**Chapter 5**

# The Demands of Youth Rugby Match-Play

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## Abstract

This chapter summarises and presents the research quantifying the technical-tactical and physical demands of male youth rugby league and rugby union match-play, and compares between playing positions, standards, and age grades. In both rugby codes positional differences are apparent, with some differences attributed to the playing standard, indicating the need for position specific prescription of training practices. Differences in technical-tactical demands between standards of competition are apparent in rugby league match-play, providing potential focus areas for youth rugby league coaches, but further research is required to analyse these differences in rugby union. The physical demands of match-play in both codes vary dependent upon the playing standard and age-grade of competition, influenced primarily by the match-length. Further research considering contextual factors and the interaction between the physical and technical-tactical demands that underpin performance across youth rugby are still required.

## Introduction

Within the rugby codes, time motion and performance analysis approaches are used to quantify the locomotor (i.e., running) and collision demands alongside technical-tactical indicators during match-play. While both performance and time-motion analysis were traditionally conducted using video based notational analysis, developments in technology have improved the efficiency of the time-motion analysis process. Wearable microtechnology devices including global navigation satellite systems (GNSS) and micro-electrical-mechanical systems (MEMS; including tri-axial accelerometers, gyroscopes and magnetometers) have facilitated more widespread quantification of the time motion characteristics of youth rugby match-play, with video-based methods still the predominant method for quantifying technical-tactical performance.

The area of performance analysis commonly refers to the quantification of the technical-tactical components of team sport match-play. Given the nature of the rugby codes and the significance of these aspects towards playing success (Kempton et al., 2017), capturing performance indicators is important. This may include defensive (e.g., number of tackles, rucks) and offensive (e.g., passes, kicks) statistics at a team or individual level, as well as more in-depth analysis on the tactical performance and playing styles (Woods et al., 2017b). This information can be useful for coaches looking to develop practice conditions and game strategies that can increase the likelihood of player and team success.

Time motion analysis (i.e., change in location over time) allows multiple variables to be calculated including average and maximum speed, acceleration and distances covered above certain speeds (e.g., low-speed- or high-speed-distance). More recently, developments in algorithms using MEMs signals have facilitated valid automated quantification of collision counts in rugby league (Hulin et al., 2017) with mixed success in rugby union (Chambers et al., 2019). The intermittent and dynamic nature of rugby match-play mean several variables need to be considered. For example, whilst average speed captures the overall motion of a player, it does not isolate their high-speed motion. Equally, both measures do not represent acceleration and deceleration which are important due to spatial constraints in rugby competition (Osgnach et al., 2010). Finally, given the additional physiological cost of collisions (Costello et al., 2018), quantification of this aspect of competition is also warranted.

Time motion and performance analysis data in youth rugby can be useful for both the researcher and practitioner as it can allow an understanding of the positional (e.g., forwards and backs) differences in locomotor, collision and technical-tactical characteristics between playing standards (e.g., club *vs* international) and age grades (e.g., U16 *vs* U18 *vs* U20). Such data can facilitate more targeted training prescription by identifying components that differ between position and level.

The purpose of this chapter is to summarise the research on the characteristics of youth rugby league and union match-play, and discuss how the demands differ by position and level of competition, alongside limitations of current research and future directions. The chapter will provide normative values for the time motion and collision characteristics with performance analysis characteristics between positional groups and levels of competition for rugby union and rugby league. These data can help practitioners develop more specific training practices and inform areas for future research.

## Rugby League

*Technical-Tactical Demands*

The technical-tactical demands of youth rugby league match-play have been quantified in six studies (Bennett et al., 2016; Dempsey et al., 2017; Gabbett, 2012; Kempton et al., 2013; Waldron et al., 2014; Woods et al., 2017a). The total ball-in-play time for elite U20 match-play (80 minute game) has been reported as 49:40±4:29 minutes, with an average activity cycle of 72±15 seconds, and a longest activity cycle of 289±58 seconds (Gabbett, 2012). Yet, further studies across other youth competitions and age-grades that provide detail on the ball-in-play times are needed, especially given the differences in match-lengths between age-grades.

