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Tackle and ball carrier demands of rugby league: A seven-year league-wide study including over 1,000,000 tackle events

ABSTRACT

Objectives: Describe the highest frequency and variability for tackle events in rugby league. Investigate seasonal differences in total tackle events per match over a seven-year period.

Design: Retrospective observational

Methods: Tackle events (i.e., ball carrier events [attacker] and tackler involvements [defender]) from 864 male professional rugby league players competing in 1,176 Super League matches from 2014 to 2020 were included. A series of linear mixed effect models were used to determine the frequency and variability during peak 1-, 3-, 5-, 10-, 20-, 40-min and whole-match tackle events per player per match at a positional group level. Differences between seasons for the total number of tackle events per match were compared using a one-way analysis of variance and with Tukey's honestly significant difference test.

Results: Tackle events were greatest for Props (51.5 [47.7 - 55.4] per match). Within-players, between-matches, and between-seasons variability was less than 10% for tackle events. There were significantly less tackle events and tackler involvements per match in 2014 and a significantly more tackle events per match in season 2020_b when compared with all other seasons.

Conclusion: Large between-position variability in peak tackle events, ball carrier events, and tackler involvements would suggest that coaches should separate players into positional groups and prescribe training accordingly. Total number of tackle events, ball carrier events, and tackler involvements were significantly greater in season 2020_b when compared to season 2014 to 2019 (inclusive) which may be a consequence of rule changes introduced to the sport.

Key words: Rugby league; tackle; team sports; match demands

Tackle and ball carrier demands of rugby league: A seven-year league-wide study including over 1,000,000 tackle events

Introduction

Rugby league players undertake intermittent locomotor activities (e.g., accelerating and sprinting) and tackle events (i.e., ball carrier [attacker] and tackler involvement [defender]) during match play¹⁻³. The tackle event is the most injurious activity⁴. The characteristics (e.g., frequency, intensity, and duration) of tackle events are typically reported using microtechnology or video-based notational analyses⁵. Locomotor activities are well documented^{1,6,7} yet the characteristics pertaining to tackle events are less understood, despite their importance from a physical performance and an injury perspective⁵.

Tackle events are typically reported as total frequency (i.e., tackle events per match) or rate (i.e., tackle events per minute)^{3,8}. Understanding the frequency and rate of tackle events collectively, and separately as a ball carrier or involvement as a tackler, is important from a load monitoring, injury risk reduction, and physical preparation perspective^{1,5,9}. During rugby league matches, forwards are involved in a similar number of tackle events as a ball carrier ($n = 11.2$ vs 11.4 per match) and approximately twice as many involvements as a tackler ($n = 24.6$ vs 12.8 per match) compared to backs⁵. Whilst useful, these data are based on whole-match frequencies, and do not report the maximal number of tackle events a player is involved in for a given duration (e.g., 1-min, 5-min, or 10-min) which may impact both performance and injury risk within a match.

Johnston et al.² used a rolling sum approach to determine the peak tackle event rate (i.e., tackle events per minute) for forwards and backs in Super League (SL) and National Rugby League (NRL), which are the two professional rugby league competitions based in Europe and Australasia, respectively. The peak number of tackle events per minute for a 1-min epoch were the same for SL and NRL forwards and backs (e.g., 4 ± 1 and 3 ± 1 tackle events per minute). Weaving et al.³ reported that SL players were exposed to 4.9 to 9.7 tackle events during their highest average running demands during a 10-min period. Both of these studies^{2,3} measured tackle events using a validated microtechnology collision detection algorithms¹⁰, which does not differentiate if a players involvement was a ball carrier (i.e., attacker) or tackler (i.e., defender). Consequently, the peak ball carry and tackle demands of rugby league match-play remain unknown and requires investigation. This is important given 61% of injuries

during rugby league occur during the tackle event ¹¹, and the ball carrier has a higher injury rate than the tackler ⁴.

Rugby league has also implemented several rule changes. In 2020, SL temporarily removed the scrum and introduced the ‘six-again’ rule. In comparison to the previous season, adjustables and backs completed more ball carries, and forwards completed more tackles during matches ¹². In the NRL, following rule changes the mean duration of a ball-in-play phase increased from 76.6 ± 11.9 s in 2019 to 90.1 ± 14.9 s and 98.7 ± 17.5 s in 2020 and 2021 ¹³, suggesting more tackles are undertaken prior to a rest period (i.e., ball out of play). Whilst research has shown a difference in overall match demands due to rule changes ^{12,13}, the evolution of the total number of tackle events, and tackle events as a ball carrier or tackler or per match, and for different durations of time (e.g., 1 to 10 minutes) is yet to be determined.

