



Sports scientists classify team sports like rugby as "intermittent sprint sports" because, in the course of a match, players will alternate between fast running or sprinting, walking, jogging and standing. Rugby matches are a bit like random interval workouts "except that they also involve non-running activities, such as rucking, mauling and scrummaging.

These are game-specific tasks, during which groups of players push against the opposition; and, like fast running and sprinting, they are [high-intensity](#) activities.

When rugby players perform these high-intensity activities, their anaerobic systems provide the required energy, while the aerobic system predominates during the low-intensity activities.

If the high-intensity periods are short (less than 10 seconds) and recovery times between efforts are relatively long (60 seconds-plus), then the phosphocreatine (PCr) system will be the key source of anaerobic energy.

Phosphate + ADP = ATP

This is the simplest and most rapid means of [energy](#) production, in which phosphate (donated by phosphocreatine) and ADP combine to make [ATP](#) "the body's primary energy currency and supplier to all cells. During the low-intensity periods, the aerobic system will replenish PCr stores, ready for the next high intensity effort.

However, PCr stores can provide energy for only about 10 seconds of activity. So, if the high intensity periods are of intermediate length (10-45 seconds) or the recovery times are relatively short (20-40 seconds), then the glycolytic system of anaerobic energy production, involving the breakdown of [carbohydrate](#) within muscle cells to release energy, comes into play.

Similarly, short periods of high-intensity work, interspersed with recovery times that are too brief for complete replenishment of PCr stores, also bring the glycolytic system into play.

Intensity Levels

From The Physiological Point Of View, There Are Two Interesting Questions About Rugby:

- What is the ratio of high-intensity to low-intensity activity?
- Does the work/rest ratio vary with player position?

The answers to these questions should help us to understand the key physiological demands on the players so that we can help them train for top performance.

Early research on rugby suggested that players spend only 5-10% of match time involved in high-intensity activity and the researchers concluded that the PCr energy system would be the most important. However, this study did not analyze the ratio of high-intensity to low-intensity activity, which makes this conclusion unsound.

Another study of under 19s matches analyzed individual players, focusing on time spent in various activities and work/rest ratios. An interesting finding of this study was that forwards

performed three times more high-intensity work than backs - 11.2 minutes per match versus 3.6 minutes per match. This suggests that forwards may make more use of the glycolytic system and backs more use of the PCr system.

The research drawn on for this article is an unpublished study which analyzed the time and motion of 29 top class professional rugby union players, who were filmed during the course of eight professional 'Super 12' matches in New Zealand.

Positioning Players

Players Were Placed Into One Of Four Positional Groups:

- Front row forwards (props and locks, or numbers 1,3, 4 & 5);
- Back row forwards (hooker, flankers and no 8, or numbers 2, 6, 7 & 8);
- Inside backs (fly half and centers, or numbers 10, 12 & 13);
- Outside backs (wingers and full back, or numbers 11, 14 & 15).

The hooker was placed in the back row group as they have a roving role at line-outs and do not push as much in the scrum as other front row forwards. The scrum half position was not analyzed. One or two players from each positional group were analyzed during each match.

Table 1: Intensity Of Rugby Play According To Position

| <i>Per Match</i> | Front Row Forwards | Back Row Forwards | Inside Backs | Outside Backs |
|---|--------------------|-------------------|--------------|---------------|
| Average High-Intensity Efforts | 128.5 | 113.5 | 51.5 | 41.6 |
| Average Duration Of High-Intensity Effort | 5.0s | 5.2s | 4.2s | 5.2s |
| Average Duration Of Low-Intensity Effort | 35s | 37s | 88s | 115s |

Player Movements

The Researchers Broke Down Player Movements As Follows:

- Standing still, walking, jogging, side/backwards stepping - All classified as low-intensity activity;
- Running, sprinting, rucking/mauling, scrummaging and tackling - All classified as high-intensity activity.

They then analyzed the amount of time spent in each category of movement and the frequency and average time of each individual activity. The key data are summarized in the table above.