The quantification of collision frequency is the most evaluated technical action within youth rugby league (Table 5.1). Specifically, during international U18 match-play, Dempsey et al. (2017) reported defensive collisions of 10±7 for backs and 19±10 for forwards, compared to offensive carries into contact of 7±4 and 5±4 for backs and forwards respectively. Others have investigated the frequency of missed or unsuccessful tackles (Waldron et al., 2014; Woods et al., 2017a), with a squad total of 36±11 missed tackles during elite U20 match-play reported (Woods et al., 2017a).

<INSERT TABLE 5.1 NEAR HERE>

Positional Differences

Few studies have investigated position specific technical-tactical characteristics of youth rugby league match-play; similarly to the senior game (e.g., Sirotic et al., 2011), some positional differences have been identified (Bennett et al., 2016; Dempsey et al., 2017). Significant differences between playing positions on offensive (i.e., ball carry, support run, line break, line break assist, offensive miss), defensive (i.e., tackle completed, tackle not completed) and total skill involvements in elite junior match-play have been identified (Bennett et al., 2016). Hit-up forwards undertook a significantly greater number of offensive (0.3±0.1 $n \cdot min^{-1}$), defensive (0.4±0.2 $n \cdot min^{-1}$) and total (0.7±0.2 $n \cdot min^{-1}$) skill involvements than adjustables (offensive: 0.2±0.1 $n \cdot min^{-1}$, defensive: 0.3±0.1 $n \cdot min^{-1}$, total: 0.5±0.2 $n \cdot min^{-1}$) and outside backs (offensive: 0.2±0.1 $n \cdot min^{-1}$, defensive: 0.1±0.1 $n \cdot min^{-1}$, total: 0.3±0.2 $n \cdot min^{-1}$) (Bennett et al., 2016), which is also supported by others, both in absolute numbers and relative to playing time (Dempsey et al., 2017).

## Differences in Playing Standards and Age-Grades

Studies have compared technical actions between playing standards within youth rugby league (Gabbett, 2014; Johnston et al., 2015; Waldron et al., 2014), and between youth and senior match-play (Kempton et al., 2013; Whitehead et al., 2021; Woods et al., 2017a). Whilst differences have been identified, the range and inconsistency of actions used across a limited number of studies restricts the ability to draw clear conclusions from the current research.

Differences in collision frequency have been investigated between playing standards within school (Gabbett, 2014; Johnston et al., 2015) and elite youth rugby league (Waldron et al., 2014). Teams competing in a higher division at a school tournament completed a greater number of total (15±7) and relative (0.4±0.2 $n \cdot min^{-1}$) collisions compared to the lower divisions (total = 9±3; relative = 0.3±0.1 $n \cdot min^{-1}$) demonstrating significant, *moderate* to *large*, differences (Gabbett, 2014; Johnston et al., 2015). Waldron et al. (2014) investigated differences in successful and unsuccessful tackles between retained or released players (i.e., for the next season) across three age groups (U15, U16 and U17) in a Super League (SL) club, with retained players demonstrating a greater number of successful tackles than released (selected: $n$=13, unselected $n$=8).

When comparing between youth and senior match-play, Kempton and colleagues (2013) partitioned National Rugby League (NRL) and U20 matches into five-minute blocks and quantified the peak, subsequent and mean number of skill involvements and skill-rating (on a Likert scale 0 to 5). There was no difference in the mean number of involvements between NRL and U20 competition, but there was a small, significant difference in skill-rating over the match between the two levels (NRL: 2.92±0.13 *vs* U20: 2.81±0.16) (Kempton et al., 2013), suggesting greater technical abilities of the NRL players, rather than a greater number of opportunities. However, whilst difference in ability would be expected between professional and age grade players (e.g., Gabbett et al., 2011), further research of match-play with a larger sample size is required.

