Chapter 6

The Demands of Youth Rugby

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Abstract

The quantification of the technical, tactical and physical demands of match-play in youth rugby is important for the appropriate prescription of training practices. Differences in the demands of match-play have been identified between positions, playing standards , age grades and phases-of-play. This chapter presents the research that has explored the match-demands of youth rugby, including the physical and technical-tactical. It then provides a practical overview of how coaches can utilise match-demands data to assist in appropriate training prescription through the adaptation, manipulation and evaluation of training drills and practices. The

chapter concludes with a range of recommendations and practical implications for the use of match-play data in youth rugby environments.

Introduction

Within the rugby codes, time-motion and performance analysis quantify the technical, tactical and physical demands of match-play. While both performance and time-motion analysis were traditionally conducted using video based notational analysis, developments in technology have improved their efficiency . 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 data derived from the analysis of match-play on the technical-tactical and physical demands across different age-grades and standards can be used inform training practices in youth rugby players.

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 tactical performance and playing styles (Woods et al., 2017b). Time motion analysis (i.e., change in location over time) allows multiple variables to be calculated including average and maximum speed, changes in speed (e.g., acceleration) and distances covered above certain speeds (e.g., low-speed- or high-speed-distance). More recently, developments in algorithms using MEMs allow valid and automated measurement of collision counts (Hulin et al., 2017). The intermittent and dynamic nature of rugby match-play mean several variables need to be considered.

Quantifying the match demands through time motion and performance analysis has practical applications in youth rugby. It provides 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 information can support youth rugby coaches in the prescription of training practices to assist in optimal player development and progression through playing pathways.

Current research on the demands of match-play has highlighted several considerations within the prescription of training and drill design such as the appropriate metrics (e.g., average speed, accelerations and collisions) to use and their specificity and appropriateness for positions, phase-of-play specificity and age grade. Additionally, the quantification of match volume should be considered in training prescription by considering the previous match, and the subsequent weekly training volume. The systematic monitoring of match-play demands over a season can identify the match-to-match variability in demand to assist in the planning and manipulation of weekly volume and training practices based on the difficulty of the previous match (Dalton-Barron et al., 2020; McLaren et al., 2016). Training volume and intensity should be manipulated by the coach to elicit performance enhancing adaptations (Weaving et al., 2020) to assist in optimal match-preparation and progression through playing pathways. In this chapter, volume refers to the amount of actions/movement, and intensity refers to the amount of actions/movement per unit of time, both of which are important in the use of match-demands data in the design and monitoring of training practices in youth rugby.

The purpose of this chapter is to firstly summarise the research that details the technical-tactical and physical demands of youth rugby league and union match-play, and secondly consider the practical application of the match-demands data and research in terms of training prescription and monitoring. These practical applications can assist coaches in understanding the specific demands of match play, which can be used to help player preparation.

Research overview

Rugby league

Technical-tactical demands

The technical-tactical demands of youth rugby league match-play have been quantified in several studies (e.g., Bennett et al., 2016; Dempsey et al., 2017; Woods et al., 2017a). The total ball-in-play time for elite Under 20 (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). Collision frequency is the most evaluated performance indicator. 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). Additionally, hit up forwards have greater skill involvements than adjustables (total: 0.5 ± 0.2 $n\cdot\text{min}^{-1}$) and outside backs (total: 0.3 ± 0.2 $n\cdot\text{min}^{-1}$) (Bennett et al., 2016). It is evident that there needs to be a position specific consideration towards technical-tactical training, specifically around contact training.

Studies have compared technical-tactical performance indicators (PI) between playing standards and age-grades (Johnston et al., 2015; Kempton et al., 2013; Waldron et al., 2014). Teams competing in a higher division at a school tournament carried out a greater number of total (15 ± 7 $n \cdot min^{-1}$) and relative (0.4 ± 0.2 $n \cdot min^{-1}$) collisions compared to the lower divisions (total = 9 ± 3; relative 0.3 ± 0.1 $n \cdot min^{-1}$) (Gabbett, 2014; Johnston et al., 2015). Additionally, there are dissimilarities in the team PI profiles of the U20 and senior professional match-play (Woods et al., 2017a) and defensive play-the-ball losses alone can classify between U19 and senior professional match-play for forwards, with number of quick play-the-balls, carries and collisions deemed as important for the classification between the two levels for backs (Whitehead et al., 2021a). These studies demonstrate differences in these match-play behaviours between playing standards, providing specific focuses for coaches when preparing players for the next level of competition.