The primary aim of this study was to describe the highest frequency and variability of tackle events, ball carries and tackler involvements per player for playing positions during professional rugby league matches over a seven-year period. The secondary aim was to investigate seasonal differences in total (i.e., sum for all players during a match) tackle events, and involvements as a ball carrier or tackler during rugby league matches between 2014 and 2020.

Materials and Methods

This study used a retrospective observational design in which tackle events, ball carries, and tackler involvements were analysed from 864 individual male professional rugby league players competing in 1,176 SL fixtures from 2014 to 2020. Eight observational periods were included: one for each season (2014 – 2019) and two for the 2020 season (2020_a pre-COVID break and 2020_b post-COVID break). Season 2020 was separated into two sub-seasons due to the duration of the enforced break in fixtures ¹² and different rules of match-play (e.g., with and without scrums ¹⁴). Players were categorised by their primary playing position during each match; props ($n = 315$), hooker ($n = 169$), second rows ($n = 262$), loose forward ($n = 292$), scrum half ($n = 130$), stand-off ($n = 149$), centres ($n = 229$), wings ($n = 216$) and fullback ($n = 129$). A breakdown of the number of fixtures and positional groups during each match are available in Supplementary Materials, Table 1. Institutional ethics approval was granted by Leeds Beckett University Human Ethics Research Committee.

Match-play event data was provided by Opta (Stats Perform, London, United Kingdom) and extracted online (<https://www.optaprourugby.com/index.php>) as an extensible markup language (XML) file. Commercial match-event providers have been used extensively as a data source within rugby league research ^{11,15-18}. Each XML file was converted to a comma separated value (CSV) file that contained date, a unique fixture identification number (ID), player ID, position category, event ID, event timestamp, and event type (e.g., ball carry or tackler involvements). *Ball carries* were defined as a player being in possession of the ball when being tackled by a defending player and included instances whereby the ball carrier offloaded the ball in the process of being tackled ^{16,19}. *Tackler involvements* were defined as a player attempted to halt the progress or dispossess an opponent in possession of the ball regardless of the outcome (e.g., incomplete tackles during which the defender made initial contact but ‘missed’ the tackle due to physical contact with the attacker were included within the tackler involvement frequency ¹⁹). *Tackle events* were interpreted as collective ball carries and tackler involvements. These operating definitions ¹⁹ were consistent throughout the data collection period.

A CSV file containing the precise second of tackle events, as a ball carrier or involvement as a tackler, for each player and match was imported into R (version 4.1.2) for analysis. The highest number of tackle events, ball carries and tackler involvements accumulated per individual within each match were calculated for each defined time epoch (e.g., 1, 3, 5, 10, 20, 40-min and whole-match) using a rolling sum via the *roll_sum()* function, contained within the *RccpRoll* package ²⁰. The highest value was taken as the peak tackle event frequency for each time epoch ^{2,3}. The total number of tackle events, ball carries, and tackler involvements performed within each match (i.e., sum total of events during a match) were determined by grouping and summing all defined events within a match.

Prior to analysis, normality was inspected through kernel density and quantile-quantile plots. The distributions of peak match-event dependant variables (tackle events, ball carries, and tackler involvements) were not normal, so variables were log-transformed to reduce error arising from non-uniform residuals and then back-transformed post-analysis. To account for zero values within the peak match-event dataset, a value of 1 was added to each count variable which was subsequently deducted from the resulted back transformed estimates. The distribution of total tackle events, ball carries, and tackler involvements per match was normally distributed.

For the peak 1-, 3-, 5-, 10-, 20-, 40-min and whole-match analysis, peak match-event data were analysed through a series linear mixed effects models (LMM’s) using the *lme4* package in R ²¹, with

random effects for player ID (to estimate differences between-player means), position category (to estimate changes between-positions), fixture ID (to estimate changes between-matches) and season (to estimate changes between-seasons) ²². The resultant estimates were presented with 95% confidence intervals (CI). Within-player variation was then attributed to that of otherwise unexplained variability (i.e., the residual). Variability was expressed using the coefficient of variation (CV) and was presented with 95% CIs as markers of uncertainly estimates; large changes were interpreted as >10% ²³.

