

A FITNESS ASSESSMENT PROTOCOL FOR RUGBY UNION

BY
IAN LAHART.

The author is a Sports Therapy Lecturer at the Birmingham College of Food, Tourism and Creative Studies. He has a BSc in Sport and Psychology and is in the second year of a two-year MSc in Applied Sport and Exercise Science. He is a certified Strength and Conditioning specialist with a particular passion for rugby union.

Introduction:

The purpose of this article is to provide an appropriate fitness assessment protocol for rugby union. An effective fitness assessment should provide coaches with essential information in terms of their players' readiness for competition and the effectiveness of training programmes. In order for a testing protocol to be effective it must reflect the specific demands of the sport. This article will provide an assessment protocol, with a rationale provided for each fitness test. Each test was chosen due to its specificity in relation to the demands of rugby union competition.

The tests are sequenced in the following order and spread over separate days, so as to ensure fatigue is not a limiting factor in test performance. At least 24 hours recovery should be given between each testing day, and sufficient recovery provided between tests.

The Tests:

<u>Day 1.</u>	<u>Day 2.</u>
1. Anthropometrical Measurements	1. Multi-stage fitness test
2. Leg Power	
3. Grip Strength	<u>Day 3.</u>
4. Speed	1. 1 RM Squat
5. Flexibility	2. 1 RM Deadlift
6. Anaerobic Capacity	3. 1 RM Bench Press

1 RM = 1 repetition max.

Anthropometrical Measurements:

Body size and composition influence the speed, power and endurance capacity of rugby players (Withers et al. 1987). In the lineout, taller forwards can achieve greater absolute jumping height than can shorter players, resulting in a more competitive lineout (Quarrie et al., 1996). Forwards also require greater body mass than backs; in particular, players involved in the scrum need to be strongly built and sufficiently heavy to withstand and apply forces while scrummaging (Milburn, 1990).

Body composition is measured due to the belief that excess body fat is associated with negative performance. This is partly based on Newton's second law, which specifies that increases in fat mass without an increase in muscle force will reduce acceleration. In addition to this, the displacement of additional fat mass requires extra energy, which causes an increase in the relative cost of exercise (Duthie, 2006). Therefore, excessive body fat can negatively affect speed, acceleration and economy of movement.

The Durnin and Womersley skinfold technique (1974) provides the most valid and reliable method of assessing an individual's body fat compared to the gold standard method, hydrostatic weighing, with a standard error of 3 to 4% (ACSM, 2006). This method measures the thickness of subcutaneous fat at four sites; the biceps, triceps, supra-iliac, and subscapular (Durnin & Womersley, 1974). However, the reliability of the skinfold measurement is dependent on standardizing the caliper and site of measurement, and upon the measuring skill of the tester (Wang et al., 2000). Furthermore, it is difficult to compare body fat percentages established through estimates, due to the different measurement error associated with each method (Duthie et al., 2003). These limitations have led researchers and coaches to monitor athletes' body mass and sum of skinfolds rather than estimating percentage body fat (Gore, 2000).

Leg Power:

Rugby players require leg power to jump and lift in the lineout, during the initial push in the scrum, for tackling and for explosive acceleration (Duthie et al. 2006). To measure leg power, vertical jump tests can be used reliably. Vertical jump height can be determined either by using a platform connected to a digital timer, a vertec device, or by using chalk to mark the highest point of a jump. A standard vertical jump test protocol with a standard counter movement jump and an arm swing allowed can be used.

Grip Strength:

Grip strength is required for players to bind properly to each other in the scrum, thus the assessment of grip strength would be a useful tool for forwards (Quarrie & Wilson, 2000). The Harpenden grip strength dynamometer has been found to possess excellent test-retest reliability (Balogun et al., 1991).

The protocol used in the grip strength test has been found to significantly affect the scores obtained (Innes, 1991). Performing the grip strength test while standing, results

in higher grip strength scores than when sitting and using the same equipment (Balogun et al., 1991). There has been equivocal evidence as to whether the mean of three trials or the highest score in three trials produces the highest grip strength score (Innes, 1991). Subjects should be instructed to stand with their shoulder flexed at 180 degrees with the elbow fully extended, because this has been shown to produce the highest mean grip strength scores (Su et al., 1993).

