



## Introduction

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#### Aim

The aim of this module is to present a detailed review of the analysis of the Rugby sevens game.

#### Outcome

The S&C coach will demonstrate an understanding of the physical, physiological and time-motion demands of the sevens game.

#### Key Terms

##### Accelerometry

A micro mechanical device used to quantify acceleration, deceleration and impact. In a Rugby Union game, the device is concealed within a small global positioning system unit and placed on the upperback/neck and inside the player's jersey.

##### Global Positioning System:

The technology employed to track distance and time using the signals received from orbiting satellites.

##### Gravity Force:

Also known as 'G' force, this is the measurement of acceleration.

##### Metrics:

The commonly used term to describe a 'measurement' relating to time, distance and impact.

### The sevens game described

Rugby sevens has been steadily growing in popularity over recent years. The announcement that the game is to be played at the summer Olympic Games of 2016 has also popularized the sport (Engebretsen et al 2010). Recent data indicates that the sevens game is played in over 100 countries with estimates of more than 31,000 teams participating in the game with over 315,000 players (IRB data 2014).

In this section we describe the demands of the sevens game for men and women. It must be noted that with the accessibility of Global Positioning System software in recent years, a greater depth of information on the demands of Rugby Union, be it in the 15-a-side game or Rugby sevens game is now available.

A Rugby sevens game is played for 14 minutes (two 7 minute halves). Teams play with 7 players and the rules are similar to the 15-a-side game. The game is played on a full-size 15-a-side Rugby pitch. Recent studies have indicated that the game involves repetitive high speed running with short recoveries between running bouts as well as frequent intense physical contact and collision events (Suarez-Arrones et al 2012, 2014, Higham et al 2012, 2013) regardless of the level of play.



*Figure 1. High speed running is a feature of the sevens game.*

Typically, sevens games are played in a tournament format. This means that players may participate in several games within a short period of time, for example, tournaments may require teams to play between two and five games over a period of 48 hours.

In this topic, we will examine the specific demands of Rugby sevens for both men and women. An understanding of the physical demands helps us to prescribe training and conditioning that better prepares players to perform at all levels of the game. For example, knowing the ratio of work to rest periods in the game allows the S&C coach to plan appropriate and specific work to rest practices when devising conditioning drills or games.



## Locomotion metrics

### Metrics and measurements

Metrics here can be described as measurements derived from analysis systems such as GPS and video capture. As with the 15-a-side game, the following locomotion metrics are frequently used to describe the sevens game (Cunniffe et al 2009, Higham et al 2012, Suarez-Arrones et al 2014):

- Total distance covered (metres per game - m)
- Relative distance covered (metres per minute – m/min)
- Speed thresholds (expresses as kilometers per hour - km/hr):
  1. Standing-walking (0 – 6.0 km/hr)
  2. Jogging (6.1 – 12.0 km/hr)
  3. Cruising (12.1 – 14.0 km/hr)
  4. Striding (14.1 – 18.0 km/hr)
  5. High-intensity activity (18.1 to 20km/hr)
  6. Sprinting (sprints > 20.1 km/hr)

Exercise intensity is expressed using heart rate and the following heart rate categories of exertion are typically used:

- Zone 1 (<60% HRmax)
- Zone 2 (61-70% HRmax)
- Zone 3 (71-80% HRmax)
- Zone 4 (81-90% HRmax)
- Zone 5 (91-95% HRmax)
- Zone 6 (>96% HRmax)

Work-to-rest ratio is an important metric to consider. A work-to-rest ratio of 1:0.5 means that for every 1 minute of work, the player rested for 0.5 minutes.

The use of GPS with accelerometry also allows us to quantify other metrics such as player physical collision data.





Figure 2. Contact and collision events in the game may be quantified using accelerometry technology.

Typically, the intensity and number of collisions through tackle and other contact events are classified using gravitational or ‘G’ force. The intensity of collisions has been previously graded using GPS accelerometry technology in a number of studies and is described in Table 1.

‘G’ force	Contact type
7 – 8	Heavy impact (tackle)
8 – 10	Very heavy impact (scrum engagement, tackle)
>10	Severe impact, tackle or collision

Table 1. Contact and collision force classified according to ‘G’ force (from Cunniffe et al 2009, McLelland & Lovell 2012, Suarez-Arrones et al 2014).

## Locomotion demands

Table 2 below summarises key metrics representing the main locomotion demands (distance covered) in the sevens game for men and women. Note that the data described is for men's at club level and women's at international level.