For the total number of tackle events per match analysis, differences between the total number of events per match were compared using a one-way analysis of variance (ANOVA) using the *aov()* function in base R. Tukey's honestly significant difference (HSD) test was used post-hoc using the *TukeyHSD()* function in base R to compare differences between seasons and adjusted p-values were interpreted at an alpha-level of $p < 0.05$. The adjusted p-value identifies positional comparisons that are significantly different, whilst limiting the family error rate ²⁴.

Results

A total of 1,173,014 tackle events (355,724 ball carries and 817,290 tackler involvements) were coded from 2014 to 2020 and included within this study. Table 1 presents the mean peak tackle events, ball carries, and tackler involvements per player for playing position for each time epoch.

*** INSERT TABLE 1 HERE ***

Table 2 details the variability in tackle events, ball carries, and tackler involvements within- and between-players, between-matches, between-positions, and between-seasons. Within-players, variability (%CV) ranged from 0.5% to 5.7% for all time epochs. Between-matches variability ranged from 1.9% to 8.4% for tackle events, 1.5% to 7.7% for ball carries, and 2.0% to 7.2% for tackler involvements. Between-seasons, variability ranged from 0.6% to 1.8% for tackle events, 0.5% to 2.2% for ball carries, and 0.8% to 1.2% for the tackler. Between-players, variability was <10% for tackle events (1- to 10-min epoch), ball carries (1- to 3-min epoch) and for tackler involvements (1- to 5-min epoch). Between-positions, variability was <10% for ball carry exposures in the 1-min time epoch. All other measures of variability were >10% CV (Table 2).

*** INSERT TABLE 2 HERE ***

There was a significantly lower number of tackle events and tackler involvements per match in 2014 when compared with all other seasons. Except for ball carries in the 2020_b to 2020_a comparison, there was a significantly greater number of tackle events, ball carries, and tackler involvements per match in season 2020_b than all other seasons (Table 3).

*** INSERT TABLE 3 HERE ***

Discussion

The primary aim of this study was to describe the highest frequency of tackle events experienced for a given duration for ball carries, and tackler involvements per player during professional rugby league matches over a seven-year period. During a whole-match, Props were involved in the highest number of tackle events ($18.5 \pm 95\%$ CI; 16.9 – 20.1) and ball carries (14.5; 12.6 – 16.4), and Hookers were involved in the highest number of involvements as a tackler (38.7; 36.7 – 40.7). Within a 1-minute period both Props and Loose Forwards were involved in the highest number of tackle events (both 3.4; 3.3 – 3.5), Props and Fullbacks were involved in the highest number of ball carries (both 1.6; 1.5 – 1.7) per minute, and Props, Hookers and Loose Forwards were involved in the highest number of involvements as a tackler (3.2; 3.1 – 3.3, 3.2; 3.1 – 3.4, and 3.2; 3.1 – 3.4, respectively) per minute. Variability in peak tackle, ball carries, and tackler involvements across all time epochs was relatively stable (<10% CV) between matches and seasons. A secondary aim was to investigate seasonal differences at a match level between 2014 – 2020, where significantly more tackles and tackler involvements per match were observed for season 2020_b, in comparison to all other seasons, which may be a consequence of competition rule changes. These findings are important considerations from a player welfare, physical preparation, and competition structure perspective.

Based on over 1,000,000 tackle events over seven years, this study showed that during a whole-match, forwards undertake 32 to 39 tackles and 6 to 15 ball carries, whilst backs undertake 7 to 21 tackles and 6 to 12 ball carries. This equates to approximately one tackle every 2 – 3 mins and one ball carry every 6 to 13 mins for forwards, or approximately one tackle every 4 to 11 mins and one ball carry every 7 to 13 mins for backs. Evans et al. ¹⁶ reported similar frequencies per positional group in SL,

with forwards undertaking one tackle every approximately 2 to 3 mins and one ball carry every 5 to 7 mins, and backs undertaking approximately one tackle and one ball carry every 9 mins. During peak 1-min periods, forwards were involved in one tackle every 19 seconds, or one ball carry every 38 to 55 seconds, whilst backs was one tackle every 22 to 40 seconds, or one ball carry every 38 to 50 seconds. These data can be used to ensure players are appropriately prepared, mitigating the likelihood of reduced tackling technique due to fatigue ²⁵ potentially increasing the risk of injury ²⁶. This is important since the ball carrier is almost twice as likely to be injured than the tackler (39 vs 20 injuries per 1000 hours) during a tackle ⁴.

