Available online at www.scholarsresearchlibrary.com

Scholars Research Library

European Journal of Sports and Exercise Science, 2023, 11 (1) 01-06
(http://scholarsresearchlibrary.com/archive.html)

ISSN: 2278-005X

Performance Testing for Rugby League

Thomas J Brunsden*

Master of Exercises Science Student, Strength and Conditioning in
Edith Cowan University, Australia

****Corresponding Author:*** *Thomas J Brunsden, Master of Exercises Science, Strength and Conditioning in ,*
Edith Cowan University Australia .

E-mail: coachbrunsden@gmail.com

Received: 30 Dec, 2022, Manuscript no. ejses-22-78754; **Editor assigned:** 01 Jan, 2023, Pre-QC no. ejses-22-78754 (PQ) **Reviewed:** 15 Jan, 2023, QC no. ejses-22-78754 (Q); **Revised:** 22 Jan, 2023, Manuscript no. ejses-22-78754 (R); **Published:** 27 Jan, 2023

ABSTRACT

Rugby league is a collision-based sport that last for 80 minutes. Teams are made up of 13 players (6 forwards and 7 backs). For athletes to be highly competitive in this sport, they have to be: fast; have good aerobic capacity, strong, powerful, and agile. Therefore, Strength and conditioning professionals must be able run an effective testing battery that is reliable, valid and specific to rugby league. In most cases these tests need to be performed with limited time and equipment. Based on Scientific research the following testing battery has been advised: Anthropometry (height, body mass, and skin folds), 40 m sprint, 5-0-5 agility, reactive agility, repeat high intensity ability test, intermitted Yo-Yo test, counter movement jump, 1 rm power clean, 1 rm bench throw, 1 rm parallel back squat, 1 rm bench press, and 1 rm pull up/chin up. After the testing battery it completed coaches can use this data for: Athletic profiling; assessing training adaptations; providing feedback to coaches and their athletes; and to predict athletic performance.

Keywords: Rugby league, Movement analysis, Performance testing.

INTRODUCTION

Rugby league is a collision-based sport that last for 80 minutes. Teams are made up of 13 players (6 forwards and 7 backs). To effectively program and train athletes for rugby league, fitness testing should be completed before athletes undergo a strength and conditioning program. To select an appropriate testing battery, a movement analysis should be completed to understand and identify the biomechanical and physiological requirements of the sport. After the testing battery is completed, coaches can use this data for: Athletic profiling; assessing training adaptations; providing feedback to coaches and their athletes; and to predict athletic performance. The Same testing battery should then be completed throughout the season. This is so coaches can make alterations to their programs and track athletic progression. It is recommended that in season testing should be done more than two days out from competition to limit fatigue [1-7].

The purpose of this paper is to present strength and conditioning coaches with information on selecting and implementing an appropriate testing battery that is specific to rugby league. This article initially discusses a movement analysis of the sport. Which will provide an understanding of the testing battery selected. The movement analysis of the article provides evidence-based information on fitness testing for rugby league. Various laboratory and non-laboratory testing are then discussed, with the aim of providing the appropriate testing battery specific for rugby. Finally, the appropriate tests are recommended with a timeline of when the tests should be performed.

Movement Analysis

Aerobic capacity

Training demands are high for professional rugby league players, often training 5 days-6 days per week. These demands require high levels of fitness. It has been documented that, International players have a average VO2 max of (62.6 mL/kg/min) whilst players in the national competition are around the (55.8 ml/k/min). Other studies in professional rugby league, have reported a estimated VO_2max of 48.6 mL/kg/min-56.4 mL/kg/min. Outside Back were found to have the highest score of (52.8 mL/kg/min) with backrowers and Props having scores of (51.1 mL/kg/min and 48.6 mL/kg/min) respectively. During the Nation Rugby League (NRL) competition players where shown to cover 6500 to 4500 m per game. Outside backs covered the most distance running 6265 m ± 318 m, followed by adjustable with distances of 5908 m ± 158 m a game. Hit up forwards recorded the least distance during a game covering 4310 m ± 251 m [8,9]. Hit up forwards tend to be interchanged more often during games. Sometimes interchanging more than once per game, spending a mean time of 21 minutes per game on the bench. Meir et al, suggests that, hit up forwards require more interchangers because they are involved in more high intensity efforts. Performing more hit ups and tackles per game than other positional groups. These findings are supported by Coutts et al , reporting that blood lactate concentration in forwards is higher than backs with 8.5 mmol/L and 6.5 mmol/l respectively during match day competition [10].

