rugby under a law variation condition, i.e. the maximum legal height of the tackle was set at the armpit-level of the ball carrier. In addition, factors associated with 'high tackles under the new law' were investigated.

This study provides descriptive data for over 14,000 coded tackles. The tackle has been noted as a prime target for interventions to reduce the incidence of concussion in rugby union, as it has the highest propensity for concussions (and other head injuries) within the sport. Thus, characterising and describing this phase of play provides valuable scientific information to inform policy and practice. It should be emphasised that these data were collected during a season played under a tackle law variation with no comparison to a 'standard', shoulder-level legal tackle height law season.

Table 2
Logistic regression model for factors associated with 'high tackles under the new law'.

	OR	95 % CI	p-Value
League (c/f 1st league)			
2nd–4th leagues vs. 1st league	1.95	1.61–2.35	<0.001*
Tackle type (c/f shoulder)			
Arm	1.65	1.31–2.08	<0.001*
Smother/jersey/tap	1.18	0.92–1.53	0.195
Tackle aspect (c/f side-on)			
Front-on	1.61	1.30–2.00	<0.001*
Oblique/from-behind	1.13	0.92–1.38	0.259
BC position on contact (c/f upright)			
Bent at waist	1.93	1.58–2.35	<0.001*
Falling/diving	2.21[a]	1.60–3.05	<0.001*
Tackler position on contact (c/f bent at waist)			
Upright	3.38[a]	2.73–4.19	<0.001*
Falling/diving	0.44[a]	0.33–0.57	<0.001*

OR, odds ratio; CI, confidence interval; c/f, compared with.
[a] OR <0.5 or >2.
* $p < 0.05$.

There was a mean of 137 (±30) tackles per match in this study, with fewer tackles per match in first league than in the other leagues (corrected for match duration, i.e. 4th league adjusted to match duration of 60 min). As noted, matches in the present study were played over 50–60 min, whereas 80 min is the standard for senior level matches. A previous study in community rugby in the United Kingdom spanning six seasons and ~176,000 player match hours reported a mean of 140.9 tackles (defined as "tackler stops the progress of the ball carrier with the use of his arms") per match.[19] A systematic review[30] of 73 studies that summarised the collision frequencies and intensities for rugby union and rugby sevens reported a mean of 156 tackles per match for rugby union. The study by Tucker et al. in elite rugby reported a mean of 158 tackles per match.[20] A recently published study of 201 matches and ~33,000 tackles across age groups from under 12 s to elite level senior players reported tackle frequencies that ranged from a mean of 155 tackles per match at under 12 level to a mean of 221 tackles per match at senior elite level.[31] Therefore, the mean number of tackles per match in the current study, corrected for match duration, is similar to the reported number of mean tackles per match in other cohorts that included playing levels that varied from amateur community level to international level. We expected a higher number of tackles per match in first league, in comparison to the lower leagues.[18,31] Speculatively, this may be due to match play in lower leagues being less structured, and more chaotic, unpredictable, and disorganised, which increases the likelihood of tackles occurring.

In this study, 'high tackles under the new law' had significantly greater odds of occurring in the lower leagues (leagues 2–4 combined) than in the first league. This is likely due to the higher tackle counts in the lower leagues, where more frequent exposure events increase the

likelihood of such incidents. Additionally, the increased competitiveness, the more intense 'semi-professional' nature characterised by more skilful and structured play (i.e. less chaotic and unpredictable), and the attitudes of players within the first league competition may speculatively result in fewer tackles being performed with greater skill.

Furthermore, we found that tackler body position (upright tackler, OR > 2), ball carrier body position (bent at the waist; falling/diving, OR > 2), tackle aspect (i.e. direction; front-on tackles), and tackle type (arm tackle) had significantly greater odds of being associated with a 'high tackle under the new law'. In contrast, a falling/diving tackler in the tackle event had lower odds (OR < 0.5) of being involved in a 'high tackle under the new law'. This apparent reduction in risk for a falling/diving tackler should be interpreted with caution. It requires careful contextual consideration of the tackle, as this tackler position may increase tackler head contact with the ball carrier's hip or knee. Thus, upright tacklers performing front-on arm-type tackles, and ball carriers that were bent at the waist or falling/diving had the greatest potential to be involved in a 'high tackle under the new law' and therefore be exposed to the risk of a head injury. These factors, i.e. upright or falling/diving tackler and falling/diving ball carrier, are likely of greatest practical relevance. The largest study to date to investigate risk factors for head injuries in elite rugby found that front-on tackles, a falling ball carrier, and more upright tacklers, in addition to an accelerating tackler, more than one tackler, higher speeds, and higher impacts increased the propensity for head injury events.[14] Therefore, the findings in the previous study conducted in a cohort of professional players at the elite level are echoed by the findings in this study conducted in an amateur, community-level cohort. An illegal high tackle (significantly so), or an upright tackler in the tackle event, poses the highest risk for subsequent head injury or concussion.[14,20,32] Therefore, a reduction in both illegal high tackles and lowering the tackler's body position upon contact in the tackle represent opportunities for concussion prevention.