As you can see, both front row and back row forwards complete many more high-intensity efforts per match than backs, with front row forwards performing over three times more than outside backs. While the average duration of high-intensity efforts are similar, at around five seconds, across all four positional groups, the average rest periods for the forwards are significantly shorter.

Since both sets of forwards only get to enjoy around 35 seconds of [recovery](#), their PCr stores will not be replenished and so the glycolytic energy system will be very important for maintaining the work rate required.

Backs, by contrast, get plenty of recovery time between high-intensity efforts (88-115 seconds), which are easily enough time to replenish PCr stores. The PCr system will, therefore, be most important for backs.

Positional Groups

The researchers also found that the type of high-intensity activity varied between positional groups. Of the different types of high-intensity activity, front row forwards performed fewer sprints, while backs performed more high-intensity runs and sprints. Back row forwards and inside backs completed an average of seven sprints per match and outside backs an average of 11.

By contrast, forwards were involved in many more rucks, mauls and scrums than backs. Front row forwards, for example, were involved in an average of 75 rucks/mauls and back row forwards in 57, while inside and outside backs were involved in only 11 and seven respectively.

This Research Data Leads To The Following Conclusions About The Key Differences Between Forwards & Backs:

- Forwards have to complete more high-intensity activity than backs, with shorter periods of low-intensity activity between them, which means the anaerobic glycolytic system is of prime importance for them;
- The type of high-intensity activity forwards perform tends to be 'physical work', ex: pushing, shoving, biting... j/k;
- Backs perform less high-intensity activity than forwards, with sufficient rest between efforts for the PCr system to predominate;
- Running and sprinting are the commonest high-intensity activities for backs.

Interval Training For Anaerobic Fitness

Clearly, forwards need to develop good anaerobic fitness, specifically targeting the glycolytic system. The best way to train this system is through [interval training](#), making sure that work periods are sufficiently long (20-40 seconds) and rest periods long enough to allow athletes to repeat the work but not recover completely (40-90s). A good example would be 10 x 200m fast running, with 60s rest.

However, as forwards tend to perform more high-intensity "physical work" than running, performing intervals on a rowing machine might be a better (ex: more sport-specific) choice; for example, 5 sets of 4 x 200m fast rowing, with 30s rest between reps and 2 minutes between sets.



Even more specific to the demands of match play would be interval workouts that combine "physical work" with running. This would prepare players to work intensively and make appropriate transitions between upper body/trunk strength tasks and running.

Players could work in pairs to push or [wrestle](#) with each other and then run a fixed distance, with the combination of push/wrestle and run counting as one interval rep; for example, 20 x 5s of push/wrestle + 50m shuttle run, with 30s rest between reps. This kind of workout would provide a close match of both the energy system and physical task demands of forwards match play.

Backs, by contrast, need high anaerobic power, targeting the PCr energy system. Interval training is also a very effective route to PCr fitness, but the work intensity must be higher and the rest periods longer than with intervals targeting the glycolytic energy system; 5-8s reps and rest periods lasting a minimum of 60s would be highly appropriate, ex: 10 x 50m sprints with 90s recovery.

For backs, this sprinting workout would be highly sport-specific, reflecting the amount of high-intensity running they perform in matches.

Aerobic Fitness

Aerobic fitness is important for both backs and forwards, since the aerobic system will provide most of the energy for movement and replenishment of PCr stores during all low-intensity activities. In addition, research has demonstrated that players with high aerobic fitness are able to perform more high-intensity efforts during a match than those with lower levels of this type of fitness because of the aerobic system's influence on recovery.

Forwards will also use their aerobic systems to provide energy for the longer high-intensity or shorter recovery periods, providing valuable back-up for the anaerobic glycolytic system.

As far as aerobic endurance training is concerned, the rowing machine may still be the best activity choice for forwards, with running best for backs. A combination of continuous steady state training and interval workouts would be an effective approach: for example, 20 minutes running or rowing at 75% of max heart rate, or 10 x 400m running with 60s rest, or 6 x 500m rowing with 2mins rest.

More specific workouts could be developed by performing shuttle runs instead of straight runs as intervals to increase the agility running component for backs. In addition, sessions incorporating circuit exercises to develop pushing and wrestling strength would be useful for forward players.