Speed

There are 3 stages of straight-line sprinting: acceleration, reaching maximum velocity, and speed endurance. Backs have been reported to be faster than other positions, one of the reasons is forwards are generally being heavier than their other counterparts (force=mass x acceleration). Conversely backs generally have space out on the edge of the field meaning they have a greater distance to reach higher speeds. Johnston et al reported that forwards ran the lowest distances at high speeds (513 ± 298 m) followed by adjustables (907 ± 255 m) with backs, running the most with (926 ± 291 m) per game. Out of the total distance covered, athletes completed 75 - 95 high intensity efforts in less than 10 m only 1-3 runs were completed over 50 m.

Sprinting efforts followed similar patterns with 40% of sprints being performed within 6-10 meters and 85% being less than 30 metres. Johnston et al., reported that, only 1.4% of the sprints performed were classed as high velocity efforts (7.0 ms^{-1}) with the remainder being acceleration efforts. Gabbett and King et al , found that, there was no significant difference between backs and forwards over 10 metre efforts. However, backs and hookers were reported to be significantly faster over 40m with reported sprint times of: Centres (5.81 seconds), fullbacks (5.84 seconds) and hookers (5.88 seconds).

Repeat sprint ability

With rugby league being a high intensity, intermitted based sport. Importance should be placed on players ability to performed repeated sprint efforts. According to literature, repeated-sprint bouts are when three or more sprints are completed with less than 21 seconds rest between each sprint. This seldomly occurs in rugby league as players generally only performing 1 ± 1 (range 0-3) repeated-sprint bouts during a match. This suggests that repeat sprint ability does not necessary replicate the most demanding passages of play during a match.

A paper done by Johnston et al, suggests that, a more appropriate definition on Repeat High Intensity Efforts (RHIE), should be used to quantify the most demanding passages of play. Similar to repeat sprint ability, RHIE is the ability to perform three or more high intensity efforts with less than 21 seconds between each effort. It is suggested that, the ability to perform these repeated high intensity efforts could influence the outcome of a game as they tend to occur during crucial passages of play. Johnston et al, reported that players completed 9-14 bouts of repeated high intensity efforts per game. The greatest frequency of bouts were performed whilst defending close to their try line (0 m-30 m). Over half (70%) of the repeated high intensity efforts occurred within 5 minutes of a try being scored. Teams who completed more repeat high intensity efforts were found to be more successful [11,12].

Agility

Throughout literature, practitioners have described agility as any movement that involves rapid change of direction. However, recent studies have described agility as a rapid change of direction in response to sport-specific stimulus [13-15]. Agility is a vital part of rugby league. Players are required to rapidly accelerate, decelerate, and change direction throughout a match. It has been reported; that backs are slightly better at agility than forwards with average L run times of 5.46 seconds for backs and 5.37 seconds for forwards. This is support by Gabbett et al, reporting slightly faster times for backs during the Illinois agility test with mean times of 16.6 seconds, compared to 17.2 seconds for forwards.

Strength and power

Strength and power are essential qualities in rugby league to be successful. Maximal strength and power, in both the upper and lower body have been shown to increase as the playing quality rises. Furthermore, players need to be strong and powerful in order to get a quick play the ball, or to make an effective tackle though explosive leg drive. Multiple studies have reported that, forwards were significantly stronger and more powerful than backs. O'Connor [16,17], found that; props and back rows were significantly stronger than hookers, halves and outside backs when performing a 3 repetition max (3 rm) (Table 1).