The higher odds of a 'high tackle under the new law' with a low ball carrier position, i.e. bent-at-the-waist of falling/diving, in the tackle event may seem contradictory, considering that the aim of the law variation is to 'nudge' players performing a tackle into lower body positions. It should be pointed out that the present law variation did not impose any restrictions on the ball carrier upon entering a tackle. The authors of the only other published law variation trial study conducted in a professional cohort in the United Kingdom noted that video analysis of tackles showed that ball carriers were more likely to enter tackles in lower body positions, i.e. more bent at the waist, thus forcing tacklers to assume an even lower (more bent at the waist) body position in the tackle event.[33] In terms of the real-life interpretation hereof, these tackles (ball carrier in low/very low/falling body position) generally occur in specific phases of play, e.g. a ball carrier changing body position ('dipping') into the tackle, 'pick up and go' situations, or when an attacking team is driving towards the opposition goal line. Thus, a ball carrier may pick up the ball, or receive the ball in a one-pass situation when driving for the goal line and remain with a torso-position that is relatively low and parallel to the ground. From a risk perspective, these tackles are generally low speed, with low inertial forces, and low transfer of energy and therefore, carry relatively low injury risk in comparison to tackles where there is high energy transfer. High-speed tackles with a ball carrier 'dipping' into the tackle clearly pose a higher injury risk.[14] In the context of the present study, the tackle situation described above had implications for coding and data generation, as the coders followed the predefined coding framework. Thus, when a tackler contacted the ball carrier anywhere above the line of the armpit (e.g. to the shoulder of a ball carrier with a torso-position parallel to the ground), that tackle would be coded as a high tackle under the law variation conditions. These factors have implications for sanctioning and the future implementation of lowered maximum legal tackle height law variations, as these specific tackle event situations may require additional considerations (e.g. limiting ball carriers' actions into tackles) and law interpretation in law variation trials.

The COVID-19 pandemic (and associated governmental regulations, including 'hard lockdowns' during which sport was cancelled) was the biggest study limitation. The pandemic led to the cancellation of the 2020 rugby season. Thus, the study is limited to one season of video data analyses as we could not collect a second season of video data to allow for more robust data analyses of a second season under the law variation trial conditions and comparison to data collected under the standard, shoulder-level tackle law condition. Technical and logistical limitations resulted in not all matches being filmed. In this study, the data were generated by grouping the output of four different coders. This introduces a measure of subjectivity, despite reliability testing of coders, that may influence the accuracy of coded tackles. The completeness of the dataset was also affected by database organisational limitations imposed by the version of the coding software that was used. Therefore, despite the use of custom parsing scripts to address these software-imposed limitations by matching coded data according to time stamp, not all collected data could be matched. We found no difference in the overall main effects of the independent variables using two methods to account for missing data – multiple imputation and the addition of a binary independent variable to the logistic regression that indicates if a variable had missing data or not. Finally, the coding of a tackle is an inherently difficult task, as the tackle represents a very dynamic activity. Therefore, it is often difficult to discern exact interactions between the ball carrier and tackler. This could lead to potential further subjective interpretive differences between coders.

5. Conclusion

This study describes over 14,000 tackles in male amateur rugby during a law variation trial. The overall number of mean tackles per match was similar to other senior male amateur and elite cohorts. We identified factors associated with high tackles under the lowered legal tackle height condition. Factors with significantly higher odds of being associated with a high tackle under the law variation condition, and thus greater potential risk for head injury, include lower level of play, front-on arm tackles, tacklers in upright positions, and ball carriers dipping into contact. These findings further support the implementation of a lowered maximum legal tackle height in rugby union, with consideration of ball carrier behaviour in the tackle event. Previous research identified the tackle event as a target for intervention with the potential to reduce injury risk to players. These data support those findings highlighting tackle-related injury risk, expand the scientific evidence base detailing tackles in community-level rugby, and provide scientific basis for continued efforts to reduce tackle-related injury risk.

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Confirmation of ethical compliance

Stellenbosch University Health Research Ethics Committee approval was granted (N20/02/017) for this study.

CRediT authorship contribution statement

Riaan van Tonder: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Data curation, Writing – original draft, Project administration. **Sharief Hendricks:** Conceptualization, Methodology, Software, Validation, Formal analysis, Data curation, Writing – review & editing, Supervision. **Lindsay Starling:** Conceptualization, Methodology, Investigation, Data curation, Writing – review & editing,

Project administration. **Sean Surmon:** Conceptualization, Resources, Writing – review & editing. **Pierre Viviers:** Conceptualization, Methodology, Investigation, Writing – review & editing. **Wilbur Kraak:** Conceptualization, Methodology, Software, Formal analysis, Data curation, Writing – review & editing. **Keith A. Stokes:** Conceptualization, Methodology, Software, Writing – review & editing, Supervision. **Wayne Derman:** Conceptualization, Methodology, Resources, Writing – review & editing, Supervision. **James Craig Brown:** Conceptualization, Methodology, Resources, Validation, Formal analysis, Investigation, Data curation, Writing – review & editing, Supervision, Project administration, Funding acquisition.

Declaration of interest statement

KS is employed by the Rugby Football Union, the national governing body for rugby union in England. LS is employed by World Rugby, the world governing body for rugby union, however this appointment only started once data collection for this study had concluded. SH is a JSAMS editorial board member. JB's salary is part-paid by World Rugby.

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