This study showed the peak number of tackle events, ball carries, and tackler involvement across all time epochs between matches and seasons were relatively stable (<10% CV). Larger variability was observed for 1-min peak ball carries (CV = 7.4% (4.6 – 12.3%)), between-position variability was large (>10% CV) for all positional groups at all time intervals. The amount of variability in tackler events, tackles and carries appear similar to those reported for displacement variables (e.g., distance [m], average speed [$\text{m}\cdot\text{min}^{-1}$] and average acceleration [$\text{m}\cdot\text{s}^{-2}$]) in rugby league ²³. Collectively, these finding can be used to determine if a worthwhile change in tackle events or involvements has taken place, which is important for player management strategies. These findings are consistent with the unique attacking and defensive responsibilities for playing positions during match-play. Therefore, coaches and governing bodies should ensure this is reflected in player rest and recovery strategies and policies.

This study is the first to present summated tackle events data per match. There were no significant differences between any pairwise comparison from 2015 to 2020_a (pre-COVID) when analysing total number of tackles, ball carries, and tackler events per match (i.e., summated total number of tackle events during a match) (Table 3). However, there was a significant increase in the total number of tackles and tackler involvements when comparing season 2020_b (post-COVID) to all other seasons. This finding may be explained because of rule changes implemented at the commencement of season 2020_b. Following a 141-day suspension of fixtures due to COVID-19 restrictions ¹², competitive SL matches returned with the removal of the scrum and the introduction of the “six-again” rule. This rule change allowed the referee to award six more tackles in the event of an infringement by a defending side. As such governing bodies should be aware of the impact rules changes have on match activities, specifically tackle events, given their injury ¹¹ and concussion risk ²⁷. Gardner ²⁸ demonstrated that,

during NRL match play, 94.5% of head injury assessments (HIAs) occurred during the tackle event and reported 1.6 HIAs per 1000 tackler involvements. Considering the number of tackler involvements reported within the present study, it would be reasonable to speculate that the risk of HIA during rugby league match-play has increased from a propensity of 1.5 HIAs per match in season 2014 (964 tackler involvements per match) to a propensity of 1.7 HIAs per match in season 2020_b (1068 tackler involvements per match); however further research is required to substantiate this speculation.

The majority of studies within rugby league utilise small sample sizes (i.e., single team ⁷) during data collection which is considered as a limitation ²⁹. In contrast, the large number of players and matches is a strength of the present study (e.g., previous large sample studies have included data from 380 players collected from 323 matches during a two-year period vs. the present study included >1,000,000 tackle events and data from 864 players collected from 1176 matches during a seven-year period). This study is not without its limitations. Firstly, the specific action of the tackler (e.g., type of tackle completed) during the tackle event is not specified therefore the tackling player may be the tackler making initial contact or perform the role of a supporting tackler. Secondly, the tackle events reported do not provide a magnitude of the collision. Collisions of different intensity are likely to have different metabolic (e.g., fatigue) or mechanical (e.g., muscle damage) costs. One way to examine collision intensity, specifically at the head, is in the form of head acceleration magnitudes and exposures, which has the potential to be achieved using instrumented mouthguards ³⁰, however this method of collision quantification remains in its infancy.

Conclusion

For the first time, this study quantifies the highest number of tackle events, ball carry, and tackler involvements within rugby league match-play at various time epochs ranging from 1-min to whole-match. While whole-match analysis shows that players are exposed to one tackle event every 93 to 259 seconds, peak 1-min analysis reveals an exposure at a substantially greater rate of every 17 to 29 seconds. This is an important consideration since during periods of a greater tackler involvement rate, players will experience fatigue which may compromise tackle technique and therefore it is important that players prepare physically to develop the capacity to perform to these demands. This study demonstrated low variability (CV <10%) within-player, between-matches and between-seasons for tackles, ball carries, and tackler involvements at all time epochs which suggests a consistent exposure

to these events. This enables practitioners to understand when a player has been exposed to a meaningful change in collision stimulus and allows for simple tackle exposure modification via match selection/deselection or rest. Matches completed following a break in fixtures due to COVID-19 restrictions reported significantly greater total number tackle and tackler involvements when analysed at a match level.

Practical Applications

- Understanding the exposure and frequency of tackle events, ball carries, and tackler involvements is paramount for practitioners to adequately prepare players to the demands of the rugby league match-play.
- Large between-position variability in peak tackles, carries, and tackler involvements indicates players in different positional groups should have bespoke training, playing and recovery schedules.
- Given the stable between-match variability within a positional group, practitioners should monitor for meaningful increases and decreases in tackle event exposure between matches and plan subsequent training accordingly.
- Total number of tackles, carries, and tackler involvements were significantly greater in season 2020₆ when compared to season 2014 to 2019 which may be a consequence of rule changes introduced to the sport ahead of competitive return following COVID-19 restrictions.