Metric	Sevens Game	
	Men	Women
Total distance (m)	1580+/-146	1556+/- 189
Total relative distance covered (m/min)	102.3+/- 9.8	111
Standing, walking, (<6km/hr) total distance (m)	549.7+/-79.1	462.6+/- 94.6
Striding (14.1 – 18.0 kph) total distance (m)	244.5+/-80.1	255.7+/- 88.3
High intensity running (> 18.1-20.0 kph) total distance (m)	79.5 +/- 37.2	57.1+/-40.8
Sprints (>20.1 km/hr) total distance (m)	137.7+/- 84.9	84.0+/-64.8
Mean speed (km/hr)	6.4 +/- 0.6	6.2 +/- 0.6
Max speed – individual player (kph)	29.9	28.3
Longest sprint distance (m)	67.1	54.6
Mean max sprint distance (m)	29.5 +/- 11.7	28.1 +/- 21.6
Number of sprints (n)	7.4 +/- 3.9	5.3 +/- 3.2
Average sprint distance (m)	18.0+/- 7.6	17.2 +/- 8.8
Work:rest (min:min)	1:0.5	1:0.4
Period with HR over 80% max	75%	75%

Table 2. Summary table of metrics describing demands of the sevens game for men and women (data from Suarez-Arrones et al 2012, 2014, Higham et al 2012).



## Total distances covered

Table 2 displays average or mean results for various metrics that describe the game. While the mean figure is a useful statistic, it does not provide the full picture of the demands of the game. When we examine the range of any particular metric recorded we get a better picture of the spread of the demands across the majority of players. Thus, it is important to inspect the standard deviation (SD) shown with the mean figure. Note that the standard deviation is the spread of scores or individual results of the majority of players about the mean score.

For example, in the women's game, players' mean total distance ( $\pm$  SD) covered over the whole match by all players was  $1,556.2 \pm 189.3\text{m}$ , but the range was between  $1,364.5$  to  $1,724.1\text{m}$ . This tells us that some players completed  $1,724$  metres during the game while other completed just over  $1,300$  metres.

For the men's game, the mean total distance ( $\pm$  SD) covered over the whole match by all players was  $1,580.8 \pm 146.3\text{m}$ , but the range was from  $1,348.8$  to  $1,975.7\text{m}$ . So from this we can state that while the mean of the total distance covered is relatively similar between the men's and women's game ( $1,580\text{m}$  vs  $1,556\text{m}$ , respectively), the greater range reported within the men's game suggests greater variation between players in the total distance covered. Further, it seems that in the men's game some players cover a greater distance compared to the women's game ( $1,975\text{m}$  v  $1,724\text{m}$ , respectively).



Figure 3. Greater relative distance is covered for men and women sevens players compared to the relative distance covered in the 15-a-side game.

## Relative distance covered

When the game is examined in terms of metres covered per minute of the game, the range for men's sevens is between 85.9 metres and 127.4 metres per minute. Further, when sevens players are compared to their 15-a-side counterparts (approximately 87 metres per minute), it is evident that the sevens players complete a significantly greater distance per minute of play (Cunniffe et al 2009).

Backs seem to cover greater distances compared to forwards, covering approximately 10% more distance, with distances at the top speeds being less during the second half for players in both positions.

## Speed of movement

When we examine the maximum speeds metric, we note that for men at club levels the mean speeds range between 26.5 and 27.5 km/hr. Such a close clustering of maximum speeds suggests that high speed levels are important for all players. This implies that speed in itself may be a very important trait for player of the sevens game.

For women's international players, mean speeds are reported at approximately 23 km/hr (Suarez-Arrones et al 2013) and while greater speeds of running would be expected in the male game, the speed demands for the women's game is on average greater than that of the 15-a-side men's game. Men's club sevens players display an average running speed of 6.4 km/hr and international women sevens players display an average running speed of 6.2 km/hr. With the same technology used in the studies cited above (i.e. GPS), it was found that male 15-a-side Rugby Union players covered a total distance of 6953 m and exercised at an average running speed of approximately 4.2 km/hr (Cunniffe et al 2009). (Further description and discussion regarding physical and performance traits of 15-a-side versus seven players is available in a later topic).



Figure 4. The sevens player requires well developed sprint capacities and also evasion skills.



## Distances at top speed

The data from Table 2 shows that Rugby sevens players are required to sprint over distances longer than 40m. It is also clear that the range of distances at top speeds extend to over 50m.

For example, in the women's game Suarez-Arrones et al (2014) report the longest sprint distance in the tournament analysed was 54.6m. This implies that specific sprint training should reflect these demands and both short ( $\leq 20$  m) and longer sprints (30-50m) are important to mimic the demands of the game.

## Work-to-rest ratio

The work-to-rest ratios reported in Table 2 for male and female games are similar. These ratios are however, lower than previously reported ratios in the 15-a-side game (ranging from 1:4 to 1:2) (Austin et al 2011, Cunniffe et al 2009, Duthie et al 2005). While comparisons with previous studies are problematic due to different analysis systems being used the results from recent studies suggest that stoppages in play are shorter and less frequent in Rugby sevens compared to the 15-a-side game (King et al 2009).

Results from studies also report that players spend longer in a given game standing, walking and jogging (that is at speeds between 0 and 12 km/hr) compared to running at higher speeds (Suarez-Arrones et al 2012). The latter group of researchers reported that low intensity activities represented 61% of total game time. This is very similar to that reported for the women's game (Suarez-Arrones et al 2012).