Some studies have employed machine learning techniques to allow for multivariate patterns to be revealed within the characteristics of match-play. Clear dissimilarities in the team performance indicator profiles of U20 and NRL match-play have been identified (Woods et al., 2017a). Additionally, out of 144 match observations in which there were >167 'all runs', >36 'tackle breaks' and >288 'tackles', 98.6% were classified as NRL match-play and only 1.4% classified as U20, demonstrating clear differences in these game-play behaviour's (Woods et al., 2017a). A similar approach compared youth and senior levels of the United Kingdom's professional playing pathway but with the addition of physical performance indicators. Findings showed that out of the 157 performance indicators investigated, the number of defensive play-the-ball losses alone had the highest classification of U19 and senior match-play for forwards (Whitehead et al., 2021). For backs, the number of quick play-the-balls, carries and collisions were among nine performance indicators (alongside six physical) that were collectively deemed as important for the classification between the two levels of match-play. The differences in important performance indicators identified between studies (Whitehead et al., 2021; Woods et al., 2017a) could be due to the classification of player observations compared to team observations, or the variances in the sport played at the senior professional level in Australia (NRL) compared to Europe (SL) (Woods et al., 2018), and therefore, likely differences in the development pathways.

*Physical Demands*

The physical demands of youth rugby league match-play have been quantified by several studies (e.g., Hausler et al., 2016; Johnston et al., 2015; Whitehead et al., 2020). Table 5.1 provides a summary of the whole match duration on field, locomotive and collision characteristics for different age groups. In addition to whole- and half-match analysis, the duration-specific peak locomotive and collision (Kempton et al., 2013) characteristics have been quantified. Peak average running speeds of ~157 to 178 $m \cdot min^{-1}$ (Thornton et al., 2019; Whitehead et al., 2018; Whitehead et al., 2020) and ~94 and 106 $m \cdot min^{-1}$ (Whitehead et al., 2018; Whitehead et al., 2020) for 1- and 10-minutes respectively have been reported, compared to the average running speed of the whole match of ~83 to 88 $m \cdot min^{-1}$ (Table 5.1).

Positional Differences

Position, or positional group, specific physical characteristics of youth rugby league match-play have been reported for the U20 (Gabbett, 2013; McLellan & Lovell, 2013), U19/18 (Dempsey et al., 2017; Thornton et al., 2019; Whitehead et al., 2020) and U16 (Thornton et al., 2019; Whitehead et al., 2018) age-grades, yet few studies have analysed positional differences (Dempsey et al., 2017; Thornton et al., 2019; Whitehead et al., 2020).

Total distance covered during match-play reported for youth backs (~5707-6767 m) are greater than reported for forwards (~4063-4911 m), but with minimal differences apparent for whole match average running speeds (backs: ~83-96 $m \cdot min^{-1}$ *vs.* forwards: ~89-97 $m \cdot min^{-1}$) (Dempsey et al., 2017; Whitehead et al., 2018). Specifically, international U18 backs cover significantly greater total distance, high-speed running distance and acceleration and decelerations compared to forwards, but with no differences in the average running speeds, relative high-speed running, or relative acceleration and decelerations (Dempsey et al., 2017).

Positional differences in the peak locomotive characteristics have been identified in elite U16 (Thornton et al., 2019) and U19 (Whitehead et al., 2020) match-play. Fullbacks have been found to have the greatest peak average running speeds across all durations (e.g., 106±9 $m \cdot min^{-1}$ for 10 minutes *vs.* ~94-101 $m \cdot min^{-1}$), but other positional differences are duration dependent. Outside backs had greater peak running speeds for short durations compared to the forward positions but lower over the longer durations (e.g., 10-minutes) (Whitehead et al., 2020). In comparison, Thornton et al. (2019) only identified differences in the peak average running speeds between two positions; U16 hookers (174±15 $m \cdot min^{-1}$) had a *likely* higher speed intercept compared to middle forwards (158±16 $m \cdot min^{-1}$). Hookers were also found to have a *likely* higher acceleration intercept compared to edge forwards (1.13±0.4 $m \cdot s^{-2}$), and *very likely* higher compared to fullbacks (1.04±0.06 $m \cdot s^{-2}$).