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Table 1: Peak tackle events, ball carries and tackler involvements per player for positions (Mean \pm 95% CIs)

| Event | Positional Group | 1 minute | 3 minutes | 5 minutes | 10 minutes | 20 minutes | 40 minutes | Whole Match |
|--|------------------|-----------------|-----------------|-----------------|--------------------|--------------------|--------------------|--------------------|
| Tackle Events (n) | Props | 3.4 (3.3 - 3.5) | 5.4 (5.3 - 5.6) | 7.1 (6.8 - 7.3) | 10.4 (10.1 - 10.8) | 15.6 (15.0 - 16.2) | 22.9 (21.9 - 23.8) | 51.5 (47.7 - 55.4) |
| | Hookers | 3.3 (3.2 - 3.5) | 5.1 (4.9 - 5.3) | 6.5 (6.2 - 6.8) | 9.4 (9.0 - 9.8) | 14.1 (13.4 - 14.7) | 21.3 (20.3 - 22.3) | 44.8 (42.5 - 47.0) |
| | Second Rows | 3.3 (3.1 - 3.4) | 5.0 (4.8 - 5.1) | 6.4 (6.1 - 6.6) | 9.3 (8.9 - 9.6) | 13.9 (13.3 - 14.5) | 21.8 (20.9 - 22.6) | 42.0 (40.2 - 43.7) |
| | Loose Forwards | 3.4 (3.3 - 3.5) | 5.4 (5.2 - 5.6) | 7.0 (6.7 - 7.2) | 10.3 (9.9 - 10.7) | 15.6 (15.0 - 16.2) | 23.2 (22.3 - 24.1) | 49.1 (47.0 - 51.2) |
| | Scrum-halves | 2.7 (2.6 - 2.8) | 3.9 (3.7 - 4.0) | 4.8 (4.5 - 5.0) | 6.8 (6.4 - 7.2) | 10 (9.4 - 10.6) | 14.9 (14.0 - 15.9) | 27.4 (25.7 - 29.2) |
| | Stand-offs | 2.7 (2.6 - 2.8) | 3.8 (3.7 - 4.0) | 4.8 (4.5 - 5.0) | 6.8 (6.4 - 7.2) | 10 (9.4 - 10.6) | 15.0 (14.0 - 15.9) | 27.6 (25.9 - 29.3) |
| | Centres | 2.7 (2.6 - 2.8) | 3.9 (3.8 - 4.0) | 4.9 (4.7 - 5.0) | 6.9 (6.7 - 7.2) | 10.2 (9.8 - 10.6) | 15.3 (14.7 - 15.9) | 28.4 (27.3 - 29.6) |
| | Wings | 2.1 (2.0 - 2.2) | 2.9 (2.8 - 3.1) | 3.6 (3.3 - 3.8) | 5.0 (4.6 - 5.3) | 7.1 (6.6 - 7.7) | 10.3 (9.4 - 11.1) | 18.5 (16.9 - 20.1) |
| | Fullbacks | 2.1 (2.0 - 2.3) | 3.0 (2.8 - 3.2) | 3.7 (3.5 - 3.9) | 5.2 (4.8 - 5.6) | 7.6 (7.0 - 8.2) | 11.1 (10.1 - 12.0) | 20.3 (18.6 - 22.0) |
| Ball Carries (n) (i.e., attacker) | Props | 1.6 (1.5 - 1.7) | 2.3 (2.1 - 2.4) | 2.7 (2.6 - 2.9) | 3.6 (3.5 - 3.8) | 4.9 (4.6 - 5.1) | 6.7 (6.3 - 7.1) | 14.5 (12.6 - 16.4) |
| | Hookers | 1.1 (1.1 - 1.2) | 1.5 (1.3 - 1.6) | 1.7 (1.5 - 1.8) | 2.1 (1.9 - 2.3) | 2.8 (2.5 - 3.1) | 3.7 (3.2 - 4.1) | 6.1 (5.1 - 7.2) |
| | Second Rows | 1.5 (1.4 - 1.6) | 2.0 (1.9 - 2.1) | 2.4 (2.3 - 2.6) | 3.2 (3.0 - 3.4) | 4.3 (4.0 - 4.5) | 6.0 (5.6 - 6.4) | 10.5 (9.7 - 11.3) |