Although forwards have greater absolute strength when compared to other playing positions. Research has found that, relative strength is similar across all playing positions. It is suggested, that forwards absolute strength is greater due to the demands of the position. Forward tend to perform more contact and collision-based activities. Meaning forwards require a higher absolute strength. Additionally, a study has reported significant strength and power differences between younger (<24yrs) and older players (>28yrs) with younger players having a stronger bench press and squat [18].

Table 1. Weights lifted in relation to playing position, O'Connor [26]

Exercise	Weights lifted by position
Squat	Props: 149.3 kg
	Back rowers: 143.5 kg
	Hookers: 130 kg
	Halves: 131 kg
	Outside backs: 135.6 kg
Bench press	Props: 123.4 kg
	Back rowers: 112.4 kg
	Hookers: 99.7 kg
	Halves: 100.1 kg
	Outside backs: 106 kg
Power clean	Props: 92.5 kg
	Back rowers: 86.8 kg
	Hookers: 76 kg
	Halves: 78.8 kg
	Outside backs: 81.4 kg

Body composition

Body fat percentage has been shown to impact performance. Too much body fat can hindrance: power to weight ratios, thermoregulation and aerobic capacity. It has been reported that, rugby league players have the highest body mass and body fat percentages compared to other football codes i.e. Australian football (AFL) and soccer. Forwards were shown to be the heaviest with skinfold thicknesses at (15.6% body fat) compared to backs (12.6% body fat).

Low body fat percentage has been linked to improved performance in some aspects of rugby league. Having a low body fat has been related with an improved vertical jump (r =-0.345), sprint times over 30 metres (r = 0.417), 505 agility (r = 0.391) and maximal aerobic power (VO2max (r =-0.464). Suggesting that a low body fat percentage of 13.5 ± 3.5% is important to maintain so that performance is not compromised [19].

Physiological Assessment

Laboratory vs field testing

When selecting the appropriate tests for athletes, it is important to know whether to test in a laboratory or out on the field. Generally, laboratory testing can be quite expensive, making them financially difficult to utilise throughout the season. It can also be difficult to test a whole team in a laboratory at once, meaning it can take some time to test all the athletes. In some cases, coaches only have a few days to complete their performance testing, meaning the tests need to be time efficient. It is important that these tests do not compromise the reliability and validity of the data collected and that the players have enough time to recover between testing. It is for this reason valid and reliable field tests have been discussed.

Field Tests

Aerobic capacity tests

Rugby league places a high demand on metabolic conditioning of the players as they need to perform for long periods during the game. It is therefore essential to assess the aerobic capacity of the players. Many tests have been developed to assess aerobic capacity, these included: the 1.2 km run, Yo-Yo intermittent test, modified Yo-Yo intermittent test and the 30-15 Intermittent Fitness Test (30 IFT-15 IFT). As rugby league requires players to perform high intensity efforts with short rest intervals, the tests such as the Yo-Yo intermittent test and the 30 IFT-15 IFT has been recommend. Both assessments test the players aerobic capacity by assessing their ability to perform repeated high intensity runs with short rest intervals, closely mimicking the demands of rugby league [20-21].

Speed tests

Protocols for measuring speed tend to use linear running over distances of 5 m to 40 m. Data shows that, rugby league players hardly ever sprint over 40 m distances meaning that 40 m will be efficient for this test. The data collected from this test, can then be used to measure acceleration in conjunction with velocity, saving time. This can be done, by recording split times at 5 m and 10 m It is recommended that 3 repetitions of the sprint be completed with a 5minute recovery between trials to limit fatigue. The time taken to complete a 5 m to 10 m sprint from a stationary start is well accepted as a valid and reliable test to measure acceleration.

Speed endurance tests

As rugby league is an intermittent sport played at a high intensity, players should be tested on their ability to perform repeated sprint efforts. Repeat sprint ability is generally competed over multiple sprinting efforts with a limited resting period between sprints. Studies suggests that tests should comprise of 6 to 8 repetitions, covering 30 to 40 metres. After the test is completed results should show a speed decrement. This decrement in sprininting ability is then oftern expressed as a percentage of speed lost throughout the test [22].