## Differences in Playing Standards and Age-Grades

The whole-match physical demands of school, elite U16, U18 and U20 age-grades are summarised in Table 5.1. Differences in at least one locomotive parameter have been identified between playing standards in most (Dempsey et al., 2017; McLellan and Lovell, 2013; Whitehead et al., 2018), but not all studies (Dempsey et al., 2017).

Two studies (Gabbett, 2014; Johnston et al., 2015) have investigated differences in the standards of competition within an Australian schools tournament, both reporting the highest standard (Division 1) of competition to have the greatest total average match-speed and high-speed running distance in comparison to the lower standards (Divisions 2 and 3). For example, Johnston et al. (2015) found the average match-speed of Division 1 match-play to be *likely* higher than Division 2 (Division 1: 90±7 $m \cdot min^{-1}$ *vs* Division 2: 85±7 $m \cdot min^{-1}$), and the high-speed running distance covered to be *very likely* higher (Division 1: 174±51 m *vs* Division 2: 116±58 m). The differences between the standards of play in these studies could be reflective of the team's ability to cope with an intensified period of competition (five matches in four days) (Johnston et al., 2015). However, such intense tournaments are likely unique to school-based competitions and the differences in physical characteristics of match-play cannot be inferred across other standards of competition.

Differences between standards have also been identified; Waldron et al. (2014) found differences between the 'selected' and 'unselected' at each age group within a SL club, however when controlled for maturation status no differences were apparent. Yet, Whitehead et al. (2018) found position specific differences between standards in the UK professional and international pathway, shown in Figure 5.1. In contrast, Thornton et al. (2019) found no difference in the intercept or slope for the peak average running speeds between elite Australian U16 and U18 age grades, suggesting that manipulating the running speed of training according to age-grade is not required. However, some age group differences in the peak average absolute acceleration were present which were dependent upon position; U18 halves had a higher intercept than U16 halves, but U16 hookers had a higher intercept than U18 hookers.

<INSERT FIGURE 5.1 NEAR HERE>

When investigating differences across professional playing pathways, studies have again found the highest level of competition to have greater physical match characteristics. For example, U20 backs and forwards covered less total distance, had a lower average match speed and covered less sprint distance during match-play compared to NRL (McLellan & Lovell, 2013). These differences are not surprising given the average activity cycles and ball in play time are greater in the NRL compared to U20 (Gabbett, 2012). In the UK professional pathway, the classification of U19 and SL match-play (Whitehead et al., 2021) has identified four and nine physical and technical-tactical characteristics that collectively could accurately classify between the two levels for forwards and backs respectively. Indeed, for backs the combination of variables with the highest classification rate were all physical characteristics (PlayerLoad$_{2D}$, PlayerLoad$_{SLOW}$ per Kg body mass, and high-speed running distance), indicating that SL backs complete greater "global" external workloads (PlayerLoad$_{2D}$), complete either more or the same amount of high-intensity movements at low locomotor velocities (e.g., change of direction) whilst carrying more body mass (PlayerLoad$_{SLOW}$kg), and cover greater high-speed running distance than U19 backs.

Whilst no differences in the locomotive characteristics of international match-play have been found across age-grades (Figure 5.1), differences in the collision profiles were identified with senior players having greater defensive and offensives collisions compared to junior players (Dempsey et al., 2017). This agrees with other studies that found greater collision counts in higher levels of competition (Gabbett, 2014; Johnston et al., 2015) (Table 5.1). However, given the low sample size of matches (i.e., senior: n=6, junior: n=4) (Dempsey et al., 2017), further research on international match-play is required to support these findings.