Physical demands

In youth rugby league whole match total distances of ~2516 to 6773 m, with ~116 to 404 m high-speed running, ~ 9 to 26 collisions (Dempsey et al., 2017; Gabbett, 2013; Johnston et al., 2015), and peak 10-minute average running speeds of ~94 to 106 $m \cdot min^{-1}$ (Whitehead et al., 2018; Whitehead et al., 2020) have been reported. The large range in values reported is in part due to the different match lengths (40 to 80 mins), however, positional differences and differences between playing standards and age-grades have also been identified.

The total distance covered during match-play reported for youth backs (~5707 to 6767 m) are greater than reported for forwards (~4063 to 4911 m), but with minimal differences apparent for whole match average running speeds (backs: ~83 to 96 $m \cdot min^{-1}$ *vs.* forwards: ~89 to 97 $m \cdot min^{-1}$) (Dempsey et al., 2017; Gabbett, 2013; McLellan & Lovell, 2013; Whitehead et al., 2018), highlighting the need to take into consideration differences in playing time when comparing positions. Positional differences in the peak locomotive characteristics have been identified in elite Under 16 (U16) (Thornton et al., 2019) and U19 (Whitehead et al., 2020) match-play. Under 19 fullbacks have the greatest peak average running speeds across all durations (e.g., 10 minutes: 106 ± 9 m·min^{-1} *vs.* ~94 to 101 m·min^{-1}), but other positional differences to be duration dependent (Whitehead et al. 2020). At the U16 age-group, hookers have a *very likely* higher acceleration demands compared to fullbacks (Thornton et al., 2019). Such research highlights the differences in locomotor profiles between positions which should be considered when prescribing training.

Differences in the physical match-demands have also been identified between playing standards and age-grades (Johnston et al., 2015; Thornton et al., 2019; Whitehead et al., 2018). Higher standards of competition in a school tournament have the greatest average match-speed and high-speed running distance compared to the lower standards (Gabbett, 2014; Johnston et al., 2015), which could be reflective of the team's ability to cope with an intensified period of competition through enhanced physical qualities (Johnston et al., 2015). Position-specific differences between U16 club and international standard have been reported for the whole and peak match demands; backs have greater whole match, and peak 60-second average running speeds and cover greater high-speed running distance at the club level, whilst forwards have greater peak average running speeds and greater sprint speed distance, at the International level (Whitehead et al., 2018). Additionally, U18 halves have higher acceleration demands than U16 halves, but U16 hookers to have higher demands than U18 hookers (Thornton et al., 2019. Further differences in the physical demands of match-play have also been identified across professional playing pathways (Gabbett, 2013; Hausler et al., 2016; McLellan & Lovell, 2013). The classification of Academy and Super League match-play found that for backs the combination of variables with the highest classification rate were all physical characteristics, indicating that 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) but whilst carrying more body mass ($PlayerLoad_{SLOW}$kg), and cover greater HSR distance than backs during Academy match-play (Whitehead et al., 2020). Such research further supports the need for position specific consideration when in the planning and prescription of training within youth development pathways.

Rugby union

Technical-tactical demands

The research on the technical-tactical demands of youth rugby union typically provides the frequency of technical actions and events (Ashford et al., 2020; Ungureanu et al., 2019). In U18 match-play 86 ± 28 tackles have been reported per team (Ungureanu et al., 2019) and ~6 to 9 per player (Roe et al., 2016). Additionally, winning teams make less inefficient tackles and lose possession less frequently than losing teams (Ungureanu et al., 2019). Forwards have been found to perform more attacking rucks and tackles than backs, alongside the addition of 14 ± 5 scrums (Roe et al., 2016), indicating the need for the position specific prescription of contact training practices.

Studies have investigated technical-tactical demands of U16 and U18 rugby union Academy match-play (e.g., Ashford et al., 2020; Read et al., 2018a; Ungureanu et al., 2019), but with no direct comparison between age-grades or standards of play. In U16 match-play 1.54 ± 0.32 passes per minute occur (Ashford et al., 2020), compared to a total of 94 ± 27 passes per game in U18 match-play (Ungureanu et al., 2019). Ball-in-play time as a percentage of the match duration appear similar across age-grades, with 27 ± 3 min (~37% of match-play) reported for U18 match-play (Read et al., 2018a), compared to 40 ± 4% of match time reported in U16 match-play (Ashford et al., 2020). Furthermore, it has been found that during ball-in-play time at the U18 age grade, 13 ± 3 minutes is spent in attack and 15 ± 3 min in defense, with the longest ball in play cycle reported as 2.5 min (Read et al., 2018a). Information on the phases and cycles of match-play provides the parameters for which the physical demands are performed which should be considered for training practices.