Research done by Gabbett and collegues, suggest that, repeat sprint ability may not simulate the true demands of rugby league.

Therefore they comprised a test that measures repeat high intensity efforts through sprinting and tackling. Evidence has found that, repeat efforts involving sprinting and tackling with limited rest significantly increases heart rate, fatigue and percived exersion more than performing the repeat sprint ability test.

Johnston and Gabbett devised a test to measure repeat high intensity efforts. This test involves 12 m x 20 m sprints at maxium effort. Players then performed one tackle at the end of each sprint. The tackle requires a player to accelerate 2 m too then tackle someone holding a tackle bag. The player then graples with that person for 3 seconds whislt maintain on their feet. The tackler and the tacklie are both told to exert maxium force during tackle and grapple, this is to mimic the demands of an actual game. Once the tackle is completed the player has 20 seconds rest inbetween sprinting efforts. This test has shown to be more reliable than the repeated-sprint test for analysing percentage decrement (ES=1.02, p=0.06) [23].

Agility testing

Strength and conditioning practitioners need to be aware that most "agility" test only assess pre-planned movements. Therefore, they do not measure a player's ability to change direction in response to a stimulus (30). Most drills such as the 5-0-5, L run, and Illinois agility tests, only assess a player's ability to accelerate, decelerate and change direction in pre-planned movements. In rugby league, the ability to change direction in response to a stimulus, is crucial.

Research as suggested that, pre-planned, change of direction drills are not able to distinguish between positions and playing standards in senior players. However, when players are assessed on their ability to change direction in response to a sports specific stimulus, clear differences can be seen. This suggests that, test other than pre-planned change of direction need to be assessed.

An assessment by Gabbett and Brenton was created to measure a player's agility in response to a sports-specific stimuli. In this assessment players performed a randomised selection of four different cues that are related to varies demands of the game. These cues are to be completed twice, resulting in 8 trials. The participants sprinted forward and were told to react to the cues instigated to the investigator. This was done by changing direction and sprinting through the timing gates positioned on the left or right. Movement times, decision times and response times, were then determined by filming the players with a slow-motion camera. A full description of the reactive agility tests can be found on Gabbett and Benton's article [24-25].

Gym Based Tests

Body composition

The measurement of body fat percentage can be done through various methods. Skin fold calibres however, are by far the most practical and cost-effective alternative. The sum of skin fold measures can be taken at either 4 or 7 sites. If time is an issue the four sites (triceps, sub-scapular, supra-iliac, and mid-abdominal) method is recommended. The readings at each of the four sites are taken twice and the average is recorded. Each score is then added together to get a sum of skinfolds. A specific formula is then applied to calculate the players body fat percentage ({4.95/{1.1765-[$\log_{10}$ x sum of skinfolds]}-4.5} x 100). The estimate body fat percentage generally has a standard error of between 2% and 5%. It is recommended that; the same practitioner take the players skin folds throughout the season to reduce the standard error [26].

Strength testing

The most common way for testing a player's maximum strength is the 1-repetition max (1rm) or the 3-repetition max (3rm) method. Pulling and pushing is deemed one of the most fundamental abilities in rugby league. Players are required to push their opposition backward or to pull them down to the ground when making a tackle. It is for this reason the flat bench press and the weighted chin up/pull-up has been recommended for testing upper body strength. Furthermore, as mentioned above, powerful and strong legs are required when performing a hit up or when tackling an opponent. An effective method for assessing lower body strength is the parallel back squat. It is recommended that, these tests be administrated before a resistance program has been commenced, so that proper intensities and volumes can be calculated.

Power testing

Just like strength test, power testing is typically done through 1 rm or 3 rm testing. It is important to note that power is often referred to as speed-strength, as power=force x velocity. Strength and conditioning coachers need to consider the force velocity curve when measuring power. The force velocity curve can be divided into separate qualities (speed strength, and strength-speed). Both need to be accounted for during the testing battery. When catering for both training modalities of power, it is suggested that the Counter Movement Jump (CMJ) and 1rm power clean be used to assess lower body power. Additionally, rugby league players need to possess upper body power to tackle and push off players. The smith machine bench press throw is recommended to assess the players power through the upper body. It is suggests that, weights of 40 kg, 50 kg, and 60 kgs be used when performing the smith machine bench press throw [27-29].