## Contact metrics

### Contact intensity and frequency

The number of impacts greater than 7G and the number of tackles and rucks is reported for men's club forwards and backs in Table 3 below.

Contact type	Forwards	Backs
Number of impacts > 7G	45.1+/-24.5	41.8+/-20.7
Number of tackles	7.4+/-1.8	4.1+/-2.4
Number of rucks	1.0 +/- 1.1	0.6+/- 0.9

Table 3. Contact intensity and frequency in men's club forwards and backs (data from Suarez-Arrones et al 2014).

Data derived from GPS accelerometry (Table 3 above) indicate that both forwards and backs experienced a similar number of contacts/impacts (3.0 and 2.8 impacts per minute of play, respectively) during play. The number of impacts (per minute of play) reported for the sevens players are higher than those reported for the 15-a-side game where 1.8 and 2.1 impacts per minute of play have been reported for forwards and backs respectively (Cunniffe et al 2011).



Figure 5. A higher relative number of impacts occurs for the sevens player compared to the 15-a-side player.



During the game, players experienced an average of 26 impacts from 7 to 8G, 15 impacts from 8 to 10G and 3 impacts greater than 10G. The forwards in the sevens game engaged in a greater number of tackles compared to the backs throughout play. The total number of tackles performed for the sevens player (0.5 and 0.2 for forwards and backs, respectively) is greater than that reported for the 15-a-side player where 0.2 tackles per minute are reported for both forwards and backs (Coughlan et al 2011).

## Heart rate response

Overall, it seems that forwards may experience a greater relative heart rate response due in part to their greater tackle count and their engagement in 3.9+/-1.5 scrums which likely adds to their greater intensity of effort during play. Further, the forwards display more time spent at an intensity greater than 90% of HRmax compared to the backs. Note that forwards covered less total running distance at medium and high intensity levels compared to backs. This suggests that the accumulated effect of greater impacts and contact resulted in greater internal load or stress on the forwards.

## Comparison of club and international level

Higham and colleagues (2012) reported that key differences in the sevens game exists between club and international level.

The authors reported that the international game is more intense than the club game. Specifically, a greater distance was covered at high velocity (approximately 27% at  $\geq 6$  m/sec) and 4-39% more accelerations and decelerations were performed in international games compared to club games. The relative distance covered by players at velocities  $>2$  m/sec and the number of changes in velocity were reduced by 1-16% from first to second half. The authors also reported that small differences were observed in locomotion activity at  $<5$  m/sec and moderate accelerations (-18%) from first to last tournament match. This latter metric - the comparison of workload from first to last tournament game - promoted the authors to note that despite some reductions in work-rate within individual matches, there is little indication of accumulated fatigue over a multi-day tournament.



## Summary

A summary of the main demands of the game as determined from a limited number of studies include:

### Sevens game in general:

- The international game demands are more intense than the club game. Specifically, a greater distance is covered at high speeds with more accelerations and decelerations performed in international games
- Sevens backs cover a greater running distance at medium and high intensity compared to forwards
- Sevens forwards are involved in a greater number of collisions compared to backs in a game
- The greater contact by forwards in the sevens game is likely to be responsible for a greater relative heart rate response compared to backs

### For the woman's sevens game, it is also clear that:

- While there may be a greater spread of distances covered by men, mean total distances for women appear to be similar to the distance covered in men's sevens
- Compared to the men's sevens game, women appear to engage in a similar work to rest ratio during play
- Although not attaining the same maximal speed levels compared to the men's sevens game, women are also required to sprint frequently over distances of 30 m and above

### Compared to the 15-a-side game, the following comparisons can be made:

- The sevens game is shorter in duration compared to the 15-a-side game
- The demands of Rugby sevens per minute of match play are significantly greater than the 15-a-side game
- The relative distance covered in a sevens game for both women and men (in metres per minute) is higher and greater than the relative distance completed in international men's 15-a-side Rugby
- The work-to-rest ratios for both men and women sevens are higher than the corresponding ratios for the 15-a-side game
- Sevens forwards and backs complete a greater number of tackles compared to the 15-a-side player per minute of play
- Sevens players complete approximately 45% greater relative running volume compared to players of the 15-a-side game
- Sevens players complete significantly more high speed (>5 m/s) running compared to 15-a-side players





## Implications

The studies reviewed suggest that the physical demands of Rugby sevens are different from those encountered in the 15-a-side game. Taken together, the findings provide important information for the S&C coach when he or she is preparing to plan training aimed at developing physical and physiological qualities specific to the demands of competitive sevens Rugby.

Conditioning should take into account the increased overall running demands, which reflect high-intensity running training and an emphasis on reduced work-to-rest ratios. Further, the relative high engagement in longer sprinting at maximal efforts is an important component of fitness to develop. The requirement for both long and short sprinting traits for the game suggests that the faster player may have a distinct advantage in this sport.

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