Physical demands

Across youth rugby union whole match total distances of ~3841 to 6510 m (Cunningham et al., 2016; Phibbs et al., 2018) and average running speeds of ~59 to 70 $m \cdot min^{-1}$(Phibbs et al., 2018; Read et al., 2017) with peak 10-minute average running speeds of ~80 to 97 $m \cdot min^{-1}$ (Read et al., 2018) have been reported, with positional, age-grade and playing standard differences apparent. The total distance covered, and average running speed of match-play have been found to be greater for backs compared to forwards (~5254 *vs.* 4811 m and ~72 *vs.* 69 $m \cdot min^{-1}$) at the U18 Academy standard (Phibbs et al., 2018; Read et al., 2018b; Roe et al., 2016). Yet, during U16 school match-play the locomotive demands have been reported to be greater for forwards than backs (Read et al., 2017). Across all positions most of the distance covered is at low speeds, however during U20 International match-play high-speed running (>5 $m \cdot s^{-1}$) distance covered was found to be greatest in the back three players (728 ± 150 m) and the lowest in front row players (212 ± 113 m) (Cunningham et al., 2016). The positional differences suggest that position-specific physical demands become more apparent in older age-grades, highlighting the importance in the specialisation of positions at older ages and higher standards of play, which must be considered in training.

Further position specific demands have been highlighted in different phases-of-play (Read et al., 2018b) and peak average running speeds (Read et al., 2019). In attack, there are unclear differences between forwards and backs, but greater average running speeds have been found for U18 forwards during defense (Read et al., 2018b). Under 18 forwards have been found to have lower peak average running speeds across all durations investigated, with further sub-positional comparisons identifying differences between front row and second and back row players, as well as scrum halves having greater average running speeds than inside and outside backs (Read et al., 2019). These data provide position-specific reference values for coaches preparing academy rugby union players for the most intense periods of play.

Differences in total distance between younger age-grades (i.e., U16, U18 and U19) are marginal, however, at the U20 age-grade the distances are greater, particularly for backs; for example, back three U20 international players (6192 ± 748 m) cover ~1000 m more than U19 club outside back players (5174 ± 660 m) (Cunningham et al., 2016; Flanagan et al., 2017). The increase in the volume of distance is likely due to longer playing durations, with average match-speeds appearing similar between age-grades. At the school level, backs have been found to cover lower sprint distance at the U16 age-grade (165 ± 101 m) compared to the U18 (319 ± 176m m), but with little difference for forwards (Read et al., 2017). Additionally, Academy forwards have been found to cover greater sprint distance than school forwards (Read et al., 2018a), indicating academy rugby to be more physical demanding than school rugby, and given players can play in both standards concurrently they should be conditioned to meet the additional demands.

Summary

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.

Practical applications

The demands of youth rugby match-play can be used by coaches to enhance and support player development by ensuring appropriate prescription of training practices. During field-based training, a major focus by coaches is to prescribe a variety of drills to holistically develop the technical and tactical skills of players during different phases of the game (e.g., attack, defense, transition). Given the time constraints of youth rugby programmes, there is a need for efficient training practices that provide concurrent development of the physical, technical and tactical elements of the game. Understanding match demands data can assist in both the design of new drills and the evaluation of current drills to ensure players are more consistently exposed to the physical intensities and technical-tactical requirements of their position, for their current age category, future age categories and playing standards. Importantly, the measures (e.g., average speed, collisions) utilised by coaches must be considered to reflect the activity performed and training outcome.

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Designing and prescribing training drills

Given the intermittent nature of rugby training and matches, coaches should maintain awareness of which variables might best be targeted to reflect the intensity of the activity performed. The average speed (distance/time) of a drill is often used as a measure of intensity, but this does not reflect the regular changes of direction and physical contact players perform during match specific training and will therefore potentially underestimate the intensity of the activity. As such, for more intensive drills (i.e., those performed in a confined space), such as goal-line defense, measures of changes in speed (acceleration and deceleration) provide a better reflection of drill intensity. On the other hand, for extensive drills (i.e., those performed over a large space), such as small-sided games on a half field or kick chase drills, average speed and high-speed measures may be a suitable variable to reflect intensity. When the drills performed are position specific, different metrics may need to be considered between positional groups. For example, the greater distances covered at high-speed by backs, which becomes more of a factor in older age groups (Cunningham et al., 2016; Read et al., 2017), may carry more significance towards the total load performed for backs compared to acceleration and physical contact for forwards.