| | Loose Forwards | 1.5 (1.4 - 1.6) | 2.1 (2.0 - 2.2) | 2.5 (2.4 - 2.6) | 3.3 (3.1 - 3.5) | 4.4 (4.2 - 4.7) | 6.0 (5.6 - 6.4) | 10.7 (9.7 - 11.7) |
| | Scrum-halves | 1.2 (1.1 - 1.3) | 1.6 (1.4 - 1.7) | 1.8 (1.6 - 1.9) | 2.3 (2.1 - 2.5) | 3 (2.7 - 3.3) | 4.0 (3.6 - 4.4) | 6.4 (5.5 - 7.2) |
| | Stand-offs | 1.3 (1.2 - 1.4) | 1.7 (1.6 - 1.8) | 1.9 (1.8 - 2.1) | 2.4 (2.2 - 2.6) | 3.2 (3.0 - 3.5) | 4.3 (3.9 - 4.7) | 6.9 (6.0 - 7.7) |
| | Centres | 1.5 (1.4 - 1.5) | 2.0 (1.9 - 2.1) | 2.4 (2.3 - 2.5) | 3.1 (3.0 - 3.2) | 4.2 (4.0 - 4.3) | 5.8 (5.6 - 6.1) | 10.0 (9.5 - 10.5) |
| | Wings | 1.5 (1.4 - 1.5) | 2.1 (2.0 - 2.2) | 2.5 (2.4 - 2.6) | 3.3 (3.1 - 3.5) | 4.6 (4.3 - 4.8) | 6.5 (6.1 - 6.9) | 11.3 (10.6 - 12.0) |
| | Fullbacks | 1.6 (1.5 - 1.7) | 2.2 (2.1 - 2.4) | 2.7 (2.5 - 2.8) | 3.5 (3.3 - 3.7) | 4.9 (4.6 - 5.2) | 7.0 (6.6 - 7.4) | 12.2 (11.4 - 13.0) |
| Tackler involvements (n) (i.e., defender) | Props | 3.2 (3.1 - 3.3) | 4.8 (4.6 - 4.9) | 6.0 (5.8 - 6.2) | 8.5 (8.2 - 8.9) | 12.1 (11.5 - 12.6) | 17.3 (16.5 - 18.2) | 37.3 (33.8 - 40.8) |
| | Hookers | 3.2 (3.1 - 3.4) | 4.8 (4.6 - 4.9) | 6.0 (5.7 - 6.2) | 8.5 (8.1 - 8.9) | 12.5 (11.9 - 13.1) | 18.7 (17.8 - 19.6) | 38.7 (36.7 - 40.7) |
| | Second Rows | 3.1 (3.0 - 3.2) | 4.4 (4.2 - 4.6) | 5.5 (5.3 - 5.7) | 7.8 (7.4 - 8.1) | 11.2 (10.7 - 11.7) | 16.9 (16.1 - 17.7) | 31.5 (30.1 - 33.0) |
| | Loose Forwards | 3.2 (3.1 - 3.4) | 4.8 (4.6 - 5.0) | 6.1 (5.8 - 6.3) | 8.7 (8.3 - 9.0) | 12.6 (12.1 - 13.1) | 18.4 (17.6 - 19.2) | 38.4 (36.6 - 40.3) |
| | Scrum-halves | 2.6 (2.4 - 2.7) | 3.5 (3.3 - 3.7) | 4.2 (4.0 - 4.5) | 5.8 (5.4 - 6.2) | 8.3 (7.7 - 8.8) | 11.9 (11.1 - 12.7) | 20.8 (19.3 - 22.4) |
| | Stand-offs | 2.5 (2.4 - 2.7) | 3.4 (3.3 - 3.6) | 4.2 (4.0 - 4.4) | 5.7 (5.4 - 6.1) | 8.1 (7.5 - 8.6) | 11.7 (10.9 - 12.5) | 20.6 (19.1 - 22.0) |
| | Centres | 2.4 (2.4 - 2.5) | 3.2 (3.1 - 3.3) | 3.9 (3.8 - 4.0) | 5.3 (5.1 - 5.5) | 7.4 (7.0 - 7.7) | 10.5 (10.0 - 11.0) | 18.4 (17.5 - 19.3) |
| | Wings | 1.5 (1.4 - 1.6) | 1.8 (1.7 - 2.0) | 2.1 (1.9 - 2.3) | 2.7 (2.3 - 3.0) | 3.5 (2.9 - 4.0) | 4.5 (3.7 - 5.2) | 7.1 (5.8 - 8.5) |
| | Fullbacks | 1.7 (1.6 - 1.8) | 2.1 (1.9 - 2.3) | 2.4 (2.2 - 2.7) | 3.1 (2.7 - 3.5) | 4.0 (3.5 - 4.6) | 5.1 (4.3 - 5.9) | 8.0 (6.6 - 9.4) |