Selected testing battery

When selecting an appropriate testing battery, the most valid and reliable tests should be used throughout the season to ensure the data collection is analytical. For aerobic capacity, the intermittent Yo-Yo test, best suits rugby league for its high intensity interval efforts. The 40 m linear sprint test should be implemented to measure maximal velocity with times recorded at 5 m and 10 m to calculate acceleration. For Repeat sprint ability, it is suggested that the test invented by Johnston and Gabbett, should be implemented as it closely resembles the high intensity effort that players must perform during a game. The 5-0-5 agility test is included as research has deemed it the most valid test for examining change of direction and results in the highest correlation with accelerating during the turning phase of the test. The 5-0-5 should be used in conjunction with the Gabbett and Benton agility test, as it is used to assess the players ability to react to specific stimuli. Gym field tests such as the 1RM squat, Bench press and chin up/pull up should be used to measure max strength. The 1 rm power clean, bench press throw and CMJ should be used to assess power (Table 2).

Table 2. Recommended norms for elite male rugby league players

Testing battery	Recommended normative data for elite male rugby league players
Skin folds (Body fat %)	Backs: <13%
	Forwards: <15%
40 m sprint	Backs: <5.2 s
	Forwards: <5.5 s
5-0-5	Backs: 2.34 s-2.42 s
	Forwards: 2.41 s-2.49 s
Reactive agility test	Total time: 1.98 s ± 0.16 s
	Change of direction: 1.67s ± 0.15s
	Response time: 0.25 s ± 0.14 s
Repeat effort ability test	Effort Decrement: 15.0 % ± 3.5%
Intermitted yo-yo test	Backs: 15.8 (1080m)-19.8 (2360m)
	Forwards 14.4 (600m) - 19.2 (2120m)
Counter movement jump	Backs: 51.5 cm-56.7 cm
	Forwards: 48.9 cm-53.3 cm
Power clean	102.2 ± 13.4 kg
Bench throw	40kgs: 500 w-550 w
	50kgs: 550 w-625 w
	60kgs: 575 w-650 w
Parallel back squat	Backs: 132 kg-190 kg
	Forwards: 155 kg-225 kg
Bench press	backs: 90 kg-140 kg
	Forwards: 90 kg-140 kg
Pull up/Chin up	Backs: 90 kg-140 kg
	Forwards 90 kg-140 kg

The general guidelines for the testing selection are to perform the least fatiguing test through to the most fatiguing. This is to limit the amount of error during the collection of data. However, it is suggested to perform the Yo-Yo intermittent test with the rest of the field testing to save time. It is recommended that plenty of recovery is allowed before commencing the intermittent Yo-Yo so that fatigue does not interfere with results.

CONCLUSION

Strength and conditioning professionals must be able to select a testing battery that is reliable, valid and specific to rugby league. In most cases these tests need to be performed with limited time and equipment. This article was created to provide practitioners with an appropriate testing battery that is backed by scientific research. This testing battery was created with the assumption that players would be available for 2 days at the beginning of the season. This article can guide strength and conditioning practitioners and sports coaches in designing and running an effective, scientific backed testing battery which can help program future training sessions throughout the season.

REFERENCES

1. Meir RA., Evaluating player fitness in professional rugby league: reducing subjectivity. *Strength Cond. Coach.,* **1994.** 1(4): p.11-7
2. Meir RA, Arthur D and Forrest M., Time and motion analysis of professional rugby league: A case study. *Strength Cond. Coach*., **1993.** 1(3): p.24-9
3. Gabbett T, King T and Jenkins D., Applied physiology of rugby league. *Sports med.,* **2008**. 1(38): p.119-38
4. King D., et al., A review of the physiological and anthropometrical characteristics of rugby league players. South African *J. Res. Sport Phys. Educ. Recreat.,* **2009.** 31(2): p.49-67
5. Johnston RD, Gabbett TJ and Jenkins DG. Applied sport science of rugby league. *Sports med.*. **2014**. 8(44): p.1087-100
6. Till K, Scantlebury S and Jones B., Anthropometric and physical qualities of elite male youth rugby league players. *Sports Med*., **2017.** 47(11): p.2171-86