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Coaches can manipulate training drills to influence the physical and technical demands. Figure 6.1 presents a number of ways to manipulate the demands of any drill to either increase or decrease the difficulty and also alter the training focus (Figure 6.1):

1. Size of the playing area. This will largely govern the types of movements and involvements players will perform, and should be the first thing to decide upon. Increasing the area will allow for more opportunity for high-speed running, whereas a

smaller area constrains the players so they cannot reach high-speeds (Kennett et al., 2012; Gabbett et al., 2012).

2. Area per player. Whilst this may be governed in part by player availability, this is the second aspect that should be decided upon. Increasing the area per player by reducing the player numbers, will result in a more difficult drill with more frequent movements and involvements (Morely et al., 2016).
3. Onside *vs.* Offside. Offside games will lead to increased running, but reduces the specificity of the technical-tactical requirements of the drill (Gabbett et al., 2010).
4. Contact *vs.* No contact. This may increase the specificity of the drill, but will reduce the running demands of the games due to the time spent in contact. This will also alter the fatigue response, inducing more upper-body fatigue and muscle damage (Johnston et al., 2014; Roe et al., 2017).

There are a number of other constraints that can be manipulated regarding the rules of the games to influence physical and technical-tactical demands of game-based training drills (Zanin et al., 2021). Coaches should be encouraged to monitor the internal (e.g., heart rate, or perceived exertion) and external (e.g., acceleration, speed, touches of the ball) demands of the drills as they manipulate the constraints to understand how the intensity of various aspects are impacted.

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Positional and phases-of-play specific design and prescription

The physical and technical match demands of the rugby codes by position and phases-of-play can be used in the design of training drills to enhance the specificity of training. The greater volume of high-speed and sprint speed running encountered by backs in both rugby codes

(Whitehead et al., 2018; Cunningham et al., 2016) indicates the need for greater exposure and preparation for these demands in training. Similarly, the differences in acceleration and deceleration demands between the positions needs to be prepared for. For example, for backs, the pitch area can be made larger to provide greater opportunities to reach and maintain high-speed or sprint-speed efforts more frequently whereas for forwards by reducing the dimensions of a playing area the acceleration and deceleration load would be increased (Figure 6.1).

Designing and selecting drills that achieve these physical differences can be assisted by understanding which phases-of-play elicit greater physical and technical-tactical exposures (Tierney et al., 2017; Whitehead et al., 2021b). For example, Whitehead et al. (2021b) reported higher average speeds and peak high-speed running intensities when transitioning from attack to defense (e.g., chasing kicks) and defense to attack (e.g., returning kicks), as well as the greatest acceleration/ deceleration intensity when defending in senior professional rugby league players. Therefore, when considering this within drill design, if the training goal is greater average speeds and high-speed exposure, training drills incorporating constraints that lead to frequent kick chase and kick returns could be a useful approach. This could be achieved by adding specific rule constraints, such as three tackles or rucks then kick to encourage high-speed running. Across both codes, given that backs are generally involved in more transition (i.e., attack to defense, defense to attack) activities than forwards, drills involving frequent kick returns and chases could be useful for the backs positional group. Equally, as forwards are involved in more defensive work than backs, designing and prescribing more frequent defense specific drills within spatially confined areas could be a useful approach.

As highlighted in Figure 6.1 the addition of collisions will impact the physical demands of a drill by reducing the speed of the game and impacting on the fatigue response. The frequency and type of contact to be used should be guided by the technical-tactical and physical aims of the session. To control the number of collisions, these could be performed in bouts at specific time intervals. To overload collisions, the collisions could be more frequent (e.g., every 1 minute), or more collisions per bout (e.g., 1, 2 or 3). Alternatively, if the aim of the game is to replicate the technical-tactical demands of the game, then including the normal collisions within the context of phase-of-play should be performed. The speed of the game could then either be increased or decreased by constraints around the tackle and ruck contest. For example, in rugby league, reducing the number of players in the tackle and the time it takes for the tackle to be 'completed' would increase the speed of the game. Similarly, in rugby union, having the defending team place a set number of players at each ruck would increase demands for the defending team. Both of these changes would reduce the authenticity of the tackle contest, but increase the running demands, and the associated physical cost. As such, coaches should be mindful of the aims of the session when deciding how to program contact within training drills.