## Rugby Union

### *Technical-Tactical Demands*

The technical-tactical demands of youth rugby union match-play have not been researched extensively, and less evidence is available compared to the senior game (e.g., Bennett et al., 2021). The current technical-tactical demands research in youth rugby union has investigated U16 and U18 Academy matches (Ashford et al., 2020; Ungureanu et al., 2019; Read et al., 2018b) and typically provides the frequency of technical actions. These studies are discussed in the sub-sections below.

#### Positional Differences

Positional differences in the number of collision events in U18 match-play have been identified (Roe et al., 2016). Forwards perform more attacking rucks (11±6 *vs* 4±3) and tackles (9±5 *vs* 6±3) than backs, alongside the addition of 14±5 scrums but complete a similar number of carries (4±3 *vs* 4±2) and defensive rucks (2±2 *vs* 1±1) (Roe et al., 2016). However, given this is currently the only study to investigate positional differences, further research is required.

Differences in Playing Standards and Age-Grades

Limited studies have investigated the technical-tactical demands of match-play at different age-grades and playing standards in rugby union, with research currently in U15 (McIntosh et al., 2010), U16 (Ashford et al., 2020) U18 (McIntosh et al., 2010; Roe et al., 2016; Ungureanu et al., 2019), and U20 (den Hollander et al., 2019; McIntosh et al., 2010) age-grades. Players engage in a range of tackles types, which appear to change as we progress through the age grades, with fewer jersey and passive shoulder tackles into more active shoulder tackles from the U15 up to professional levels (McIntosh et al., 2010). These findings may be indicative of improved contact proficiency as age grade increases (den Hollander et al., 2019). At the U16 age-grade, 70-minute matches have been shown to include 1.54±0.32 passes per minute, 0.25±0.11 offloads per minute and 0.12±0.05 kicks per minute (Ashford et al., 2020). Similar research in 70-minute U18 match-play found that each team had 49±17 attacking and defensive breakdowns and perform 86±28 tackles and 94±27 passes (Ungureanu et al., 2019). Additionally, Ungureanu et al. (2019) found that U18 winning teams won more set pieces (26±2 *vs* 24±4), made less inefficient tackles (9±4 *vs* 13±6) and lost possession less frequently (28±6 *vs* 36±5) than losing teams (Ungureanu et al., 2019). The current data are provided on either a match, team or positional level and therefore it is difficult to make comparisons between age-grades.

The timings and frequencies of ball-in-play cycles and phases (i.e., attacking and defending) in youth match-play have been quantified (Ashford et al., 2020; Read et al., 2018b; Ungureanu et al., 2019). During 70-minute U18 Academy matches, total ball-in-play time was 27±3 minutes (37%) with 47±4 minutes out of play time (Read et al., 2018b). During this ball-in-play time, the team in question spent 13±3 minutes in attack and 14±3 minutes in defence. Further analysis of these cycles and phases highlighted that the average ball-out-of-play cycle (59±33 seconds) was approximately twice as long as the average ball-in-play cycle (33±24 seconds), attack (26±17 seconds) and defence (26±18 seconds) phase. Notably, the longest ball-in-play cycle was 2.5 minutes (Read et al., 2018b). Others have shown ball-in-play time for U18 Academy matches was between 26±2 minutes and 29±3 minutes for 70-minute matches (Ungureanu et al., 2019), comparable with Read et al. (2018b). Also similar was the ball-in-play statistics from 70-minute U16 matches, with 40±4% of the match time with the ball in play (Ashford et al., 2020). Furthermore, winning teams spent more of the ball in play time in the oppositions 22m area (20±9% *vs* 12±7%) compared to losing teams (Ungureanu et al., 2019). Information on the phases and cycles of match-play is useful in providing the context and an overview of the demands of youth rugby union.

*Physical Demands*

The physical demands of youth rugby union match-play have been described using locomotor variables (Table 5.2). Despite youth rugby research still being underrepresented in comparison to the senior game, it is a growing area of research. Several studies have quantified the whole-match demands (e.g., Read et al., 2017a; Read et al., 2018a). In addition, the locomotor demands of cycles and phases (Read et al., 2018b) and the duration-specific peak locomotor demands have been quantified (Read et al., 2019).