Table 2: The Variability (CV \pm 95% CIs) in tackle events, ball carries and tackler involvements per player for positions

| Event | Time epoch | Residual (within-player) | Between-match | Between-season | Between-player | Between-position |
|--|-------------|--------------------------|--------------------|--------------------|-----------------------|-------------------------|
| Tackle Events | 1-min | 0.66 (0.65 – 0.66) | 1.85 (1.57 – 2.13) | 0.57 (0.18 – 1.29) | 5.21 (4.83 – 5.63) | 15.38 (9.45 – 26.23) |
| | 3-min | 0.94 (0.93 – 0.94) | 3.11 (2.86 – 3.38) | 0.99 (0.51 – 2.03) | 7.06 (6.58 – 7.59) | 21.70 (13.19 – 37.64) |
| | 5-min | 1.18 (1.17 – 1.18) | 3.88 (3.62 – 4.16) | 1.31 (0.72 – 2.64) | 8.11 (7.56 – 8.70) | 25.14 (15.21 – 44.05) |
| | 10-min | 1.66 (1.65 – 1.68) | 4.91 (4.62 – 5.22) | 1.90 (1.09 – 3.78) | 10.16 (9.50 – 10.89) | 29.40 (17.68 – 52.14) |
| | 20-min | 2.54 (2.52 – 2.56) | 5.94 (5.61 – 6.29) | 2.83 (1.68 – 5.57) | 12.61 (11.81 – 13.49) | 32.85 (19.65 – 58.83) |
| | 40-min | 3.62 (3.60 – 3.65) | 6.73 (6.35 – 7.13) | 3.03 (1.79 – 5.98) | 13.44 (12.58 – 14.39) | 35.73 (21.28 – 64.47) |
| | Whole Match | 5.65 (5.59 – 5.71) | 8.44 (7.93 – 8.98) | 1.84 (0.85 – 3.93) | 16.43 (15.16 – 17.83) | 46.61 (27.24 – 86.52) |
| Ball Carries (i.e., attacker) | 1-min | 0.54 (0.53 – 0.54) | 1.46 (0.91 – 1.89) | 0.48 (0.14 – 1.09) | 6.89 (6.40 – 7.44) | 7.36 (4.55 – 12.30) |
| | 3-min | 0.64 (0.64 – 0.65) | 1.89 (1.44 – 2.28) | 1.04 (0.60 – 2.05) | 9.20 (8.56 – 9.91) | 11.60 (7.15 – 19.61) |
| | 5-min | 0.77 (0.76 – 0.77) | 2.32 (1.89 – 2.72) | 1.10 (0.63 – 2.18) | 11.16 (10.40 – 12.00) | 13.78 (8.46 – 23.43) |
| | 10-min | 1.01 (1.01 – 1.02) | 3.09 (2.66 – 3.51) | 1.55 (0.92 – 3.05) | 14.39 (13.44 – 15.44) | 17.15 (10.49 – 29.46) |
| | 20-min | 1.37 (1.36 – 1.38) | 4.11 (3.66 – 4.56) | 1.83 (1.07 – 3.63) | 18.20 (17.01 – 19.51) | 20.57 (12.51 – 35.68) |
| | 40-min | 1.80 (1.79 – 1.81) | 5.22 (4.71 – 5.74) | 2.13 (1.23 – 4.23) | 20.45 (19.10 – 21.94) | 26.19 (15.80 – 46.13) |
| | Whole Match | 2.92 (2.89 – 2.95) | 7.67 (6.91 – 8.43) | 2.22 (1.05 – 4.70) | 26.65 (24.58 – 28.97) | 38.15 (22.37 – 69.63) |
| Tackler Involvements (i.e., defender) | 1-min | 0.69 (0.68 – 0.69) | 1.99 (1.63 – 2.32) | 0.78 (0.38 – 1.63) | 6.44 (5.96 – 6.95) | 22.85 (13.87 – 39.80) |
| | 3-min | 0.99 (0.98 – 1.00) | 2.71 (2.36 – 3.07) | 0.98 (0.49 – 2.03) | 8.72 (8.11 – 9.38) | 32.84 (19.64 – 58.76) |
| | 5-min | 1.24 (1.23 – 1.25) | 3.35 (2.99 – 3.71) | 1.16 (0.59 – 2.41) | 10.08 (9.39 – 10.84) | 39.03 (23.13 – 70.96) |
| | 10-min | 1.76 (1.74 – 1.77) | 4.14 (3.75 – 4.53) | 1.56 (0.85 – 3.17) | 12.56 (11.71 – 13.50) | 48.63 (28.43 – 90.56) |
| | 20-min | 2.62 (2.59 – 2.63) | 4.76 (4.33 – 5.20) | 2.14 (1.22 – 4.29) | 15.27 (14.26 – 16.39) | 59.05 (34.07 – 112.90) |
| | 40-min | 3.57 (3.55 – 3.60) | 5.47 (4.95 – 6.00) | 2.00 (1.10 – 4.07) | 16.73 (15.59 – 17.98) | 73.00 (41.38 – 144.10) |
| | Whole Match | 5.46 (5.40 – 5.52) | 7.20 (6.26 – 8.13) | 1.24 (0.29 – 2.86) | 20.36 (18.62 – 22.32) | 104.39 (57.01 – 220.39) |