Age grade and playing standard specific

In both rugby union and league, the relative locomotor demands have been found to be similar across age grades, with increases in match-volume due to increased playing duration (Whitehead et al., 2018; Read et al., 2017). Yet, differences in body mass of the players will likely lead to distinct physical demands. Older players are typically heavier and stronger than younger players (Darrall-Jones et al., 2015; Johnston et al., 2014), which also reinforces the need to prioritise player preparation for the contact elements of the game to ensure player safety and performance. Therefore, it is essential that training maximises the contact (e.g., tackle) skill development of rugby players.

Progressing the locomotive or running demands independently of contact may not prepare players for the progression through the age groups. This can be achieved through either the design of drills which prioritise contact skill development (e.g., small-sided games in a constraint space), or contact specific drills incorporated within this training session. Across the training session, or training week, coaches should ensure that the ball related skills, contact related skills, decision making, and physical demands relating to both movement and contact are developed in both isolation, and concurrently. This can be through specific focused drills or small-sided games, whereby the constraints are manipulated to achieve the desired outcome.

Evaluating training drills and match volumes

As a coaching process, the intensity of any training drill can be evaluated using microtechnology and performance analysis data collected during training. The data collected can be compared to published research data to identify which drills expose players to match intensity for the different physical (e.g., acceleration, high-speed and collisions) and technical-tactical components (e.g., number of carries/tackles). An example of this is shown in Figure 6.2 where the microtechnology data is exported, analysed and presented visually for coaches to compare the physical demands of each training drill, and the whole session, compared to published match data.

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Such reports provide opportunities for coaches to adapt drills to meet the target physical or technical outcome. For example, if a drill was designed to expose players to the high-speed (i.e., physical) and carry (i.e., technical) intensity of match play, yet upon review (by comparing to published data) the drill didn't expose players to these intensities, the drill could be amended for future prescription by providing a greater area per player (increasing opportunities to reach high speeds) and reduce the number of players (to allow more opportunities for players to complete greater frequency of carries). Such a process can inform the plan-do-review cycle of the overall coaching process. If microtechnology is not available to the coach, perceptual ratings of perceived exertion can be used as a global approach to understanding the intensity of training drills (McLaren et al., 2017). Using this approach, coaches could collect this measurement during match play and for individual training drills (and compare) to gauge a global understanding of whether the training drills are reflective of match intensity.

Managing the total volume that a youth rugby player is exposed to across daily, weekly and long-term periods is a key strategy to optimise training adaptation and avoid negative outcomes such as overtraining or underperformance. The match-to-match variation (McLaren et al., 2016) in the physical demands, as well as differences in duration played (e.g., substitutions or selection) poses challenges in the management of weekly load. Coaches can use match data to monitor the volume of activity a player completes during a match to inform the planning of future training weeks. If the match volume has been 'higher than normal' for a player due to playing a different position or playing a longer duration, coaches might consider a reduction in the following weeks training volume leading into the subsequent match for that player. Equally, if match volume has been 'lower than normal' due to an early substitution, coaches might consider an increase in the following weeks training volume for that player. The monitoring of volume (and its changes) can be achieved by using microtechnology variables, such as measuring the total-, high-speed- and acceleration-distances players complete, or if this technology is not accessible, via the use of perceptual ratings of perceived exertion multiplied by match duration to provide a total volume score (Foster et al., 2017). Determining a 'normal' match volume can be achieved via a mean of an individual players data. The variability between matches can be calculated using the coefficient of variation from the mean and standard deviation (standard deviation divided by mean multiplied by 100 [%]). For example, Player A completes 5000m, 5500m, 6000m, 6500m across four matches, achieving a mean (normal) volume of 5750m with a standard deviation of 645m. In this example, the coefficient of variation, and therefore typical match variability is 11% (645m divided by 5750m multiplied by 100). Therefore, changes (increase or decrease) above 11% would constitute a meaningful change in this player's match volume, triggering potential amendments to the coaches planned training programme.

Implications and recommendations for practice

- The technical, tactical and physical demands of rugby match-play quantified through time-motion and performance analysis can be used to assist with player preparation through drill design and the evaluation of training practices.
- Training drills should be designed to account for the different match demands, with both intensive (those performed in a confined space) and extensive (those performance over a large space) drills considered.
- Coaches should prescribe training drills based on the position specific and phase-of-play demands through the manipulation of space and rule constraints.

- Given the differences in the match-demands between age grades and playing standards training must be prescribed to help progress players to the older age groups, contact demands should be considered alongside the locomotive.
- Coaches can evaluate training drills through the use of microtechnology, performance analysis data and rating of perceived exertion. Comparisons can be made to published data to assist in the evaluation.
- The plan-do-review process should be used to evaluate a training and which drills expose players to match intensity for the different physical and technical-tactical components.

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