7. ArmstrongNandMcManusAM.,Exercise testing elite young athletes.*Med.SportSci*.,**2011.**(56):p.106-25

8. De Lacey J., et al., Strength, speed and power characteristics of elite rugby league players. *J. Strength Cond. Res.,* **2014.** 28(8): p.2372-5

9. King T, Jenkins D and Gabbett T., A time–motion analysis of professional rugby league match-play. *J. sports sci.,* **2009** 27(3): p.213-9

10. Coutts A, Reaburn P and Abt G., Hearth rate, blood lactate concetration and estimated energy expediture in a semi-profesional rugby league team during a match: case study. *J. sports sci.,* **2003.** 21(2): p.97-103

11. Turner A., et al., A testing battery for the assessment of fitness in soccer players. *Strength Cond. J.,* **2011.** 33(5): p.29-39

12. Johnston RD and Gabbett TJ. Repeated-sprint and effort ability in rugby league players. *J. Strength Cond. Res.,* **2011.** 25(10): p.2789-95

13. Gabbett T and Benton D., Reactive agility of rugby league players. *J. sci. med. Sport.,* **2009.** 12(1): p.212-4

14. Serpell BG, Ford M and Young WB., The development of a new test of agility for rugby league. *J. Strength Cond. Res*., **2010.** 24(12): p.3270-7

15. Sheppard JM and Young WB. Agility literature review: Classifications, training and testing. *J. sports sci.,* **2006.** 24(9): p.919-32

16. Baker DG., A series of studies on professional rugby league players.

17. Waldron M., et al., The relationship between physical abilities, ball-carrying and tackling among elite youth rugby league players. *J. sports sci.,* **2014.** 32(6): p.542-9

18. Harley JA, Hind K and O'hara JP., Three-compartment body composition changes in elite rugby league players during a super league season, measured by dual-energy X-ray absorptiometry. *J. Strength Cond. Res.,* **2011.** 25(4): p.1024-9.

19. Coneyworth P, Ward N and Turner AN., A field-based fitness testing battery for Rugby League. *Prof. Strength Cond.,* **2012.** (25): p.4-9

20. VerkhoshanskyYV.,Quicknessandvelocityinsportsmovements.*NewStud.Athl.*.**1996.**(11):p.29-38

21. Moir G., et al., The effect of periodized resistance training on accelerative sprint performance. Sports Biomechanics. **2007**. 6(3): p.285-300

22. Austin DJ, Gabbett TJ and Jenkins DG., Reliability and sensitivity of a repeated high-intensity exercise performance test for rugby league and rugby union. *J. Strength Cond. Res*., **2013.** 27(4): p.1128-35

23. Currell K and Jeukendrup AE., Validity, reliability and sensitivity of measures of sporting performance. *Sports med*., **2008.** 4(38): p.297-316

24. DarmientoA,GalpinAJandBrownLE.,Verticaljumpandpower.*StrengthCond.J.*,**2012.**34(6):p.34-43

25. Gabbett TJ., Influence of physiological characteristics on selection in a semi-professional first grade rugby league team: a case study. *J. Sports Sci.*. **2002.** 20(5): p.399-405

26. Hopkins WG., Measures of reliability in sports medicine and science. *Sports med.,* **2000.** 7(30): p.1-5

27. Johnston RD., et al., Peak movement and collision demands of professional rugby league competition. *J. sports sci.,* **2019**. 37(18): p.2144-51

28. Morland B., et al., Can change of direction speed and reactive agility differentiate female hockey players?. *Int. J. Perform. Anal. Sport.,* **2013.** 13(2): p.510-21

29. Metaxas TI., et al., Comparative study of field and laboratory tests for the evaluation of aerobic capacity in soccer players. *J. Strength Cond. Res.,* **2005.** 19(1): p.79-84