<INSERT TABLE 5.2 NEAR HERE>

Positional Differences

Different positional splits have been used by previous studies, with the majority stratifying by forwards and backs, although some articles have provided further sub-positional groups (Cunningham et al., 2016; Read et al., 2019; Venter et al., 2011). The total distance covered and average speed at the U18 academy standard is greater in backs than forwards (Read et al., 2018b; Roe et al., 2016), which is consistent with findings in senior rugby union (Quarrie et al., 2013). In contrast to this, the demands at younger age-grades and other playing standards differ. Read et al. (2017b) found that U16 school forwards had greater locomotor demands than backs, with U19 club rugby also showing that props covered more distance than back row players (Deutsch et al., 1998; Venter et al., 2011). This might suggest that position-specific physical demands become more apparent as age or playing standard increases due to inferior technical ability potentially resulting in less match involvements for backs. At the U20 international standard, the positional differences reflect a similar pattern to that of the senior game, with front row players covering the least distance (Cunningham et al., 2016). This highlights the specialisation of positions at older age-grades and higher standards of play.

The analyses of distance covered in different speed thresholds demonstrates that the majority of the distance during rugby union matches is covered at low speeds (e.g., $<5\ m{\cdot}s^{-1}$). In addition, speed threshold analysis shows that backs cover greater distances at higher speeds compared to forwards (Hartwig et al., 2011; Portillo et al., 2014; Read et al., 2018a). For example, in U20 international match-play, the total high-speed ($>5\ m{\cdot}s^{-1}$) distance covered was greatest for back three players (728±150 m) and lowest for front row players (212±113 m) (Cunningham et al., 2016). These findings are consistent with senior rugby union and are likely to occur due to greater maximal running speeds of backs alongside their tactical roles that provide more space for free running.

Dividing the match into phases-of-play highlights that the average running speed increases to 109-115 $m \cdot min^{-1}$ (Read et al., 2018b) from the average match data (59-72 $m \cdot min^{-1}$). In attack, the difference in average running speed is unclear between forwards and backs, but greater in forwards during defence. This highlights that the additional distance that backs cover might be undertaken while the ball is out of play, as they reposition around the pitch and forwards await the restart (e.g., lineout, scrum). The duration-specific peak locomotor demands have also been quantified for U18 academy players, and highlight that at all durations, forwards had lower peak average running speeds than backs (Read et al., 2019). Further sub-positional comparisons found that the peak average running speeds of front row players are markedly different from those of second and back row players at the U18 age-grade, whereas back row and second row players were largely similar (Read et al., 2019). In addition, scrum halves had greater average running speeds than both inside and outside backs, whereas inside and outside backs were largely similar. For example, the peak 60-second average speed of front row players during U18 academy matches was 154±17 $m \cdot min^{-1}$, compared to 185±20 $m \cdot min^{-1}$ for scrum halves (Read et al., 2019). These data provide time-specific reference values of peak average speeds for coaches preparing academy rugby union players for the most intense periods of match-play.

## Differences in Playing Standards and Age-Grades

Differences in total distance between younger age-grades (i.e., U16, U18, U19) are seemingly marginal, however, at the U20 age-grade the distances covered are greater, particularly in the backs. For example, back three U20 international players (6192±748 m) covered ~1000 m more than U19 club outside back players (5174±660 m) (Cunningham et al., 2016; Deutsch et al., 1998; Flanagan et al., 2017; Venter et al., 2011). The higher volume of distance is likely due to longer playing durations. Notably, the intensity of distance is not greater at older age-grades and in fact, U20 forwards have the lowest values of relative distance (Table 5.2). The exact reasons for this are unknown, but many hypotheses have been suggested such as; more unstructured play at younger age-grades, an improvement in defensive structures at older age-grades thus providing less space to run, and an increase in the frequency and magnitude of collisions at older age-grades. Read et al. (2017b) showed within the same study that sprinting progressed from 165±101 m to 319±176 m in U16 to U18 school backs but in forwards there was little difference (87±86 m to 94±93 m) between the same age-grades. The lack of consistency in the speed thresholds used by studies make age-grade comparisons difficult across multiple studies.