Flexibility:

Flexibility is the extent or range of movement that takes place in a joint or group of joints and is often a neglected component of physical fitness by the rugby player, who does not always appreciate the value of regular flexibility training. It has been suggested that chronic stretching can lead to an increased flexibility, improved muscle or athletic performance, improved running economy, injury prevention, promotion of healing and possibly decreased delayed-onset muscle soreness (Apostolopoulos, 2006). Furthermore, certain skills may be enhanced by increases in the range of movement (Holcomb, 2000). For example, although a tackle may initially be made in the acceptable range of movement of the shoulder and elbow joints, the opponent's momentum may then move these joints through an excessive range of motion.

The sit and reach and forward flexion tests were performed as a measure of lower back and hamstring flexibility (ACSM, 2006). The test is performed with the legs fully extended and knees relaxed. Subjects are required to extend their arms forward as far as possible and hold at the furthest point for two seconds. A Sit and Reach Bench (Bodycare™ Products) can be used to perform the tests.

Speed:

Speed and acceleration are essential requirements of rugby union, as players are often required to accelerate to make a position nearby or sprint over an extended distance. Rugby players typically sprint between 20-40 m (Deutsch et al., 1998). Duthie (2005) observed that the vast majority (67%) of sprints do not involve any contact with the ball. In the same study, forwards were found to perform most sprints from a standing start, with very few (7%) from a striding start, while the backs had a more even distribution between standing, walking and jogging starts, with only 14% of sprints performed from a striding start. In addition, Duthie (2005) found that most sprints do not involve a change of direction (forwards 92%, backs 78%). Therefore, rugby players' speed should be tested between 20-40 m, without the ball, from a standing start and with no changes of direction.

Anaerobic Capacity:

High intensity activity in rugby consists of 6% running and 9% tackling, pushing and competing for the ball (Doherty et al., 1988). These periods of high intensity place considerable demands on anaerobic metabolism. Research has mainly focused on cycle ergometry of short (< 10 s) to moderate (30-40 s) duration to quantify rugby

players' anaerobic capacity (Cheatham et al., 1998). The Wingate test is one of the most researched and reliable test used to assess anaerobic capacity. It is well standardized, simple to administer and, like other cycle ergometer tests, its results are independent of body mass. Results correlate to those from the Margaria step-running test and with other indices of anaerobic metabolism (Coso et al., 2006).

However, the Wingate test requires laboratory access and is not very specific to the demands of rugby. Explosive bursts of sprinting are more sport-specific rather than bouts of high intensity cycling (Reilly & Doran, 2001). In addition to this, due to the highly intense, intermittent nature of rugby, repeated sprint ability is important (Gabbett, 2005). For example, a player may need to sprint to make a cover defending tackle and then be required to sprint back into position, and then recover quickly to produce further high-intensity efforts. Based on this, multiple sprint tests have been developed to measure the ability of athletes to resist fatigue while exposed to similar demands, with respect to time and distance of sprint, as experienced in actual competition (Jenkins & Reaburn, 1998). Repeat sprints provide a more practical alternative to using cycle ergometry or treadmill testing and they are both reliable and valid (Fitzsimmons et al., 1993).

The repeated sprint test protocol, developed and utilised by the New Zealand rugby project, can be employed (Quarrie et al., 1995). This test involves testing over a distance of 70 metres, including several direction changes. The effort is repeated six times in three minutes. This test procedure involves work to rest ratios which closely resemble the demands of a rugby union game, which, based on Deutsch and colleagues' (1998) findings, means that the mean duration of movements were 19 seconds and the most frequent work to rest ratio was 1: 1.9. In addition to this, because more recovery time is available to the faster players, the test allows an increased rest time for the faster backline players. This accurately mimics the true demands of the sport, where the backs have longer recovery periods while forwards are participating in high intensity static exertion (e.g. scrums, rucks, and mauls) (Duthie et al., 2003).