Table 3. Total number (mean \pm 95% CIs) of tackle events, ball carries and tackler involvements per match

| Season | Tackle Events | Ball Carries (i.e., attacker) | Tackler Involvements (i.e., defender) |
|-------------------|---|---|--|
| 2014 | 967 (956 – 977) ^{b, c, d, e, f, g, h} | 303 (299 – 306) ^h | 664 (657 – 671) ^{b, c, d, e, f, g, h} |
| 2015 | 994 (969 – 1020) ^h | 304 (295 – 312) ^h | 691 (672 – 709) ^{a, h} |
| 2016 | 999 (973 – 1025) ^h | 299 (291 – 308) ^h | 700 (681 – 718) ^{a, h} |
| 2017 | 1002 (977 – 1028) ^h | 305 (296 – 313) ^h | 698 (680 – 716) ^{a, h} |
| 2018 | 999 (974 – 1024) ^h | 299 (291 – 307) ^h | 700 (682 – 718) ^{a, h} |
| 2019 | 997 (971 – 1022) ^h | 300 (292 – 308) ^h | 697 (679 – 715) ^{a, h} |
| 2020 _a | 1012 (975 – 1048) ^h | 305 (293 – 317) | 707 (681 – 732) ^{a, h} |
| 2020 _b | 1068 (1037 – 1099) ^{a, b, c, d, e, f, g} | 318 (308 – 328) ^{a, b, c, d, e, f} | 750 (728 – 772) ^{a, b, c, d, e, f, g} |

Values are presented as mean (95% CI); CI = confidence interval.

^a = significantly different from 2014; ^b = significantly different from 2015; ^c = significantly different from 2016;

^d = significantly different from 2017; ^e = significantly different from 2018; ^f = significantly different from 2019;

^g = significantly different from 2020_a; ^h = significantly different from 2020_b.

Supplementary Material, Table 1. Number of matches and unique players within each positional group per year

| Season | Matches | Positional Groups | | | | | | | | |
|-------------------|---------|-------------------|---------|-------------|----------------|--------------|------------|---------|-------|-----------|
| | | Props | Hookers | Second Rows | Loose Forwards | Scrum-halves | Stand-offs | Centres | Wings | Fullbacks |
| 2014 | 196 | 135 | 63 | 109 | 111 | 49 | 56 | 97 | 80 | 50 |
| 2015 | 163 | 116 | 58 | 86 | 98 | 40 | 48 | 77 | 64 | 42 |
| 2016 | 166 | 124 | 53 | 103 | 101 | 39 | 49 | 80 | 74 | 40 |
| 2017 | 168 | 119 | 47 | 92 | 99 | 44 | 43 | 83 | 63 | 39 |
| 2018 | 198 | 154 | 60 | 116 | 114 | 51 | 55 | 92 | 88 | 51 |
| 2019 | 179 | 118 | 47 | 89 | 78 | 42 | 42 | 74 | 70 | 35 |
| 2020 _a | 38 | 76 | 33 | 61 | 45 | 21 | 23 | 52 | 42 | 23 |
| 2020 _b | 68 | 101 | 38 | 79 | 59 | 32 | 39 | 58 | 62 | 36 |