Few studies have compared different playing standards within the same study (Phibbs et al., 2018; Read et al., 2018a). Read et al. (2018a) found that the academy forwards (5461±360 *vs* 4881±388 m) and backs (5639±368 *vs* 5260±411 m) covered greater total distances than schoolboy players. Notably, academy forwards covered a greater high-speed distance than school forwards (220±111 *vs* 138±114 m) (Phibbs et al., 2018). These studies highlight that academy rugby is more physically demanding than school rugby and given players can play in both standards concurrently they should be conditioned to meet the additional demands. Overall, Table 5.2 shows that the U20 international matches have greater demands than other standards in regard to total distance but the collision demands remain unknown.

## Limitations of Current Research

In youth rugby, an important aim is to understand the match-play characteristics and identify differences in the physical and technical-tactical demands of competition to inform key training prescriptions required at each level, culminating in maximising the development opportunities of players and progression through the playing pathway. However, to date, most studies investigate the physical and technical-tactical demands of single standards or-age grades of a specific development pathway, with a lack of large-scale studies across multiple pathways and countries. Coupled with inconsistency in methods between studies, comparisons are difficult. For example, the use of different microtechnology systems can be problematic for direct comparisons between studies and how researchers define high-speed-thresholds is highly variable. Additionally, the definitions of the same technical-tactical variables are inconsistent, alongside a lack of standardisation of the specific technical-tactical variables included in studies.

## Future Research Directions

It is clear there are increases in the physical demands as playing age and standard increases as well as positional differences between backs and forwards. However, there is a lack of information around how contextual factors may influence match-play and the resultant demands. This may have important ramifications for practitioners involved with prescribing training loads to players who have multiple playing commitments that is typical within youth pathways. Additionally, the technical-tactical characteristics of match-play are poorly understood at a youth level in both rugby codes. Whilst there is some description of the differences in technical characteristics between playing standards, determining the performance indicators and game styles across attacking, defending, and transition periods of match play that are central to team success within an age grade, and more importantly, player selection and progression between each age grade is important. Additionally, given the risk of injury associated with tackling, appropriate skill training frameworks should be developed and used within both codes to determine their efficacy on skill development and the subsequent transfer this has to performance, injury and player retention (Hendricks et al., 2018). Furthermore, in rugby union there are multiple collision and non-collision events (e.g., the ruck, scrum and lineout) that require further investigation with youth match-play across age-grades and playing standards. In addition, given the physical cost and injury risk associated with collisions, there is a lack of information regarding the peak collision demands of competition at any age grade. Such information should be determined so that appropriate conditioning practices can be implemented to aid performance and minimise contact-associated injury risk through the development stages.

## Conclusion

The quantification of the characteristics of youth rugby match-play, via time motion and performance analysis data, is important for the researcher as it allows an understanding of the positional differences in locomotor, collision and technical-tactical demands between playing standards and age grades. Such data can be used to facilitate better training prescription by identifying components that differ between position and level. In both rugby codes positional differences are apparent in the demands of match-play, some of which are dependent upon the playing standard, indicating the need for position specific prescription of training practices.

Current research demonstrates differences in technical-tactical demands between standards of competition in rugby league match-play, providing potential focus areas for youth rugby league coaches. However, insufficient research analysing these differences exists in rugby union, and further work is required. The physical demands of match-play in both codes vary depending on the playing standard and age-grade of competition, influenced primarily by the match-length and duration on field. The influence of contextual factors and the interaction between the physical and technical-tactical demands is also poorly understood and warrants future investigation.

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