VO₂ max:

During rugby competition, 85% of match play is spent in low activity activities and recovering from high intensity activity. This low activity exercise derives energy predominantly from the aerobic energy system and, furthermore, the higher the aerobic endurance of an individual the less recovery time is required (Tomlin & Wenger, 2001). The maximum amount of oxygen that the body can take in and the working muscles can use (VO₂ max), is used to determine an individual's aerobic endurance (McArdle et al., 2005). The VO₂ max is measured in millilitres of oxygen per kilogram of body weight per minute (ml/kg/min), and can be found using progressive incremental treadmill tests such as the Jones & Doust (1997) protocol. The highest VO₂ measured in the period from when heart rate reached 90% of age-predicted maximum heart rate until the subject reached volitional exhaustion, was accepted as VO₂ max (Jones & Doust, 1997). Laboratory VO₂ max tests are the gold standard method of obtaining VO₂ max scores.

However, similar to the testing of anaerobic capacity, the direct testing of VO₂ max requires access to a laboratory. Therefore, field tests provide a more practical method of measurement. The most widely used aerobic endurance field test is the multi-stage fitness test or 'Bleep' test (Leger et al., 1988; Ramsbottom et al., 1988, Leger & Lambert, 1982). The test is based on the completion of repeated shuttle runs between two lines 20 m apart. The test is performed on a flat playing surface. To increase specificity, the surface should match the surface of the required playing field. The running speed is incremental and is dictated by audio signals from a tape recorder. The aim is to complete as many shuttles as possible, the higher the amount of shuttles the greater the VO₂ max. To ensure test-retest reliability, potentially confounding variables such as time, wind and temperature should be recorded and attempts should be made to retest under standardised test conditions.

It is advantageous in team sport environments if the test facilitates the testing of more than one individual at a time and is relatively easily performed with minimal equipment. However, it is important to note that this method provides an estimate of VO₂ max, and has been found to either overestimate or underestimate VO₂ max by up to 3.5 ml/kg/min (Svensson & Droust, 2005). However, it has previously been shown that, although the multi-stage fitness test is not as accurate in determining the VO₂ max as laboratory tests, this may be less evident in sports of an intermittent nature (StClair Gibson et al., 1998). The test involves acceleration, deceleration and rapid changes in direction, all of which are integral components of field games such as rugby union. The laboratory test of maximal oxygen uptake involves incremental increases that are steady, with no periods of acceleration or directional changes (McArdle et al., 2005). Due to this, the multi-stage fitness test may provide a valid, reliable and easily achievable alternative to the gold standard laboratory test, in addition to allowing the assessment of aerobic capacity in conditions more similar to those found in rugby competition.

Strength Testing:

In addition to the above tests, in order to facilitate the prescription of exercise intensities for strength training, it is vital to assess the muscular strength of the players. Strength is the maximal amount of force that a muscle or muscle group can produce at a given speed, and is required in rugby for the performance of tackles, rucks, mauls, and scrums (Duthie, 2003). The most effective method of determining muscular strength is by performing 1 repetition maximum (1 RM) tests, which measure the maximum amount an individual can lift in one repetition (Fleck & Kraemer, 2004). 1 RM testing is recommended for the core lifts of the back squat, deadlift, and bench press (Harman et al., 2000).

In conclusion, the tests used to assess players' fitness levels should be based upon the specific demands imposed by rugby match play. Rugby union is an intermittent, high intensity sport, which places considerable stress on both the anaerobic and aerobic energy systems. In addition, speed, leg power and strength are integral components of the game for players of all positions. In order to ensure specificity of the test to game conditions, field testing of these components of fitness may be performed. The field tests used need to be valid and reliable alternatives to gold standard laboratory tests.

The tests recommended in this article are the New Zealand Rugby Project repeated sprint test to assess aerobic capacity, multistage fitness tests to determine aerobic endurance, vertical jump tests for leg power, and 1 RM for strength testing. The results of these tests allow the coach to assess the current status of each athlete, allow the monitoring of progression and enable accurate exercise prescription based on each athlete's strength and weaknesses.

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